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SUSTAINABLE ENERGY POLICY AND PRACTICE IN NIGERIA: LESSONS FROM ESTONIA AND EU

Jätkusuutlik energiapoliitika ja praktika Nigeerias: õppetunde Euroopast ja Eestist

Master's Thesis

EKE 70LT

Supervisor: Arvo Iital

Tallinn 2016

I declare that I have written the master's thesis independently.

All papers and major viewpoints by other authors, data from other sources of literature and elsewhere used for writing this thesis have been referenced.

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- Energy Subsidies Database
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- Analyse the contents of sustainable energy supporting policies in Nigeria with respect to overall purpose, substance, goals, targets and overall policy orientation.
- Identify sustainable energy policy and practice gaps in Nigeria.
- Evaluate policy performance and effectiveness in achieving policy goals and in promoting sustainable energy.
- Compare the energy policies in Nigeria with those in Estonia and the EU.
- Propose recommendations for improving sustainable energy policy and practice in Nigeria.

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SUMMARY IN ENGLISH

Environmental concerns are increasing in every sphere of human endeavours, and energy is not an exception. This has caused an increase in sustainable energy policies across countries. Nigeria is an oil-dependent country with several energy policies targeted at achieving sustainable energy. However, the energy situation is still largely mediocre; with energy access, renewable energy shares and energy efficiency all below par. This study therefore critically analyses the energy policies in a bid to identify possible policy gaps, and subsequently evaluate policy performance. Policy and practice issues impeding sustainable energy development were identified – the most problematic being persistent policy inconsistency, weak legislation, poor energy data collection and tactless design of policy mechanisms among others. The policy orientation in Nigeria was compared with Estonia and the EU, and possible recommendations were proposed for Nigeria based on the lessons derived from Estonia and the EU. This study bears policy relevance and will be useful to government, policy makers and energy practitioners.

SUMMARY IN ESTONIAN

Mure keskkonnaseisundi pärast on suurenenud igas inimtegevsue valdkonnas ja energiasektor ei ole erandiks. Seetõttu on kasvanud huvi jätkusuutlike energiapoliitikate edendamiseks. Nigeeria on naftast sõltuv riik kuid energiapoliitikate arendamisel on siiski silmas peetud ka jätkusuutlikuma arengu tagamist. Üldine olukord on siiski keskpärane ning energia kättesaadavus, taastuva energia osakaal ja energiatõhusus suhteliselt madalad. Sellest tulenevalt seadis käeolev töö eesmärgiks kriitiliselt analüüsida senist energiapoliitikat ja selgitada puudujäägid selle elluviimiseks. Töö raames määratleti poliitilised ja praktilised aspektid, mis pidurdavad jätkusuutliku energeetika arengut. Nendeks on poliitikate järjekindlusetus, nõrk seadusandlus, vähene teave ja andmete kättesaadavus ning mittepiisav poliitikate elluviimine. Nigeeria energiapoliitikaid võrreldi vastavate EL ja Eesti poliitikatega, mis võimaldas välja pakkuda soovitusi selle valdkonna parandamiseks Nigeerias. Töö tulemused on väärtuslikud nii valistusele, teistele poliitikate väljatöötajatele kui ka energeetika valdkonna praktikutele.

Graphic material:

There are 18 Figures and 7 Tables in this thesis.

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ABBREVIATIONS

EA – Energy Access

ECN – Energy Commission of Nigeria

ECOWAS – Economic Community of West African States

EE – Energy Efficiency

EISD – Energy Indicators for Sustainable Development

FITs – Feed-in Tariffs

FMP – Federal Ministry of Power

ILUC – Indirect Land Use Change

Koe – kilograms of oil equivalent

LHP – Large Hydropower

Mtoe – Million tonnes of energy equivalent

NEEAP – National Energy Efficiency Action Plan

NEMP – National Energy Masterplan

NEP – National Energy Policy

NNPC – Nigerian National Petroleum Corporation

NREAP – National Renewable Energy Action Plan

NREEEP – National Renewable Energy Policy

RE – Renewable Energy

REA – Rural Electrification Agency

REMP – Renewable Energy Masterplan

RESIP – Rural Electrification Strategy and Implementation Plan

RESP – Rural Electrification Strategy and Plan

RETs – Renewable Energy Technologies

SDGs – Sustainable Development Goals

SE – Sustainable Energy

SE4All – Sustainable Energy for All

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INTRODUCTION

"Ending poverty and ensuring sustainability are the defining challenges of our time. Energy is central to both of them".

- Jim Yong Kim
President, World Bank.

1.1 Background

Energy is one of the anchors on which several aspects of human life are hinged, and global evidence proves it to be a major backbone of economic development and poverty eradication. Therefore, providing energy in a reliable, affordable and sustainable manner could be the key that unlocks many other puzzles across several jurisdictions. Energy has in fact been linked with sustainable development - in the achievement of the millennium development goals (MDGs) [1] and more recently; the sustainable development goals (SDGs) in which affordable and clean energy is a key focus [2]. It is therefore saddening to realize that the energy portfolio in many regions - especially in developing countries - is still not established enough to deliver these promises.

If energy is so crucial to human development, then the issue of sustainable energy (SE) becomes even more essential for sustainable development because it reduces overall energy impacts on climate change[1] [2]. It is imperative that energy becomes 'cleaner' and that generation and consumption are managed in such a manner that can be supported infinitely by the earth's natural resources. Sustainability in this context does not refer to the sustenance or continuity of the current energy technologies or practices but rather implies that the environment is preserved, human interactions and welfare are not impeded, and economic benefits of energy use are greater than the costs required to provide it.

The issue of SE has increased public awareness and encouraged individuals to take personal responsibility in minimising energy waste [3]. These concerns are the same on the global scene especially in terms of climate change effects and externalities associated with energy consumption. These developments have driven various research efforts which have culminated in policy recommendations. Several governments have also drawn strategies, mechanisms and policies to support SE development.

[1] Energy related emissions account for about 60% of total global greenhouse gas emissions.

Such policies usually come in the form of renewable energy (RE) policies while others also promote energy efficiency (EE), and energy access (EA) or energy security. They aim to reduce dependence on fossil fuels and promote a transition to RE sources, reduce energy-related emissions, and extend modern energy services to remote areas. They also typically contain targets and goals to be achieved by certain periods, using different mixes of instruments and mechanisms. Chapter Two gives a deeper insight into these policies.

1.2 Statement of The Problem

From observation, the main energy issues in developing countries are usually those surrounding the availability, reliability, security and affordability of energy services, whereas, in developed countries, there are additional 'higher level' energy targets such as reducing energy-related emissions and securing the sustainability of the energy sector.

One of the most pressing and persistent problems faced by Nigerian residents over the years has been that of erratic power supply. As at 2015, only 45% of the population had access to electricity with at least, 70% of the people relying on traditional biomass for meeting their energy needs in 2013 [4, 5]. In 2014, firms experienced an average of 33 power outages per month accounting for 15.6% of all total value losses [6]. Consequently, the country was rated as the third most difficult country to obtain electricity for business in 2014 [7]. About 77% of electricity is generated from poor-efficiency thermal power plants [8] and the remaining from hydropower plants which is the only commercially developed RE resource in the country. The energy poverty in Nigeria is summed up by the low per capita energy consumption of 773 kilograms of oil equivalent (koe), compared to other developing countries in Africa such as South Africa (2,658 koe), Tunisia (956 koe), Algeria (1,246 koe), Gabon (1,435 koe) and Libya (2,711 koe) [6].

A 2015 survey conducted in Nigeria by Shell [9] revealed that reliability of electricity supply was the most problematic issue of concern for residents, while environmental pollution was the least pressing issue. This is consistent with another survey in the same year by NOIPolls [10] where respondents shared a similar concern. In the same survey, Shell further investigated what people perceived to be the most important factor in building future energy solutions. While majority believed that collaboration was the way out, only very few believed in policy as the solution, when in fact, a sound policy design could actually address most, if not all of the problems identified. The survey results reflect either a lack of public awareness about energy policies or a lack of confidence in them as a tool for positive change. This is not in any way strange, as a 2009 survey [11] revealed a similar situation in which about 79% of respondents were not aware of any government EE policy.

There is an increasing body of research on energy and energy policy in Nigeria. While a few authors have dealt with other energy matters in Nigeria [3, 12–14], most others focus mainly on RE [15–19], with one [20] even proposing RE as the solution to the energy crisis. Even so, only a few of the aforementioned attempts include a detailed analysis of policy. This paper is, as far as is known, the first attempt to go beyond a mere assessment of energy and energy policies in Nigeria, to assessing - from a global outlook - the effectiveness of energy policies in delivering SE in the country.

1.3 Objectives of The Study

The aim of this study is to analyse energy policies in Nigeria with the intention of identifying their orientation towards achieving SE, and to compare them with corresponding policies in Estonia and the European Union (EU) in order to propose necessary modifications for Nigerian Energy Policies.

More specifically, the objectives of this study are to:

- Analyse the contents of SE supporting policies in Nigeria with respect to overall purpose, substance, goals, targets and overall policy orientation.
- Identify SE policy and practice gaps in Nigeria.
- Evaluate policy performance and effectiveness in achieving policy goals and in promoting SE.
- Compare the energy policies in Nigeria with those in Estonia and the EU.
- Propose recommendations for improving SE policy and practice in Nigeria.

1.4 Research Questions

In achieving the aforementioned objectives this study seeks to explore the following questions:

- What policy gaps exist in Nigeria's energy policies as far as securing SE is concerned?
- How effective are the policies in achieving objectives and in improving the sustainability of energy production and consumption?
- How do these policies compare with Estonian and EU energy policies and what lessons can be learnt?
- What policy and practice options can be proposed for promoting SE in Nigeria?

1.5 Research Methodology

This study is a descriptive and comparative analysis, utilizing elements of both qualitative and quantitative research when and where appropriate. The evaluation is more ex-post than ex-ante, and in order to get the best of this exercise, this research is scoped to focus on policy content and implementation analysis.

1.5.1 Data Collection

The energy policies were obtained majorly from internet sources. Most of Nigeria's energy policies were downloaded from the document library of the Energy Commission of Nigeria (ECN), while the others were accessed through the websites of other energy agencies. Estonia's energy policy documents were obtained from several sources including the Ministry for Economic Affairs and Communications (MoEAC) and the European Commission's website, while the EU's energy policies were accessed from the EUR-Lex website of the European Union and the European Commission's website. These documents were then analysed in line with the objectives of the study, and policy-practice gaps as well as mismatches in the design of the policies were identified.

Secondary data was obtained from international databases such as the International Energy Agency (IEA), the World Bank, the World Energy Council (WEC) and Enerdata among others, to measure progress in SE development and to also compute energy indicators required for evaluating policy performance.

1.5.2 Policy Analysis

The evaluation criteria for policy performance appraisal uses the Energy Indicators for Sustainable Development (EISD) designed by the International Atomic Energy Agency (IAEA). These indicators are valuable because of their policy relevance in establishing links and causality, as they have been used to monitor progress of energy-related policies and test for the feasibility of policy proposals, and also because they cover social, environmental and economic dimensions [21].

The overall approach to this research is based on a modification of Bardach's framework for policy analysis [22]. This study uses a more simplified framework which is better adapted to the purpose of this exercise and is a product of the author's preliminary research. The reason for this is to avoid a mechanistic or tool-box approach to policy analysis which may decrease flexibility. This modified approach involves the following steps: (i) define the context; (ii) state the problem; (iii) frame questions for policy analysis; (iv) select relevant policies for analysis;

(v) assemble evidence; (vi) compare policy options; (vii) apply analytic and evaluative criteria; (viii) interpret findings (ix) make recommendations.

Compared to previous research, this study is novel in its atypical outlook to the analysis of the interaction of Nigeria's energy and its environment. It deviates from the typical RE approach to sustainability but also examines other pertinent but often overlooked issues regarding SE. This study is also very important as it bears policy relevance to the achievement of the major energy objectives of the United Nations' Sustainable Energy for All (SE4All) initiative.

The choice of Estonia and the EU for comparison with Nigeria is justified by Estonia's exemplary 100% EA and its astonishing RE progress, despite the fact that it is also a fossil fuel dependent economy just like Nigeria; and also because of its innovative EE measures. The EU is a global leader in RE, with a comprehensive energy strategy which also places special emphasis on EE and security. Moreover, it provides the framework on which Estonia's policies are built. Thus, it is impossible to discuss Estonia's energy policies without making references to the EU.

1.5.3 Limitations of the Study

There are several approaches to policy analysis, and though this study attempts to adapt the best highlights of a few approaches, there is still the risk of introducing the limitations inherent in those approaches.

Due to time and space constraints, this study does not include an in-depth analysis of the energy situation in Estonia or in the EU, but only assesses the situation in Nigeria. This would have perhaps provided room for a richer assessment and a much fairer comparison between both regions.

Another limitation is that this study relies heavily on secondary data and so, is liable to the weakness of secondary data use. This study strives to use the most recent data available, but in some cases, this was impossible. In cases like this, analysis does not exactly represent current trends. In other cases, energy data for Nigeria was not available or scattered in disparate institutions, especially those required for energy indicators, and so, some conclusions were difficult to arrive at.

Ultimately, this study is limited in scope to policy content analysis and does not include policy processes or analysis of institutions. However, irrespective of the limitations of cross-national comparative policy analysis, it is believed to hold great potentials for being instrumental in dealing with transnational analyses [23].

1.6 Structure of the Study

This paper is divided into seven chapters. Chapter One introduces the topic, describes the problem, presents the study objectives, as well as the research methodology and study limitations. Chapter Two provides a theoretical background and review of SE supporting policies, identifying best practices and global trends. Chapter Three presents an overview of the energy situation in Nigeria, and concludes with an establishment of the potential for SE development in the country.

Chapter Four contains a comprehensive analysis of the SE policies and strategies in Nigeria, eliciting major policy issues. Chapter Five evaluates Nigeria's SE policy performance. Chapter Six briefly describes the energy policy terrain in Estonia and the EU, highlighting relevant lessons for Nigeria. Chapter Seven presents a synopsis of the answers to the research questions, concludes the study and provides necessary recommendations.

2 ENERGY POLICY IN THE CONTEXT OF SUSTAINABLE ENERGY

This chapter attempts to review the common features of policies for promoting SE based on global experience, and the common conditions for success of such policies.

2.1 Sustainable Energy in Global Focus

Energy statistics presented in a recent report by the IEA and the World Bank [24] indicate that SE is still far from being realised, although some degree of progress have been recorded. Somehow, renewables seem to be at the centre of all these developments and invariably, the major challenge has therefore been to establish the necessary policy framework needed to realize the full potentials of renewables in SE development [25]. This could explain why SE is very often confused with, and usually misunderstood to refer only to RE.

In 2011, the UN Secretary-General launched the SE4All initiative to pursue three major objectives by 2030. These include [26]:

- Providing universal access to modern energy services;
- Doubling the global rate of EE improvement; and
- Doubling the share of RE in the global energy mix.

In September 2015, the international community adopted the United Nations agenda for sustainable development. This agenda contains 17 SDGs to be achieved by 2030 one of which is to *"ensure access to affordable, reliable, sustainable and modern energy for all"* [2]. The energy targets of the SDGs very closely align with the SE4All goals. In addition to the aforementioned SE4All goals which are fundamentally similar to the first three targets of the SDG7 targets, the SDG7 has two supplementary targets which are:

- To promote energy infrastructure investments and enhance international cooperation to facilitate access to clean energy research and technology by 2030.
- To expand infrastructure and upgrade SE technology and service in less developed countries, in accordance with their respective support programmes by 2030.

2.2 Sustainable Energy Promoting Policies

Energy policy is said to be a complex global issue, having enormous political and climatic significance, and is best represented in strong political commitments and actionable plans rather than as mere paper documents [27, 28].

EA supporting policies are those aimed at expanding the availability of modern energy services to deprived areas – mainly rural areas where people still depend heavily on traditional energy sources. These policies promote grid extension and provision of clean cooking solutions, as well as generation of energy from off-grid and decentralised solutions among others. Policymakers also embrace distributed RE in policy considerations as a viable off-grid solutions since grid extension cannot possibly solve energy poverty problems completely [25, p. 106]. However, most policies developed for the purpose of improving EA, typically focus more on providing electricity than cooking, heating and cooling facilities [29].

RE policies, which are easily the most common of the mix, are those that promote investment in energy generation from renewable and clean sources such as solar, hydro, wind, biomass and geothermal sources. According to a recent report [25], the number of countries with RE targets as at 2015 was estimated to be 164, with 145 of them having RE support policies in place (a 5% increase from 2014). The report also describes the evolution of policymaking in terms of policy adaptation to changing conditions and combination of different policy mechanisms across several sectors to increase integration of renewables into the energy mix.

It is important that costs of financing SE projects are taken into account when designing policies in order to promote the feasibility and chances of success of such projects. Jager and Rathmann [30] explained that policies to promote RE should ensure reduced project investments, reduced long-term political and societal commitment and reduced risks by the elimination of possible barriers. They further established that a good RE policy is one which reduces the required support for renewable energy technologies (RETs) to low levels as possible, thereby syncing the economic lifetime with the technical lifetime. Azuela and Barroso [31] were of the opinion that good RE policies should include a clear financing strategy and sustainable incremental cost recovery mechanism to prevent excessive passing over of costs to consumer tariffs.

EE policies generally promote the reduction of energy intensity, thereby reducing the energy demand of processes and improving energy resource productivity. It has been established that improving EE holds great potentials for economic savings which could be used to increase EA to energy-poor regions, and that EE measures are capable of unburdening energy supply capacity to meet the rising demand especially in areas where energy demand is growing at a faster rate than supply [32, 33]. The IEA in 2011 made 25 policy recommendations which could save as much as 7.6 Gt of CO_2 annually by 2030 if promptly implemented globally [34].

Although, the EE context differs among countries, the IEA and OECD [35] found that the policy drivers were similar. These drivers revolve around four (4) major issues which include: energy security, economic development and competitiveness, climate change and public health. They further observed that most EE policies achieved their objectives by creating markets for EE equipment and by building capacity for the delivery of EE goods and services, while occasionally combining several policy mechanisms to achieve better results.

2.2.1 Policy Mechanisms

Since EA cannot only be increased by grid extension, private investment is often required to provide off-grid RE solutions to rural areas. Therefore, common policy mechanisms used for this purpose are those which take advantage of the forces of market competition among different project developers, as was the case in Peru where a reverse auction was used to award distributed RE contracts to those with the lowest costs [25]. Policy instruments that combine elements of financial, technical, social and organizational intervention have been labelled as the most effective for extending energy services to rural areas and alleviating poverty. [33].

Other instruments include fiscal incentives such as loans, grants, and tax reductions to offset the high investment costs required to provide off-grid energy solutions, and subsidies which encourage developers to include RETs in their electrification schemes [36]. Subsidies make modern energy facilitates more affordable and encourage rural dwellers to adopt them over traditional energy which is relatively considered to be free. The challenge however, lies in striking a balance between affordability to consumers and profitability to providers as this is key to attracting investments [33]. Though there are divided opinions over the appropriateness of subsidies, 'smart subsidies' could be implemented to address emerging issues[2].

RE instruments can be classified into two major categories; price-based or quantity-based (also known as quota-based) mechanisms, although in broader terms, they could also be classified as direct or indirect based on how the desired effect is achieved. Azuela and Barroso [31] again observed that both price and quantity-based mechanisms are widely used in developed countries, while price-based mechanisms are more popular in developing countries - though some of them have experimented with some quantity-based mechanisms. They outlined the mechanisms as price-based incentives, quantity-based incentives or quota obligations, fiscal and financial incentives, pricing of environmental externalities; environmental standards and voluntary measures.

[2] Smart subsidies are those designed and implemented to maximize benefits while minimizing or avoiding the generic weaknesses inherent in subsidies.

Furthermore, quantity-based instruments could be in the form of RE penetration targets, renewable portfolio standards or RE Policy. Fiscal and financial incentives include tax credits/incentives, grants/capital subsidies, loan guarantees and R&D grants. Pricing of environmental externalities could be as carbon tax or cap-and-trade or emissions trading schemes (ETS), while environmental standards are performance standards that establish certain environmental thresholds.

Feed-in-tariffs (FITs) are the most common form of price-based instruments, and are focused on supporting the development of renewable power generation by guaranteeing access to the grid, stable long-term purchase or revenue stream, and payment levels usually above the market price, based on the cost of RE generation. Net metering could also be used as an alternative to FITs for small-scale systems such as households or small businesses.

Like the RE policy instruments, EE policy instruments can also be classified into two broad sets; price-based or quantity-based. The different approaches and measures that have been adopted are presented by the International Confederation of Energy Regulators (ICER) [37]. They include legal and regulatory obligations, financial instruments, market-based incentives, voluntary agreements, energy audits, and consumer education. Expounding on these, they further explained that governments could set product-specific legal requirements (e.g. minimum efficiency and labelling requirements) on companies, industries and markets with financial penalties for non-compliance, while incentives could also be put in place to encourage EE investments or disincentives to increase costs of energy use. Tradable certificates and tenders, and non-binding targets supported by performance indicators could also be employed.

One major issue identified with price-based measures is the inability to forecast the costs of compliance, which therefore makes it difficult to predict the success of such measures, since individuals would not be motivated to comply with EE measures if the cost of compliance is greater than the penalty for non-compliance; whereas quantity-based measures using tradable permits could prove more effective in achieving targets, although the marginal cost of meeting the targets are also not known in advance [38].

2.2.2 Policy Performance

The IEA and OECD [39] attributed RE policy effectiveness to the country’s level of policy ambition, design and appropriateness of incentive schemes, and the capacity to tackle non-economic barriers that may impede proper market and policy functioning. In their updated publication [40], other overarching policy principles were described, which include:

- Adopting a dynamic approach to policy implementation, depending on the maturity of each individual RET, while responding appropriately to national and global trends.
- Identifying and tackling early enough, overall system integration issues that may arise later on as deployment levels rise
- Developing a predictable and transparent RE policy framework, integrated into an overall energy strategy with ambitious and plausible short and long term targets

Several other factors which are unrelated to the type of mechanism adopted have been shown to greatly impede the effectiveness of RE support policies, and these factors differ from country to country. The IEA and OECD [39] therefore suggest that focus should extend beyond the effectiveness of individual mechanisms, but that the compatibility between the different mechanisms that make up the entire policy framework should also receive similar attention.

They further propounded that the maturity of the technology should be taken into account to ensure a smooth transition of mass-market integration. This implies that policy makers need to be dynamic and respond to the growth in deployment. It has however been observed that FITs tend to be more effective when combined with fiscal and financial incentives especially in developing countries with greater uncertainties and risks when there are clear rules on RE integration and when there is a sustainable incremental cost recovery system [31].

In Azuela and Barroso's review of the diversity of policy packages and the combination of the different policy instruments and incentives, the following lessons were drawn [31]:

- The overall policy design and choice of policy instrument should be tailored to suit the unique conditions of each market and the institutional arrangements.
- Some fundamental legal and regulatory provisions should be in place before the introduction of RE policy to facilitate its implementation.
- Policies that achieve RE capacity expansion may not necessarily be efficient as the costs may outweigh the benefits.
- The compatibility and complex interactions between different policy instruments have to be considered in order to foresee and avoid undesirable effects.
- Policy and regulatory design is an ever-changing dynamic process which requires occasional policy shifts.
- The effectiveness and efficiency of RE policy does not only depend on policy design but also on other critical aspects which must be considered in parallel.

2.2.3 The Theory of Change

This chapter has thus far established the role of policy in realising SE. Many of the other studies cited herein demonstrate how SE can be achieved through robust policies and institutional framework, coupled with the appropriate combination of measures and a clear implementation strategy. The theory of change is useful in policy/programme planning for assessing situations and designing targets and the required actions and strategies to reach them, especially for policies and programmes [41, 42]. It is also useful in identifying indicators to be monitored during implementation.

If the desired change is SE, there is then a need to map out the required activities and interventions to achieve this change and to also show how these activities produce the desired results. There is the need for governments and policymakers to identify the SE targets and then work backwards from these targets to identify all the necessary policy provisions, mechanisms and measures, as well as the institutional arrangements required to realise these targets. This helps to develop an outcomes framework which is useful in identifying the link between activities and targets [41]. Thus, better understanding is gained on how SE can be actualised and how progress can be evaluated.

3 NIGERIA'S ENERGY SITUATION: PROSPECTS FOR SE DEVELOPMENT

This section proves the possibility of achieving SE in Nigeria by first describing the current energy situation and the available energy resources in Nigeria, thereby establishing the theoretical feasibility of a more sustainable energy portfolio. This prepares a solid basis for policy criticisms in the subsequent chapters.

3.1 Country Overview

Nigeria is a West African Country located on the Gulf of Guinea with a total land area of 910,768 sq. km (Fig. 3.1), accounting for about 98.6% of the country's total area. It is a tropical country with two main seasons and five climatic zones.

Figure 3.1 Map of Africa Showing Nigeria [43]

According to data obtained from the World Bank [6], Nigeria is the most populous country in Africa and the 7th most populous in the world. The country has a population of about 177.5 million inhabitants, with 53% living in rural areas. Like many other countries, Nigeria has her fair share of environmental challenges, most of which are common to developing and resource-intensive economies. Some of these include flooding, desertification, biodiversity loss, water scarcity, gas flaring and oil spills [44].

3.2 Energy Situation

It is sad that despite the Nigeria's potentials in terms of her economic position in Africa and the vast array of traditional energy reserves resident in the country, the energy situation in the country is still relatively poor. In 2014, about 15.6% of all value losses was due to electricity [6], and in the same year, Nigeria was ranked as one of the worst (187th out of 189) countries on the basis of 'getting electricity'[7].

3.2.1 Energy Access

With a mere 40% (urban - 65% and rural - 28%) of its population having access to electricity in 2015 [5], about 109 million residents are left without electricity. Of those that have access to electricity, a 2014 national survey [45] revealed that 57% of households experience blackout daily, 40% experience blackouts less often than daily and only 3% never experience blackouts. Coupled with this unreliable supply, it is therefore not uncommon in Nigeria for individual homes and families to make provisions for their own energy needs. Consequently, about 70% of the population still rely on traditional biomass [4]. This ultimately results in desertification as reforestation efforts are almost negligible.

3.2.2 Energy Resources and Supply

Nigeria is an oil-dependent country, with oil and gas earnings, accounting for about 16% of the GDP, 75% of government revenues and 90% of export earnings [46]. Nigeria possesses the tenth largest crude oil reserves in the world and the second largest in Africa. With an average daily crude oil production of 2.29 million barrels[3] [47], these reserves will last for approximately 45 more years. The country's natural gas reserves also stand as the largest in Africa and ninth largest in the world. With an average of 2,444 billion SCF produced per year[4] [47], there are approximately 75 years of extraction remaining.

However, due to poor infrastructure for capturing and processing the gas, production is way below capacity, resulting in huge gas volumes being flared [48]. Biomass is also largely used in rural areas in the form of fuel wood as the major source of energy. Of all the present day viable energy sources in Nigeria, hydropower is currently the most developed renewable source [16, 49], generating an annual average of 6,185 GWh between 2004 and 2013 [50].

[3] Average for 2010-2014.
[4] Average for 2010-2014.

Overtime, the total primary energy supply in Nigeria has considerably increased, with biofuels and waste being the most abundant supply sources (Fig. 3.2). However, this could be indicative of the under-development of other energy sources, since the country also possesses huge reserves of other energy sources as well.

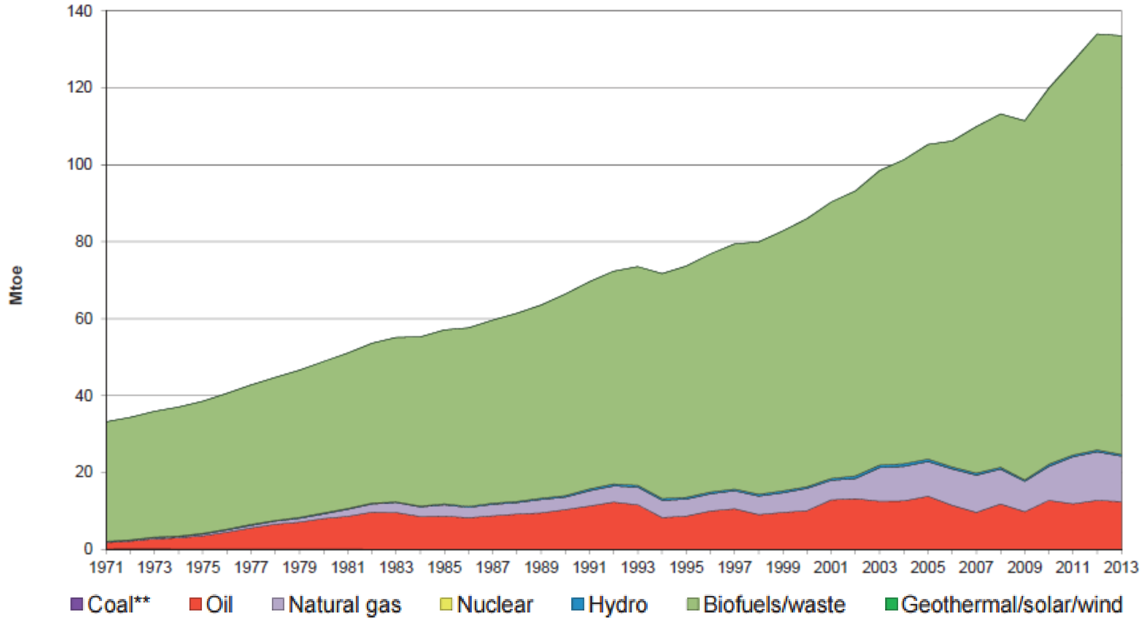

Figure 3.2 Total Primary Energy Supply in Nigeria [50]

In 2013, the total primary energy supply (TPES) in Nigeria was 133.5 million tons of oil equivalent (Mtoe) excluding electricity trade. The largest supply sources were biofuels and waste (81.49%), oil (9.31%) and natural gas (8.83%).

3.2.3 Energy Demand and Consumption

Nigeria faces a major challenge in matching supply with demand as energy demand far exceeds supply [51, p. 17]. The main energy consuming activities in Nigeria are those of the domestic, industrial, and transport sectors [50] which basically include cooking, lighting and running of electrical appliances. In 2014, the total energy consumption in Nigeria was 131 Mtoe [52]. In 2013, solid biofuels and waste was the major energy resource consumed (probably due to the extensive use of fuelwood for off-grid cooking, heating and meeting other domestic energy needs), followed by oil and gas, while hydropower accounted for a negligible portion (Fig. 3.3).

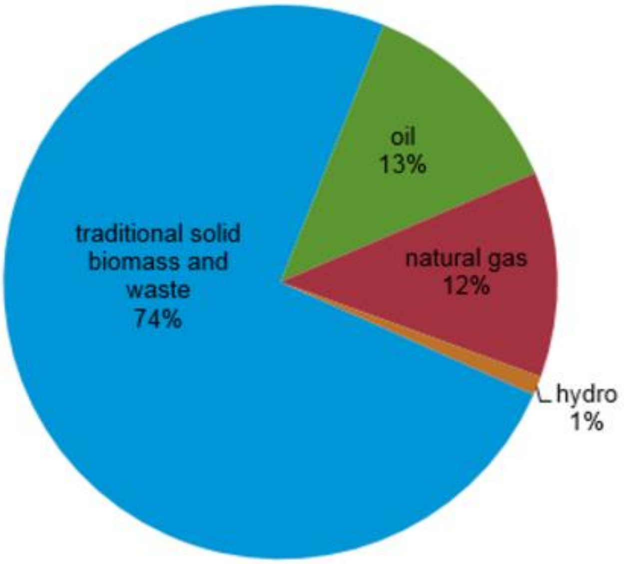

Figure 3.3 Primary Energy Consumption Mix in Nigeria (2013) [48]

Studies have revealed that energy and electricity consumption in Nigeria is skewed towards the residential sector [46, 50]. This is indicative of the extent of development to be expected in the country considering the fact that residential energy consumption is usually final compared to industrial consumption which is usually for producing goods and services, creating employment and driving economic growth and development.

3.2.4 Energy Efficiency

The issue of EE is particularly important in a country like Nigeria with low energy supply. EE has been identified as a potent means for reducing energy demands, offsetting energy costs and supply deficit, preserving the resource base and mitigating environmental problems [53–55].

As at 2014, only 46% of the 13,308 MW total installed capacity was operational, with only 23-34% of total capacity being generated [46]. Electricity is generated mainly by thermal power plants [8] which are only 40% efficient. An additional 8.9% of energy generated is lost in transmission and distribution, bringing the efficiency to 46.7%.

In Nigeria, energy inefficiency arises from the use of traditional stoves, inefficient cooking methods based largely on open fire, use of incandescent bulbs, importation of second-hand appliances and vehicles, and use of old and inefficient equipment and production processes - all of which have low or reduced efficiencies [13, 14, 56].

3.3 SE Potential in Nigeria

In terms of RE development, an extensive body of research proves the viability of the renewable resources in Nigeria for energy production. The small hydropower potential of Nigeria is estimated at 3,500MW, of which only 60.58 MW (1.7%) has been developed [57]. This leaves room for an additional 3439.42 MW. The World Small Hydropower Development report of 2013 identified the barriers to small hydropower development in Nigeria, some of which include lack of requisite skills, lack of feasibility studies, lack of information and awareness in rural areas [58]. If these barriers can be overcome, then Nigeria can begin to realise her potentials in hydropower development.

Although Nigeria has been categorised as a poor - moderate wind regime country [59] as a result of the wind patterns across the country, Aliyu et al. [18] investigated the viability of wind energy in parts of Nigeria and submitted that there are good wind resources in most parts of the country. But in spite of these potentials, the development of wind power has not attracted sufficient attention and several barriers have been identified [60, 61].

Nigeria's solar energy potential have also been proven. The country's position near the equator places it at an advantage for solar energy generation. Receiving an average solar radiation of about 19.8 MJm^{-2} day^{-1} and average daily sunshine of 6 hours, about 1.85 TWh of solar electricity could be produced per year [62, 63]. This signifies enormous energy potentials, which if properly harnessed, could help alleviate energy poverty especially in rural areas.

Adebayo [59] estimated that Nigeria can potentially generate about 6.8 million cubic metres of biogas daily from its daily production of 227,500 tons of fresh animal waste, and that cultivating energy crops on one-tenth of the country's arable land could yield up to 12.8 Mtoe of energy. He further claimed that Biomass is not being used sustainably in Nigeria, as it is used more for thermal than other purposes. Aliyu [18] submitted that in spite of resource availability, biofuel and biogas are not substantially exploited in Nigeria due to poor infrastructures and lack of technical skill.

Although, Nigeria's final energy intensity is not too high (0.139 koe/$2005p) compared to the rest of the world, there is still potential for improvement as even some African countries such as Algeria (0.11) and Egypt (0.097) have lower values [52].

It is estimated that end-use energy consumption can be reduced by an estimated 40% by introduction of energy-efficient devices and use of energy-saving lighting [46]. Also, Nigeria's

Ministry of Environment [64] explained that potential emissions reduction equivalent to 39 metric tons of CO_2 could result from energy-efficient practices.

The current energy situation in Nigeria leaves much to be desired. With 60% of the population lacking electricity access, and overdependence on traditional energy sources for cooking, there's a massive potential for improvement – considering the abundance of energy resources in the country. It therefore becomes clear that SE is feasibly within reach.

This chapter has established Nigeria's SE potential and has also identified barriers to SE development. It is therefore expedient that energy policies address these barriers and are properly designed to take optimum advantage of the energy resources for sustainable production and consumption of energy.

4 SUSTAINABLE ENERGY IN NIGERIA: ANALYSIS OF POLICIES

4.1 Nigeria's Energy Policy

The National Energy Policy (NEP), which came into effect in 2003 is the 'umbrella' policy document for all other energy-related policies in Nigeria. It contains the blueprint for the development of the energy sector and was formulated in response to the need for ensuring sustainable supply and optimal utilization of energy in the country[57]. It contains nine (9) policy objectives in line with various national development goals, touching on energy security, diversification, SE supply, EE and international cooperation in energy trade, among others.

In 2013, the NEP was reviewed to reflect developments in the energy sector. The National Energy Masterplan (NEMP) which was initially drafted to guide the implementation of the NEP was also reviewed. The NEMP [65] translates the policies, objectives and strategies of the NEP into actionable short, medium and long term plans detailing activities, implementing agencies, collaborating agencies, funding sources and timelines for the achievements of the stated objectives.

In this section, assessment focuses on EA, RE and EE as highlighted by the SE4All initiative. However, as it is practically impossible to analyse each of the energy policy documents in the country, the most relevant ones relating to SE are analysed, while references are made to any other policies worthy of mention.

The term 'policy' as used in this section is also broadly inclusive of plans and strategies targeted towards SE.

4.2 Energy Access

Despite the poor EA in Nigeria, this study gathers that of all the three major energy aspects covered in this research, EA has been the most ubiquitous objective of virtually all of the country's developmental policies for over three decades. It has been addressed by policies such as the Rural Electrification Policy, Rural Electrification Strategy and Plan (RESP) and the Rural Electrification Programme. Also, some of the country's RE and EE policies require that RETs and EE solutions be employed in extending EA to remote urban, rural, and off-grid areas. The Rural Electrification Agency (REA) is the institution tasked with these responsibilities.

NEP comprises an electricity policy which stresses government's commitment to ultimately expand EA to all Nigerians. Based on the NEP and the Rural Electrification Policy, the Rural

Electrification Strategy and Implementation Plan (RESIP) was developed to rapidly expand electricity access across the country as cheaply as possible [46, 66].

The key objectives and principles of the rural electrification programme are summarised as follows [66]:

1. Provision and extension of steady and reliable electric power at affordable prices to all Nigerians.
2. Provision of more environmentally-friendly alternatives to conventional energy sources.
3. Promotion of private sector participation in rural electrification.
4. Promotion of economic and social activities in rural areas, thereby raising the living standards of rural populations.
5. Assist in reducing migration from rural to urban areas.

From the above objectives, it can be deduced that the programme was intended to boost both the economic, social and environmental conditions of rural and urban dwellers. The expansion of modern energy services to remote areas would provide energy for domestic, industrial and commercial uses, thereby facilitating economic growth and consequently improve the welfare of the rural dwellers. At the same time, this would reduce the environmental pressure resulting from use of fuelwood energy.

4.2.1 Policy Targets

The EA targets as expressed in the various policies focus on increasing electricity access in both rural and urban areas (either by expanding the national electricity grid or through mini-, off-grid or standalone systems) and increasing access to modern energy services for cooking.

By 2020, it is expected that 75% of the whole population would have access to electricity, and by 2030, electricity access would have expanded to reach every household [57]. These targets (Table 4.1) were dubbed as ambitious by the RESIP due to the implications for implementing them.

Table 4.1 Energy Access Targets in Nigeria

S/N	**Target**		**2020**	**2030**
1	Electricity Access (%)	Total Population	75	100
		Community Health Care Centres		90
		Rural and Semi-Urban Educational Centres		95
2	Access to Modern Energy Services for Cooking (%)		53	78
3	Access to Clean Cooking Facilities (Pieces)	Biogas Digesters		8,000
		Improved cooking stoves	50%*	1 million
		Solar Cookers		150,000
4	Access to Butane Gas (LPG) or Compressed Natural Gas (CNG) (%)		15	25
**50% of traditional firewood consumption for cooking to be replaced by improved cook stove technology.*				

Data: [5, 55, 57, 66]

Taking 2015 as the base year, an additional 82.5 million people (14 million households) will have to gain access to electricity by 2020 and a further 108 million people (19 million households) between 2020 - 2030, in order to achieve these targets (Table 4.2). This adds up to a total of 190.2 million people (33 million households) between 2015-2030. This is an enormous task which would require intensive commitments.

Table 4.2 Electricity Access Scenarios in Nigeria Based on Targets and Population Projections

	2015	2020	2030
Population	182 million	207 million	263 million
% With Access	40%	75%	100%
Population with Access	72.8 million	155.25 million	263 million
Required Improvement	-	82.45 million	107.75 million
Households with Access*	13 million	27 million	46 million
Required Improvement	-	14 million	19 million
**Average household size = 5.7 people* [45]			

Data: World Bank [67], SE4All Action Agenda for Nigeria [5]

The generation capacity required to handle additional demand from connecting 10 million new households has been estimated to be around 6,000 MW [46]. By extrapolation, an additional 7,800 MW – 19,200 MW of electricity would be required to serve these new households. This is higher than Nigeria's total installed power capacity of 6,313 MW [46] and a lot of improvements to the current energy system would be required in order to achieve the targets.

A Comparison of Nigeria's targets with those of other African countries in the west African (ECOWAS) region (Fig 4.1) shows how really ambitious the country's targets are. Only Nigeria, Sierra Leone, Cabo Verde and Ghana have such an ambition to reach 100% of the population with electricity by 2030 or earlier with Cabo Verde setting the earliest date (2015).

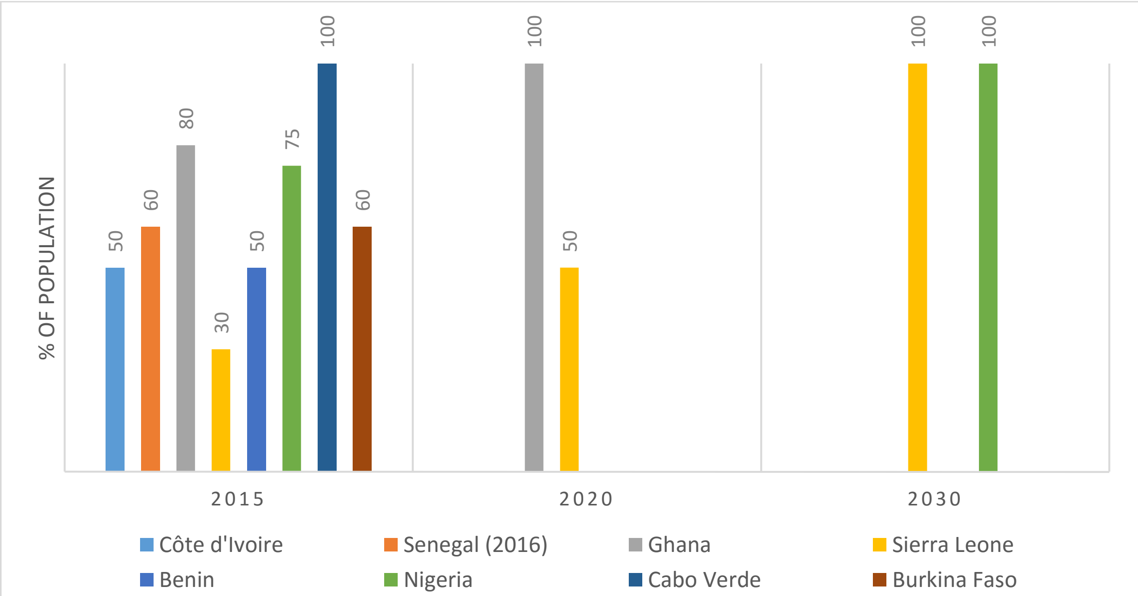

Figure 4.1 Electricity Access Targets of ECOWAS Countries *Data: ECREEE [55]*

It is also noteworthy that Nigeria is the most populous country in the continent and has an additional task of keeping up with her large and ever-growing population size in improving EA across the country. With the population figures of the countries compared (Fig. 4.2), it is no gainsaying that Nigeria has the most ambitious targets in the region.

Nigeria's electricity access target lays before it an uphill task - a magnificent feat bearing huge economic, social and environmental implications which could radically improve the country's energy situation if achieved. With the country having the largest economy [68] on the continent, and a vast expanse of energy resources, it is theoretically possible. However, it would require unwavering commitments.

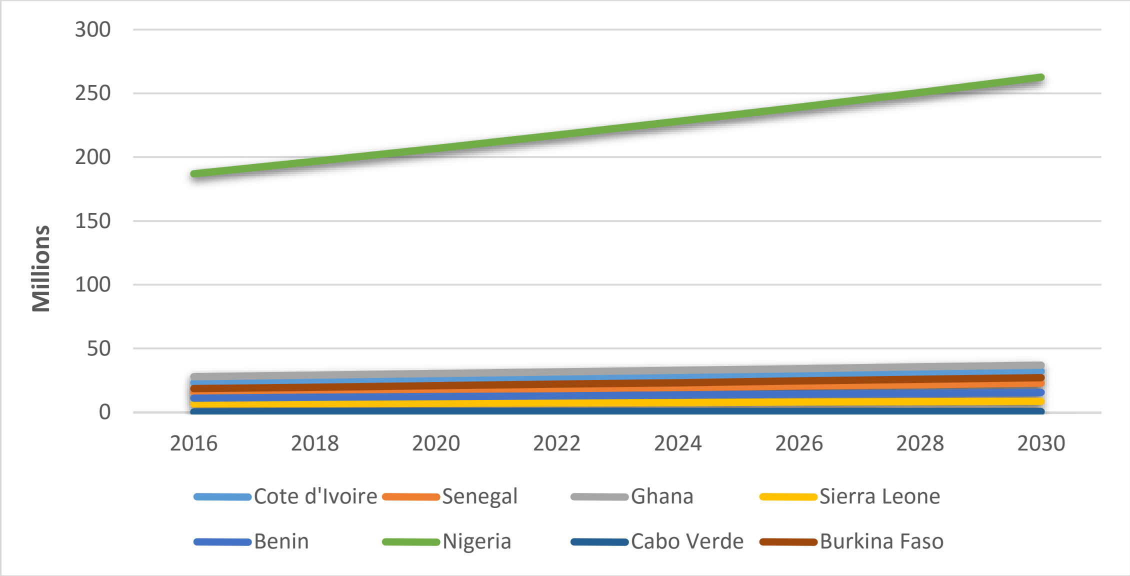

Figure 4.2 Projected Population for ECOWAS countries *Data: World Bank [67]*

One other major target is providing access to modern energy for cooking. Nigeria intends to provide modern cooking energy to 53% of the population by 2020 and 78% by 2030. Taking 2013 as the base year, an additional 58 million people (10 million households) would need to be supplied with modern cooking facilities by 2020 and a further 95 million people (17 million households) between 2020 - 2030 to meet these targets (Table. 4.3). This means that in total, 153 million people (27 million households) would have to be covered between 2013 - 2030.

Table 4.3 Scenarios for Access to Modern Energy for Cooking in Nigeria (2013-2030)

	2013	2020	2030
Population	173 million	207 million	263 million
% With Access to Modern Cooking Energy	30%	53%	78%
Population with Access	52 million	110 million	205 million
Required Improvement	-	58 million	95 million
Households with Access*	9 million	19 million	36 million
Required Improvement	-	10 million	17 million
**Average household size = 5.7 people* [45]			

Data: [4, 5]

However, the quantities of cooking facilities planned to be supplied are not consistent with the targets. About 8,000 biogas digesters, 1 million improved cooking stoves and 150,000 solar cookers are planned to be delivered by 2030 (see Table 4.1). This would be insufficient to meet the above targets. If it is assumed that one cooking facility would be supplied per household, then based on Table 4.3, least 10 million pieces would be needed before 2030 and an additional 17 million pieces before 2030.

Although, from Table 4.1, improved cooking stoves would be supplied to replace 50% of traditional firewood consumption for cooking, the exact quantities of stoves to be required is unknown. This is an ambiguous policy statement and does not provide clarity for action. In 2013, about 206 million cubic metres of fuelwood was consumed in Nigeria [69]. If $1m^3$ of wood provides 2,600 kWh [46], then stoves than can supply 40,000 kWh of energy will be required by 2030.

This study reckons that the EA targets are dispersed in several documents in an incoherent manner. In many cases, the targets set in one do not take cognisance of the targets in others. For example, the overarching policy, the NEP sets targets of 100% EA by 2030, while the RESP extends this target to 2040 and sets a new target of 90% by 2030 [46, p. 126]. Also, the EA policy documents represented in the ECOWAS report [55] contains only targets for 2020 and also contains targets for cooking facilities, which are not represented in the other policies. This fragmentation makes it difficult to understand and correctly interpret the provisions of the policies. This raises the need for a coherent EA policy.

4.2.2 Implementation Strategy

Although drafting and designing of rural electrification policies and programmes in Nigeria is the prerogative of the Federal Government through the REA, implementation and project execution will be conducted at the state community levels [46, 66]. This is a decentralized demand-driven approach which also encourages public-private partnerships, with much of the service delivery coming from the private sector.

The major strength of this approach lies in the greater chances of success and effectiveness, since programmes can be designed and executed to meet specific needs identified at the local community levels. However, the bottom-up strategy also has its own risks. The formulation and implementation of policy at the different levels could make room for policy gaps and/or overlaps if proper coordination is not done.

According to the RESIP [66], electricity access would be provided through grid extension, mini-grids and stand-alone systems. Except for cases where other options are more cost effective, preference would be given to grid extension due to its higher service delivery quality.

To achieve the electricity access targets, the total annual additional number of households electrified from 2015 onward till 2030 would be increased, with more emphasis on rural than urban households in the short term (Fig 4.3).

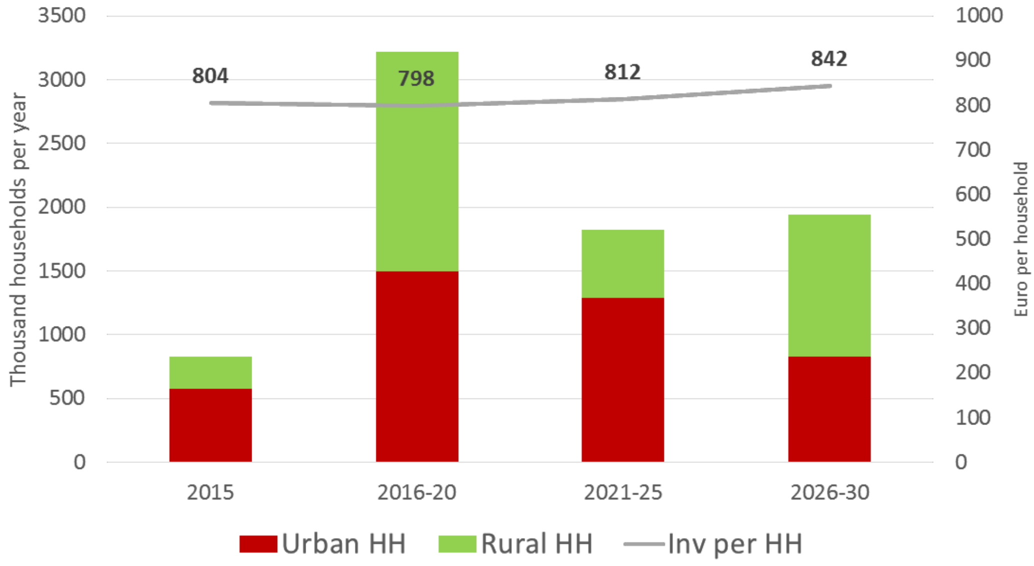

Figure 4.3 Planned Electrification Rate and Unit Investment in Nigeria [5]

If electrification is implemented at the rate indicated in the graph, the 100% electricity access target would be achieved already before the end of 2029. Only 33 million households need to be electrified (see Table 4.2), but according to Fig. 4.3, over 31.6 million households would have been covered already by the end of by 2028.

Cost calculations from Fig. 4.3, reveal that implementing the 100% electricity access target would cost about €30 billion (2015-2030). This value is consistent with the estimations of a recent study which put the costs at $34.5 billion (€30.6 billion) [70].

The strategy also includes the supply of butane to 0.8 million additional households per year, which will cause an increase in the annual butane consumption for cooking to more than 1.8 million tonnes by 2030 (Fig. 4.4).

This does not take into account, the annual production capacity of the country. Nigeria produces over 2 million tonnes of Liquefied Petroleum Gas annually, of which only 250,000 tons per annum is reserved for the domestic market [71]. In the short term, the demands could still be met up till 2015, after which production capacity will have to be expanded to accommodate for local consumption.

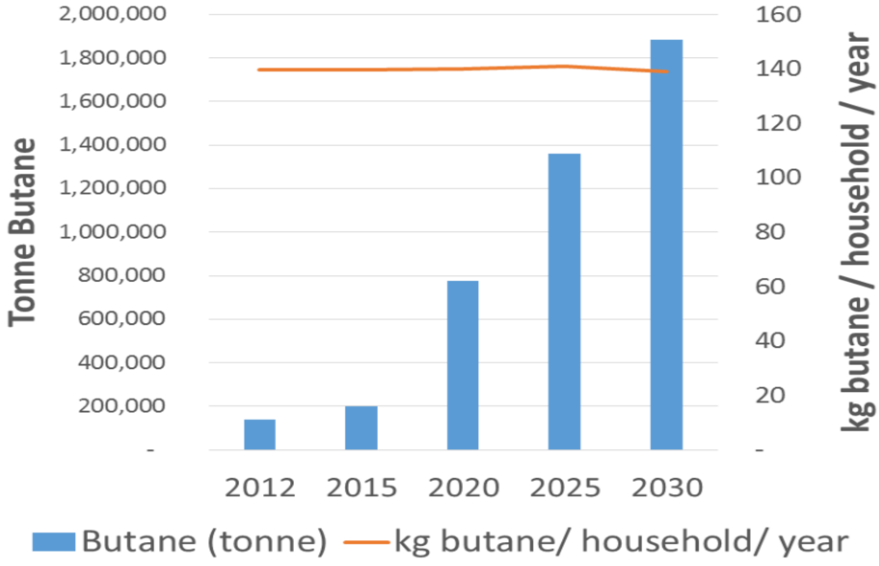

Figure 4.4 Planned Butane Supply to Nigerian Households [5]

Although the policies state government's interest in improving energy reliability, they contain no measurable targets for reducing number of blackouts. There would be no appreciable benefits of expanding EA if it is not accompanied by a commensurate expansion of energy supply capacity as demand will outgrow demand, mounting pressure on existing capabilities. This could ultimately reduce the reliability of energy supply.

4.2.3 Mechanisms and Incentives

The RESIP seeks to promote the achievement of the policy goals through competition, subsidies on capital investments, and reduced barriers to entry, as well as appropriate tariff policies that reflect costs of operation & maintenance, system expansion and upgrade, and offer a reasonable return on investment [66]. According to the policy, these incentives would help to stimulate both demand-side and supply-side interests in EA projects.

The government perceives subsidies as a key instrument of the policy mix for two reasons; it's efficiency for funding rural electrification in Nigeria and the fact that it helps achieve some sort of equity between rural and urban dwellers. It would be provided to lower the initial capital requirements of rural electrification projects, thereby improving access to electricity in rural areas and reducing the rate of rural – urban migration [66]. However, these subsidies will only apply to investors and not to end-consumers of rural electricity, as a cost-reflective tariff system would apply to consumers.

A major challenge has been identified with this tariff system in that it would erode any form of social equity which the capital subsidies for investors aims to provide, since electricity consumption in urban areas is subsidized and the urban dwellers do not pay a cost-reflective price [46]. This may ultimately result in a shortage of demand since rural dwellers might not be able to afford these improved energy services, and so, despite providing them with access, they might still remain energy-poor. The United Nations Industrial Development Organisation describes this situation as *"the vicious circle of energy poverty"* [33, p. 10.20].

4.3 Renewable Energy

The NEP identified the potential for integrating RE into the energy mix to aid in addressing the country's growing energy demand and the challenges of climate change. These initial provisions were later fully blown into an actionable plan dubbed as the Renewable Energy Masterplan (REMP) in 2005 to complement the NEP. Some other RE policy documents include the Renewable Electricity Policy Guidelines (REPG) and Renewable Electricity Action Programme (REAP) in 2006, the National Biofuel Policy and Incentives in 2007, and the National Renewable Energy and Energy Efficiency Policy (NREEEP) in 2015. The Feed-in Tariff for Renewable Energy Sourced Electricity[5] [72] which came into force in February 2016 spells out the FIT system for feeding RE into the national grid.

4.3.1 National Renewable Energy Masterplan

The REMP [73] was drafted in 2005 as a blueprint for RE development in response to the need for a market-oriented policy for existing RETs in Nigeria. It came into force in 2011 and was later reviewed in 2012 to reflect emerging local and international guidelines and developments.

The REMP envisions a gradual transition in the short term to a less carbon-intensive energy system, which would predominantly rely on gas in the medium term until Nigeria can begin to utilize RE sustainably. The document contains inter alia; Programmes on Biomass, Solar, Hydropower and Wind Energy as well as RE promotion, with each programme having short (2013–2015), medium (2016–2020) and long term (2021–2030) targets.

The objectives of the REMP include but are not limited to enhancing national energy security, expanding EA, reducing environmental degradation and health risks, and improving research and development on various RETs.

[5] The document targets a generation of 2,000 MW of electricity by 2020 from biomass, small hydro, wind and solar, and also mandates electricity distribution companies in Nigeria to source at least 50% of their total procurement from renewables.

4.3.1.1 Policy targets

In explaining the country's vision, the REMP in 2005, set an ambitious target of providing 50% of the national energy demand from SE sources by 2050 [73, p. 36].

The first difficulty the reader encounters when interpreting the targets of the REMP lies in the interchangeable use of 'electricity demand' and 'energy demand' by the policy document. The initial 2015 target was to provide 5% (701 MW) of the nation's *electricity demand* from renewable sources which would then increase to 10% of the country's total *energy demand* by 2025 [73, p. 37]. This treats electricity and energy as if they were the same, thereby causing ambiguity. It makes the targets appear clumsy, which makes implementation and evaluation even more difficult.

As at 2012, only 85 MW of electricity was being generated from renewable sources (excluding large hydro plants, Table 4.4). As this was far from the 2015 target, the REMP was reviewed and new targets and timelines were established up to 2030. Although, there is insufficient information to ascertain the underlying cause of failure of the drafted policy in achieving the targets, it can be partially attributed to the delay in approving the policy, considering the time lag between the initial policy draft (2005) and adoption (2011). This places a question on the RE policy process and framework as well as on government commitment to RE development.

The new targets in the revised policy document (Table 4.4) shows an intention to considerably improve RE shares, with about 20% (63,032 MW) of the nation's total electricity supply to be generated from renewable sources by 2030.

It is clear that if energy from large hydropower (LHP) plants is to be excluded, then RE contribution to electricity becomes negligible, with no substantial inputs until 2020 when solar energy production would begin to increase significantly. It is therefore expedient to also examine the contribution of each of the energy sources to the total amount of RE supply.

It is commendable that the targets place an emphasis on the development of solar energy and de-emphasize LHP given the latter's emerging environmental concerns [74, 75]. By 2030, solar energy will contribute 76% of total RE (up from 0.76% in 2012), while that of LHP plants would have reduced to only 18% (down from 98% in 2012). Despite these planned improvements, the targets do not reflect sufficient interest in other RE sources.

Table 4.4 REMP Renewable Electricity Supply Projection in Nigeria (MW) [62]

S/N	Resource	2012	Short Term (2013-2015)	Medium Term (2015-2020)	Long Term (2021-2030)
1	Hydro (Large Plants)	1938	4,000	9,000	11,250
2	Hydro (Small Plants)	60.18	100	760	3,500
3	Solar PV	15.0	300	4,000	30,005
4	Solar Thermal	-	300	2,136	18,127
5	Biomass	-	5	30	100
6	Wind	10.0	23	40	50
	All Renewables*	1985.18	4,628	15,966	63,032
	Projected Electricity Supply (13% GDP growth rate)	8,700 (installed capacity 2012)	47,490	88,698	315,158
	% of Renewables	23%	10%	18%	20%
	% RE Less LHP	0.8%	1.3%	8%	16%

*Totals may not sum up accurately

Based on these targets, both LHP and solar energy will produce at least a joint 94 % till 2030. Only 50MW and 100MW are to be generated from wind and biomass respectively by 2030, while no mention is made of sources like geothermal, wave and tidal energy despite the fact that Nigeria's potential for generating energy from these sources have been proven [76–80]. Although, elsewhere [51], the energy production from these sources was encouraged, there were no concrete provisions to sufficiently motivate the exploration of these resources for energy generation.

In light of Nigeria's poor infrastructural and institutional capacity [16, 17, 81], these targets may seem realistic on one hand, since it would be impractical to have ambitious targets without a proper framework for implementation. This study discovers, in consistency with previous findings [16], that there is no single government institution with the mandate of developing the RE subsector in Nigeria. Rather, there are a number of institutions who only have secondary interests in RE.

On the other hand, the targets might be deemed ambitious considering that they were based on the 13% GDP growth scenario which was the most optimistic growth scenario in the country at the time, as detailed in the REMP document. However, given the country's RE potential, these targets would appear to be a far-cry from what is possible. Newsom [82] claimed that Nigeria's RE policymaking attempts are far from fully exploiting the country's RE potential. He estimated Nigeria's concentrated solar thermal power potential alone, at over 427,000 MW. Paradoxically, Nigeria's highest peak power generation stands at a risible 5,074.7 MW [83].

Even in comparison with a few other African countries who have RE targets in place (Fig 4.5), Nigeria does not compete favourably, as a number of the countries either have higher targets or have a shorter timeframe for achieving similar targets.

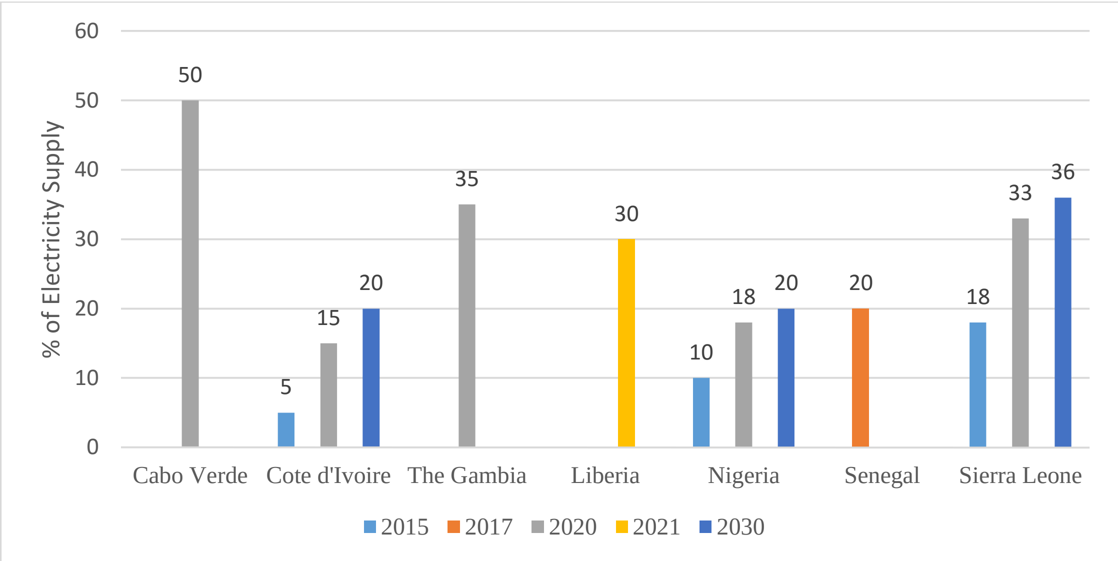

Figure 4.5. Renewable Energy Targets of African Countries *Data: ECREEE [55]*

Another notable flaw of the policy is that the RE resource data used for formulating the targets are outdated. The RE projections were principally based on the RE potentials presented in 2005, when the REMP was first drafted. The same data was used seven years after, when the REMP was reviewed. This could be erroneous as there might have been an expansion in the resources

4.3.1.2 Implementation Strategy

The REMP contains the Renewable Energy Action Plan (REAP) which identifies the required short, medium and long term activities for the implementation of the provisions of the policy. The activities for this plan are grouped into the following components [62]:

- Assessment of Resource Base/Data Acquisition
- RE Policies, Regulatory and Institutional Frameworks

- Capacity Building and Skill Development Programme
- Public Awareness/Sensitization
- Development of Financing Options Program
- Development of Renewable Projects
- Incentives for RE Development
- Research and Development
- Standards, Codes of Practice & Specifications
- Local Manufacturing and Commercialization

For each component, the REMP describes the targeted outcomes and identifies the requisite activities, responsible agencies and proposed funding sources. Except for a few shortcomings, a peek at the REAP gives the impression of a well-thought action plan, covering a broad range of issues and carefully highlighting each activity to be conducted for the present and the future.

One of the flaws identified by this study is that although the REAP suggests the incorporation of RE education into the nation's education curriculum, this move appears rather late, considering that some countries have been offering academic programmes for RE education since as far back as the 1970s [84]. However, it is still commendable bearing in mind the potential increase in the demand for qualified RET specialists in the nearest future. Other studies [82, 85] also support this move.

Also, in a bid to promote locally manufactured RETs and address the challenges of commercialization, the action plan includes arrangements to link the industrial sector with energy R&D agencies, and to also identify and bring RET practitioners in the country together under an association in order to protect their interests. While this may actually improve the profile of local RET manufacturing and generate public awareness in the country, it might not effectively lead to any substantial market activity in favour of locally produced technologies. The policy makers should know better, since Nigerians are known for having a penchant for foreign goods [86–89], which has led to a drop in the value of the Nigerian currency over the years, and has persistently thwarted the growth of local manufacturing in Nigeria as a whole.

While the plan outlines all the institutions to be responsible for implementation and funding, it fails to describe the roles of each. This could lead to role conflicts, making it difficult for the various actors to internalise the plan. Regarding funding, the Federal Government, through the relevant ministry or parastatal is listed as a funding source for each and every component of the plan. This appears unrealistic and seems more like mere formality, considering the nature of government spending in years past. Government budget has always been made up of an average of 70% recurrent expenditure for the past ten years leaving very little to be spent on such items presented in the REAP [90–92]. Therefore, piling the financial weight of the plan on the government might not yield the best results.

4.3.1.3 Mechanisms and Incentives

The range of financial incentives proposed for encouraging RE investments include: low-interest (≤ 5% per annum) soft loans to be provided by special finance agencies; subsidies and grants (of up to 30% of initial costs of RE facility); purchase tax waivers and free training programmes for developing technical capacity for RETs. The subsidies would however be in kind, and would be ratified and administered by the ECN in order to ensure they are used for intended purposes. Even so, the plan does not explicitly describe the form which the subsidies would assume. Stating that subsidies would be in 'kind' might not be enough inducement to attract investment.

The fiscal incentives include lower profit taxes of half the prevailing rates, tax holidays, import duty waivers, investment capital allowance (20% per year for the first four years and 19% in the 5th year, with 1% retained in the books) and interest-free capital relief. This capital relief will amount to 50% of the initial investments, will be provided in kind and is to be repaid from the second year of production at incremental rates of 10%, 20%, 30% and 40% in the 1st, 2nd, 3rd and 4th, repayment years respectively.

The use of solar and biogas water heaters in new housing, and bio-fuels in transport vehicles will be encouraged through demand stimulation, albeit on a very small scale. This demand is intended to be generated from within government circles by recommending installation of solar water heaters and biogas generators in new government housing, use of E10 and B20 biofuel blends in government vehicles and generators, and compact fluorescent lamps in government buildings. While this might be effective, it will produce very insignificant results, as government housing only account for a minor percentage of the national housing structures. Other fiscal incentives to be used include purchase tax waivers for consumers of RETs, and rebates on income taxes and levies for individuals who purchase RETs.

That these incentives have been put in place shows a certain level of commitment to RE, which if complemented by proper implementation, could be effective in overcoming the many cost challenges of RE (which are not only peculiar to Nigeria). The question however, will be whether or not the motivation produced by these incentives will be enough to spur the widespread uptake of these technologies, since many people already provide for their own energy needs through generating sets, and will only continue to purchase whatever energy is affordable and accessible to them, considering also that petroleum is being subsidized.

Conversely, it is clear that with the exception of the FITs designed to encourage producers of RE, all of the other incentives are installation-focused rather than production-oriented. They induce investors to invest in RETs by reducing capital cost requirements, but do not sustainably encourage clean energy production. Accordingly, Sawin [93] argued that production incentives are more effective in producing the desired results of RE compared to investment incentives.

It was also observed that there no cost recovery mechanisms to ensure the security of investments in RETs. Emodi and Ebele [81] also made this observation in their study, lamenting the risks it poses to investors and RE investments. This is a major loophole, as the success or failure of RE policy has been linked with the existence of a sustainable incremental cost recovery [31]. Additionally, these incentives also do not take cognisance of the maturity of each RET. The incentives apply across all technologies irrespective of the maturity of each. In doing this, they fall short of what has been identified as one of the 'best practices' of policy instrument design [31, 39, 40].

4.3.2 National Renewable Energy and Energy Efficiency Policy

The NREEEP was developed by the Federal Ministry of Power (FMP) [51] with an overall focus of guiding the optimal utilization of the nation's energy resources for sustainable development, laying emphasis on RE . It also considers energy from cogeneration plants, and identifies EE as a possible source of energy.

The first major inconsistency observed with the NREEEP is that it proposes the development of a REAP which had already been established by the REMP. The latest version of the REMP was produced in 2012 and already specified in details the contents of the REAP (see section 4.3.1.2). The NREEEP however, was developed and approved years later (2013 – 2015). This blunder was probably possible because the REMP and NREEEP were developed by separate bodies – the ECN and the FMP respectively. This indicates a plausible lack of institutional coherence among the players of the energy industry tasked with policy development. Ironically, the NREEEP identified and made reference to this same lack of coherence in previously existing policies - an issue which it sought to address.

Furthermore, in outlining the strategies for the RE component of the policy, the NREEEP for the large part, actually reproduced the RE content of the 2003 NEP which had been replaced with an updated version in 2013 and was no longer in force. It becomes questionable why the FMP would reach back to fetch content from an outdated policy document while there was an updated version of that same content in a more recent policy document. Again, this implies an out-of-sync working relationship between the FMP and the ECN as both versions of the NEP were also produced by the ECN.

Generally, the contents of the NREEEP mirrors the weak efforts expended in producing it; for the larger part, it appears like a mere summary of previous policy documents. Barring these few concerns, the NREEEP does well to describe the introduction of RE into the energy mix for power supply and utilisation through on-grid and off-grid solutions. The policy also contains provisions for RE financing through the attraction of foreign investment capital. The strategies are essentially similar to those of the REMP and include provision of fiscal incentives, cost-effective pricing mechanisms, subsidies, tax and duty exemptions.

4.3.2.1 Policy Targets

The targets here are essentially the same with those of the REMP, and rightly so, since they are aimed at the same outcome, except that in this case, the targets of the NREEEP are based on 7% GDP growth scenario. This less optimistic growth scenario was probably a reflection of the prevailing economic conditions at the time when it was developed. However, the NREEEP differs from the REMP in that it takes into account, off-grid generated energy as part of total energy consumed when calculating % shares of RE. This is an improvement on the REMP which ignored this.

Off-grid energy represents a portion of the suppressed demand in Nigeria, supplied through individual generating sets, and adding it to the total energy supply values means that even more amounts of RE will have to be produced to meet the RE targets. This basically implies that in 2015 example, to meet the 10% target, 2,438MW of RE has to be produced and not 1,188MW which would have been the case if the 12,500MW of privately generated energy had not been considered as part of the total energy supply. The same applies to all the other years (Fig. 4.6).

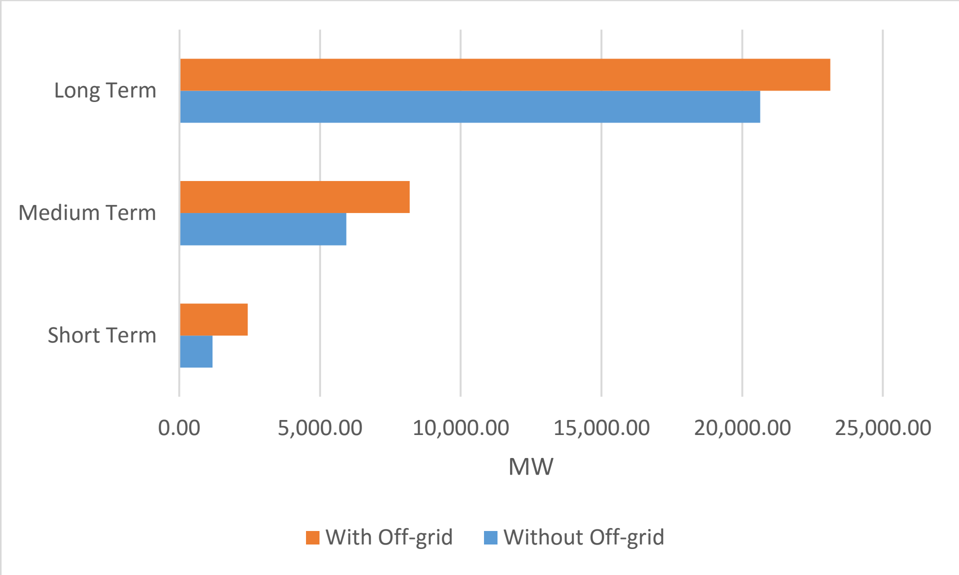

Figure 4.6. Total RE Amounts Required to Meet Targets With and Without Taking Account of Self-Generated Energy *Data: FMP [51]*

The major mechanism for driving the implementation of the provisions of the policy is FITs. The policy also recommends implementation of incentives to fast track the import and export of RE and EE components into and out of the country.

In addition to RE, the NREEEP contains provisions for EE which are discussed in section 4.4 of this chapter.

4.3.3 National Biofuel Policy and Incentives

The biofuel policy [94] was developed in 2007 in a bid to keep up with the global clamour for biofuel development and its potentials as a RE source. It was anticipated that the adoption of bio-fuels would help improve the quality of petroleum products and also help meet increasing demands for eco-friendly fuel. The policy targets, objectives and instruments are summarized in Table 4.5.

A careful examination of this policy document exposes some grey areas concerning the definition of biofuels and feedstock, the underlying aims and objectives of the policy, and the administration of the biofuel industry as specified by the policy.

The policy limits the definition of biofuels to fuel ethanol bio-diesel, and biomass fuels [94]. This definition is indeed very basic and narrow in scope, and has rightly been criticized by other authors [95–97]. The inadequacies of this definition lie in the fact that it limits biofuels to fuel ethanol and biodiesel, and while it mentions ‘other fuels’, this does not provide any clear direction for implementation. In framing biofuels in this manner, the policy overlooks a wide range of other feedstock and energy carriers [98]. The importance of this argument goes beyond semantics, because the interpretation of biofuels as intended by policymakers and as contained in the document will serve as a major determinant of the scope of resources to be explored and will also provide the ultimate direction for implementation.

Table 4.5 Summary of the National Biofuel Policy and Incentives

Policy Objective(s)	▪ Building a robust agro-based fuel ethanol industry to improve the quality of automotive fossil-based fuels in Nigeria (Nigerian Bio-fuel Policy Document). ▪ Developing the agricultural sector by linking it with the energy sector.
Policy Target(s)	▪ Blending of ethanol up to 10% with gasoline to achieve the E10 blend. ▪ 20% blend of biodiesel with petro diesel. ▪ 100% domestic production of bio-fuels consumed in the country by 2020.
Policy Instruments	Long-term preferential loans, tax waivers, pioneer status, off-take guarantees, import duty waivers, and insurance coverage.

Data: Nigerian National Petroleum Commission (NNPC) [94]

In defining its objectives, the policy clearly identifies and emphasizes the link between the biofuel and agricultural industry, with an underlying aim to develop the latter. While this link is obvious enough, the policy fails to address the concerns that have been raised about the impact of the former on the latter. That the biofuel sector will develop the agricultural sector is almost inevitable since (first–generation) biofuels rely basically on food crops, thereby expanding the market for agricultural produce. Whereas, this in itself has met with huge public disapproval and attracted questions about the sustainability and viability of biofuels in terms of its impact on food availability and prices.

Equally important are the indirect land use change (ILUC) impacts of biofuel production and its attendant emissions alongside other environmental and social impacts. However, Nigeria’s biofuel policy addresses neither of these issues, but instead, continues to place extended emphasis on developing the agricultural sector through biofuels to the extent that the policy seems more like an agricultural policy than an energy policy. This is further demonstrated by the classification of the biofuel industry by the policy as agro-allied.

While Ohimain [96] justified the above referenced classification as a result of the reliance of the biofuel industry on biomass feedstock from agriculture, he identified a conflict in the provisions of the policy concerning the governance and administration of the biofuel industry. The policy states that the biofuel industry (already classified as agro-allied), should be governed by the petroleum industry, which further embroils and encumbers the institutional framework surrounding biofuels. This has the potential to complicate the interactions between the industries and could be exacerbated by conflicts of interest among the industry players.

4.3.3.1 Implementation Strategy

According to the biofuels policy, implementation would take place in two phases: (i) – Seeding the market and (ii) – Bio-fuel production programme.

The first phase would involve the blending of gasoline with up to 10% of fuel ethanol to achieve the E10 blend. This phase would kick-off in selected cities for the first 3 years of the programme and would then extend to other cities in the country within 5-10 years. It would involve importation of fuel ethanol and development of capabilities required for large scale production of bio-fuel feedstock and establishment of bio-fuel plants.

The second phase (which is where the interplay with the agricultural sector would really take place) was planned to run simultaneously with the first phase and would involve cultivating plantations of the feedstock and constructing bio-fuel distilleries and plants. The B20 blend (20% blend of biodiesel with petro diesel) would also be developed.

While this is a good plan, and Nigeria definitely has the potential to produce sufficient feedstock, it is built on the assumption that the agricultural sector is developed enough to supply the biomass required to meet the resultant demand for biofuels, and does not take account of the country's low efficiency in the production of biomass feedstock as well as the several other challenges facing agriculture in Nigeria [95, 99–102]. Additionally, the biofuel blending mandate holds a peculiar socio-economic implication for Nigerians and as such, might not enjoy much public support. This is because the development of the petroleum sector in Nigeria came at the expense of the agricultural sector which originally was the main stay of the economy for several decades, and this shift reduced government interest in agriculture and consequently led to little support for local farming [103–105]. Biofuel production in Nigeria will definitely generate a renewed attention towards the agricultural sector, but this attention might be perceived by local farmers and the public as false. Thus, coupled with the consequent pressure on food, the strategy might not receive from local cooperation and support.

4.3.3.2 *Mechanisms and Incentives*

The array of instruments and incentives for bringing about the implementations of the provisions of the policy are generic to those of similar policies. However, two of them are particularly notable: (i) granting of pioneer status and (ii) off-take guarantees for businesses entering into the biofuel industry.

Ordinarily, the biofuel industry in Nigeria is not approved by the income Tax Relief Act to be entitled to the benefits of a pioneer status, but the biofuel policy grants this privilege to all businesses involved in biofuel production [94, pp. 12–13]. Under this arrangement, such businesses enjoy a tax holiday for an initial 10-year period with the possibility of an additional 5-year extension.

Additionally, the off-take guarantee ensures to reasonable extents, the security of investments in the biofuel industry by mandating the NNPC as a buyer of last resort for biofuels produced in the country. These are massive incentives which could spur investments in the biofuel industry. The policy states that the industry would be driven by private investment and would be regulated and controlled by the government so as to create a conducive environment for attracting such investments.

A significant shortcoming of these incentives however, is that despite the country's potential for producing feed-stocks required for the production of advanced biofuels [95], there are no incentives to promote them, neither do they encourage clean production techniques and practices. This also underlines the fact that the policy does not really address the issues of sustainability, but is merely concerned with the production of biofuels and agricultural development, as no references are made to the environmental aspects of biomass production or the source of feedstock, with no policy attempts to ensure environmental sustainability.

4.4 Energy Efficiency

On the adoption of the NREEEP, it was hoped that it would reduce the barriers of EE in Nigeria, hitherto caused by the dearth of policies and the poor implementation of the basic elements of EE contained in the NEP [46, 56]. The NREEEP spells out the nation's commitments to achieve EE through the design of incentives that would spur consumer adoption and also promote local manufacturing of energy-efficient products to replace inefficient devices, as well as the promotion of public awareness on the benefits of improved EE.

The main objectives of the policy regarding EE are to; ensure the prudent exploitation of the nation's energy resources, enhance energy security and self-reliance, reduce the production costs of energy-dependent goods and services, reduce the adverse environmental effects of energy utilization and eliminate avoidable investments in energy supply infrastructure [51].

4.4.1 Policy Targets

Nigeria’s EE targets are summarised in Table 4.6.

Table 4.6 Nigeria's Energy Efficiency Targets

S/N	Target	2020	2030
1	Households using efficient lighting (%)	40	100
2	Distribution loss reduction (%)	15-20	< 10
3	EE increase for high energy-consuming sectors* (%)	20	50
4	Replacement of old and inefficient appliances with energy efficient ones (%)	40	

*These are the transport, power and industrial sectors *Data: [5, 51]*

Other targets include:

- Curb the firewood demand below supply capacity by 2030.
- Production of guidelines on all the key components of EE by 2020.
- Enactment of all relevant legislation required for policy implementation by 2020.
- Sustain best EE practices beyond 2030.

A conspicuous omission from these targets is that of emission reduction. This is possibly due to the already low per capita CO_2 [106].

The fourth target in Table 4.6 has no deadline, and the other targets listed below the table are not specific. This might make it difficult to coordinate implementation and evaluation.

4.4.2 Implementation Strategy

In implementing the country’s EE targets, the NREEEP mandates the development of a National Energy Efficiency Action Plan (NEEAP) which would set specific energy savings target and propose concrete measures for achieving them.

The NREEEP includes a long list of strategies to implement the EE elements of the policy [51, p. 27]. While these are laudable and would undoubtedly help promote EE, the challenge with this again, is that no timelines are attached to these activities. These are rather broad statements of intention and do not appear as actionable plans. For example, no indication is given on the administration of the tradable permits to be issued or on how it will be implemented. Hopefully, the NEEAP would lay down an action plan for the achievement of the EE plans.

4.4.3 Mechanisms and Incentives

The range of mechanisms for EE in Nigeria include tradable certificates, tax incentives, custom duty exemption, low-interest loans, and labels and standards.

A five-year tax holiday applies to manufacturers of energy-efficient equipment and accessories from date of commencement of manufacturing. Importers of energy-efficient appliances would also be exempted from excise duty, sales tax and custom duty for two years. End users who install energy-efficient appliances and lighting shall also benefit from tax credits

Due to the fact that EE is a relatively new concept in Nigeria [46], there are not too many instruments employed to this effect. For example, there are no price incentives and no subsidies on the purchase of energy-efficient equipment which could encourage demand. Minimum Energy Performance (MEP) standards and labelling are also to be employed, although, they are said to be relatively new in the country, with no legislation enforcing them [46].

4.5 Summary of Findings

The policies indicate governments commitment to developing energy for sustainable development in the country and most of the resulting policy documents are well-drafted and creditable with regards to the overall policy thrust and the underlying aims. The economic, social and environmental implications of the policies are usually acknowledged and addressed. Besides improving energy, they describe measures to solve certain economic and social problems within the scope of energy projects. e.g. in providing jobs and developing specific economic sectors. The following summarizes the results of the policy analysis:

- *Policy Conflict* - In some cases, the policies are fragmented and the documents are repetitive and overlapping, resulting in policy conflict and inconsistencies. In other cases, new policies are designed with different targets without necessarily superseding the previous ones, which remain in use by some institutions. E.g. The RESP and RESIP.
- *Poorly developed institutional framework*, implicit in the duplication and overlap of roles and responsibilities, and the assignment of roles to distantly related institutions. Although this paper does not cover an in-depth institutional analysis, some defects can be inferred from this study about the energy institutional framework in the

country e.g. as revealed in the biofuel policy and also between the NREEEP and REMP

- *Poor data organisation and planning* - Lack of data and use of dated data for policy design e.g. energy resource data used for planning RE targets. This adversely impacts the quality of planning and policy making.
- *Insufficient government motivation* – A good number of the policy statements seem more like a mere display of interest or desire, with no clearly outlined strategies to pursue them. In some cases, the outlined targets ae not complemented with well-designed implementation strategies.
- *Generic incentive design*- Though, a wide range of incentives and instruments are employed, they mostly are not technology-specific and do not take account of the maturity of each technology.
- *While some targets are ambitious (e.g. EA), others are far from what is reasonably achievable.* E.g. without LHP, RE contribution to total electricity supply would just be 1.3% in 2015 and 8% in 2020, and not until 2030 will it reach 16%.
- *Most of the policies lack a strong legal backing* and do not have any obligatory requirements.
- *Funding of most of the proposed energy projects is committed to the federal government*, with only a few other funding sources identified. This might not be sustainable in the long run.
- *Delay in approving policy drafts* and reviewing approved policies.
- *Ambiguity in policy statements*, e.g. in describing policy measures, targets and institutional roles.
- *Overestimating public response to policy requirements* e.g. in the case of promoting locally manufactured RE appliances and in the rural demand for improved energy services.

5 SUSTAINABLE ENERGY PRACTICE IN NIGERIA: AN APPRAISAL OF POLICY PERFORMANCE

It is well-known that a sound policy design alone does not guarantee the desired outcome. Policy performance also often depends on implementation, among other factors [31, 39, 40, 107, 108]. It therefore follows that an ex-post analysis of energy policies is required. In doing this, the policies are evaluated on the basis of specific policy goals as well as general predefined criteria which indicate success in promoting SE. Energy investments and projects in the country are also weighed up within the timeframe of these policies as a reflection of commitment to SE.

5.1 Energy Projects and Investments in Nigeria

Since the advent of SE in Nigeria, a number of investments have been made towards implementing the provisions of the energy policies and in improving the overall energy situation. The financing requirement for implementing the SE4All initiative in Nigeria in line with the national policy objectives was estimated to be about €62 billion, with EA and RE being the greatest priorities; taking up a combined 78% of the expenditures (Fig. 5.1).

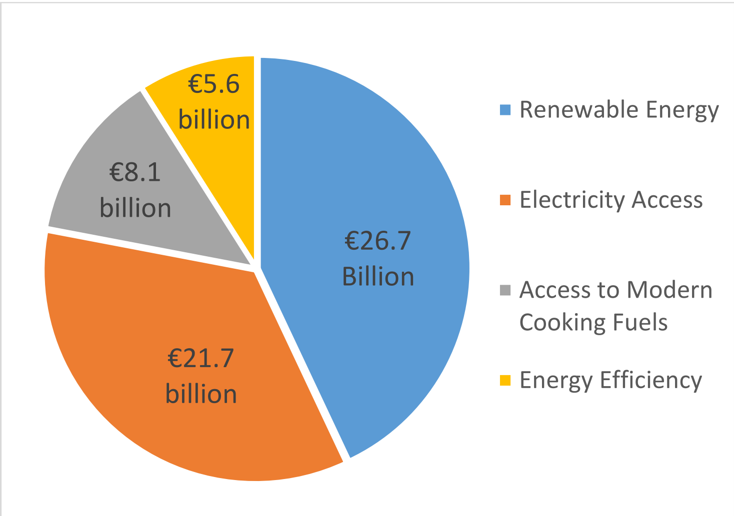

Figure 5.1 Expenditures to implement the SE4All Action Agenda for Nigeria

Adapted from the SE4All Action Agenda for Nigeria [5]

According to a report by the German Society for International Cooperation (GIZ) [46], over 1,000 of the 2,499 rural electrification projects in Nigeria were already completed. The report also identified solar-based rural electrification projects and off-grid photovoltaic systems installed in some places in the country Nigeria.

Several projects have been executed or embarked upon by the Renewable Energy Programme [109]. Against the backdrop of the energy policies, it becomes expedient to assess the effectiveness of these investments.

5.2 Sustainable Energy Practice in Nigeria

Although, Nigeria's energy policies contain provisions for monitoring and evaluation, this study gathers that as far as is known, there are no national energy indicators for monitoring energy development progress. Therefore, for this assessment, the Energy Indicators for Sustainable Development (EISD)[6] are used.

5.2.1 Social Dimensions

5.2.1.1 Equity/Accessibility

This indicator measures EA in terms of the share of households (or population) without electricity or commercial energy, or heavily dependent on non-commercial energy [21]. The situation in Nigeria has been poor for most of the past decade (Fig. 5.2).

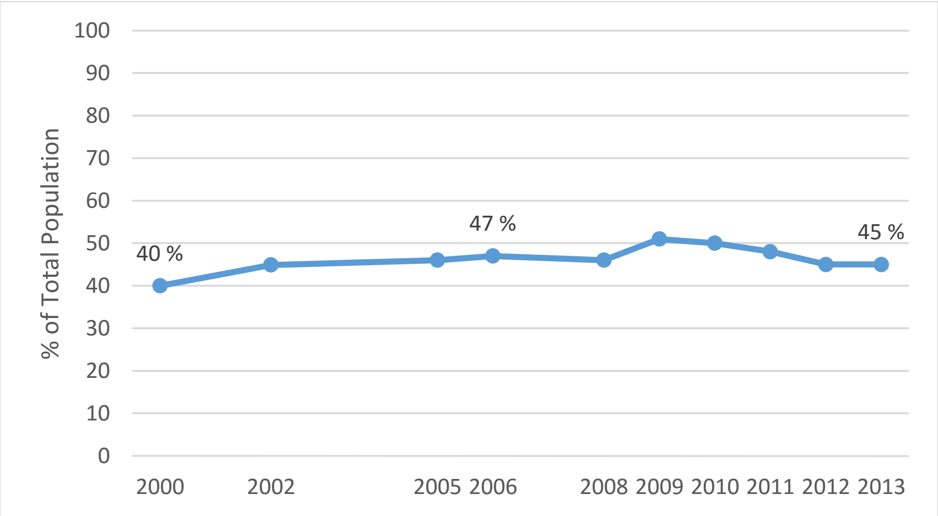

Figure 5.2 Electricity Access Trends in Nigeria (2000 – 2013) *Data: IEA* [110]
(Data missing for 2001, '03, '04 and '07)

Computations from the graph show that on the average, about only 1.7 million people per annum have been gaining electricity access since the inception of the RESIP in 2006 up till 2013. Additional computations made with electricity access and population projection data obtained from the IEA [110] and World Bank [67] respectively, reveal that this is 73% less than

[6] The indicators were developed by the International Atomic Energy Agency (IAEA), assessing the social, economic and environmental dimensions of energy production and consumption.

the required electrification rate (6.3 million people per annum) for meeting the 2020 target. This performance is totally unacceptable.

5.2.1.2 Share of Household Expenditure Spent on Fuel and Electricity

This is a very important indicator which measures energy affordability for the average household. However, the use of this indicator was somewhat hampered by insufficient data.

A 15-month survey from 2014 – 2015 conducted by NOIPolls [111] revealed that the average monthly expenditure of Nigerian households on grid electricity supply was about ₦3,397 ($17.28), while average monthly expenditure on self-generated energy was about ₦9,529 ($48.49). Average monthly household consumption was computed to be $189 per household with data from the World Bank [6] and the National Bureau of Statistics [45]).

Altogether, calculations reveal that energy expenses made up about 35% of total average household expenditures (Fig. 5.3). This is a very high percentage, despite the subsidies on fuels.

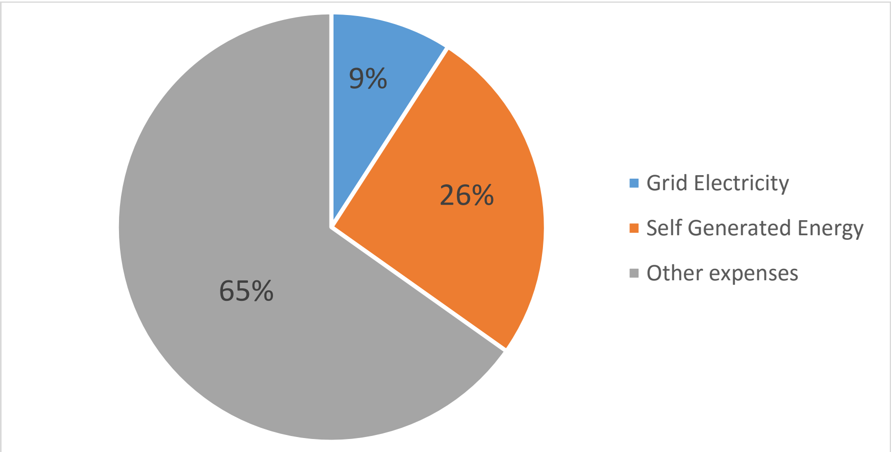

Figure 5.3. Share of Monthly Household Expenditure Spent on Fuel and Electricity in Nigeria (2015) *Data: NOIPolls* [111], *World Bank* [6]

As seen in the graph, Nigerians spend almost 3 times more on self-generated energy than on grid electricity. This is a further testament to the unreliability of electricity supply, since the residents would not deliberately incur more expenses on generating sets (which cost more per kWh) if electricity was readily available.

5.2.2 *Economic Dimensions*

5.2.2.1 *Energy and Electric Power Consumption Per Capita*

This indicator reflects the energy use patterns and aggregate energy intensity of a society. Although emphasis should be on efficient energy use and not just high per capita consumption, yet, limited EA could pose a serious challenge to any meaningful development whatsoever [21].

Despite all the policy focus on increasing energy supply, the per capita energy consumption has remained largely unimproved, fairly undulating between 743 koe/cap in 2003 (when the NEP was produced), to 773 koe/cap in 2013, with the highest being 797 koe/cap in 2012 (Fig. 5.4). On the other hand, electricity consumption increased slightly within the same period.

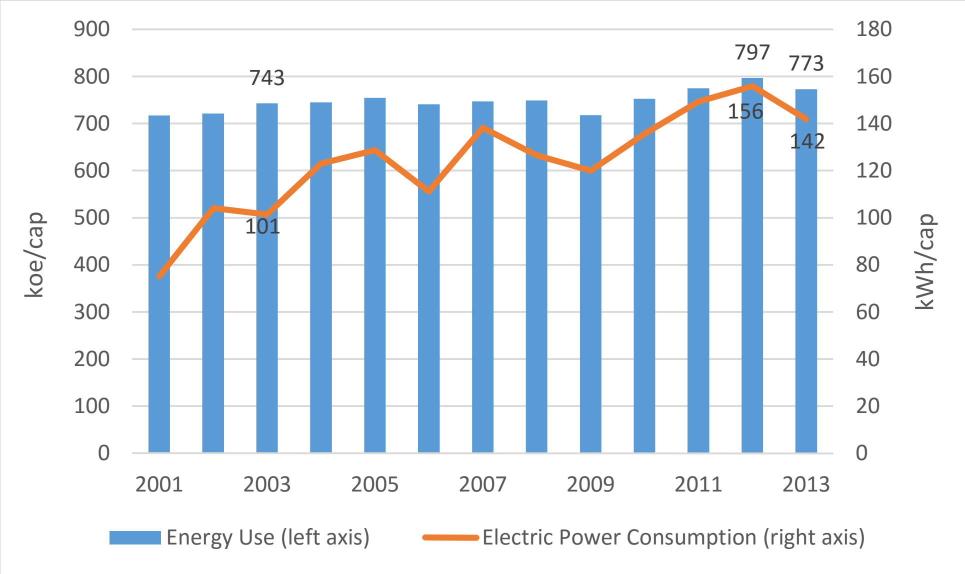

Figure 5.4 Per Capita Energy and Electric Power Consumption Patterns in Nigeria (2001 – 2013) *Data: World Bank* [6]

This is an indication of the fact that these policies have not been effective in bringing about increased energy supply to the population.

5.2.2.2 *Efficiency of Energy Conversion and Distribution*

As the name implies, this indicator gives an indication of the economic sustainability of energy production. The more efficient energy production is, the lower the financial losses incurred.

Given that the concept of EE is relatively new in Nigeria, a thorough assessment of policy performance might be premature since the NREEEP was just recently approved (2015). However, general efficiency trends can still be observed against the backdrop of the efficiency provisions of the NEP which had been in force earlier.

Although, transmission and distribution losses have reduced considerably from 34.4% in 2003 to 8.9% in 2014, generation efficiency on the other hand reduced slightly within the same period (Fig. 5.5).

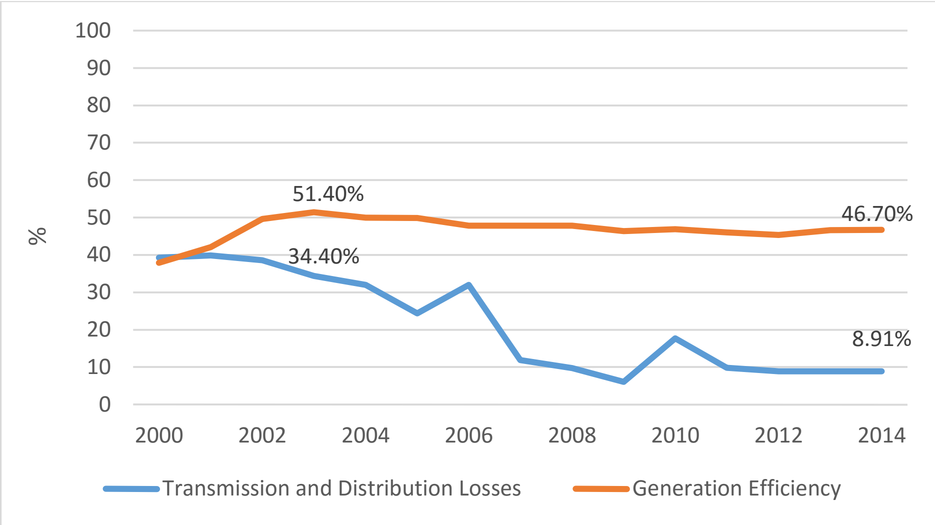

Figure 5.5 Overall Efficiency of Electricity Production in Nigeria (2000 – 2014)

Data: World Bank [6]

While the policies have been effective in reducing transmission and distribution losses, this performance has not been replicated in increasing energy production efficiency.

5.2.2.3 Energy Use Per Unit of GDP (Energy Intensity)

This indicator is an expression of energy intensity (or efficiency) and measures the extent of decoupling between final energy consumption in various sectors and its drivers.

Between 2000 and 2014, final energy intensity in Nigeria decreased by 48.7% at an annual average rate of 4.7% (Fig. 5.6). Examining the trends in energy use and GDP growth gives a clearer picture of the situation. Between the same time period (2000 – 2014), annual final energy consumption actually increased (2.8%), albeit at a slower pace than annual GDP growth (7.8%). This is an indication of relative decoupling, which implies a reduction in environmental pressures from energy production and consumption due to the avoided supply of energy.

However, a major contribution to reduction of final energy intensity values comes from the rebasing of the GDP which led to an increase in GDP [68], while also increasing the contribution of the less-energy intensive service sector (such as the telecommunications, music and movie industry) and a reduced contribution of the energy-intensive sector (such as the oil and gas industry) to the GDP base. This activity had a reverse effect on energy intensity by increasing the denominator by a greater proportion than the numerator.

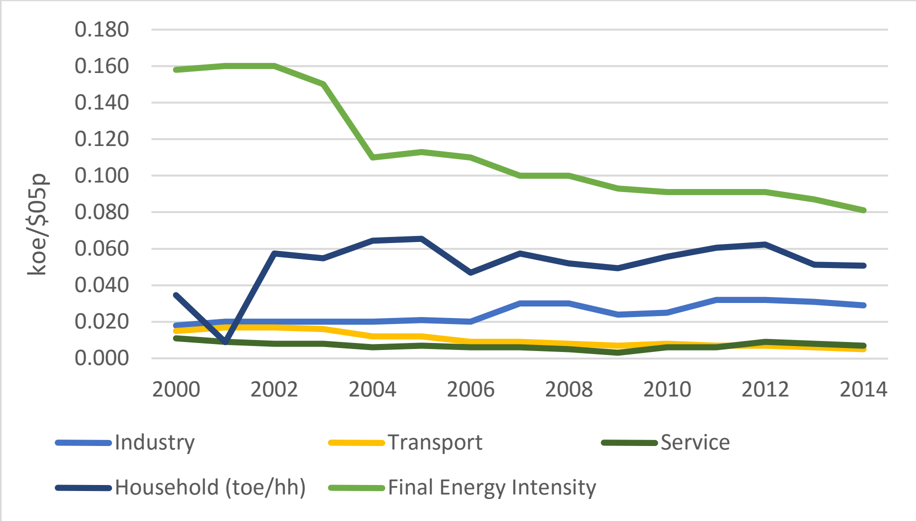

Figure 5.6 Final Energy Intensity in Nigeria, Disaggregated by Sector (2000 – 2014)

Data: World Energy Council [106]

Within the same period, final energy intensities reduced in the transport and services sectors by 7.5% per year and 3.2% per year respectively, while increasing in the industry and household sectors by 3.5% per year and 5% per year respectively.

The intensity reduction in the transport sector can perhaps be attributed to a number of factors including several episodes of fuel scarcity (which translates to reduced vehicular movements), a likely increase in the use of motorcycles (known to have high fuel efficiency) to beat heavy traffic and an almost non-existent rail system among other possible reasons, while an increased emergence of less energy-intensive, more service-oriented businesses have reduced the energy intensity of the service sector. Whereas, the increase in intensity in the industry and household sectors can possibly be attributed to an increased use of electric generating sets (which are less efficient) due to reduced energy supply.

Although some EE measures could also have been implemented across sectors, this study concludes that the improvements are more as a result of a number of systemic changes (described above), rather than any EE practices per se.

5.2.2.4 Renewable Energy Shares in Energy and Electricity

Fig. 5.7 shows the trends in RE in the country. The figure further establishes the position of hydropower as the only RE source, as without hydropower, RE shares in electricity production up till 2014 was zero (0%), including biofuels [106]. This is surprising considering the argument of Lamers et al. [112] that developing countries with favourable agro-climatic, environmental, agricultural and labour conditions (such as Nigeria) tend to have a competitive edge for liquid biofuel production.

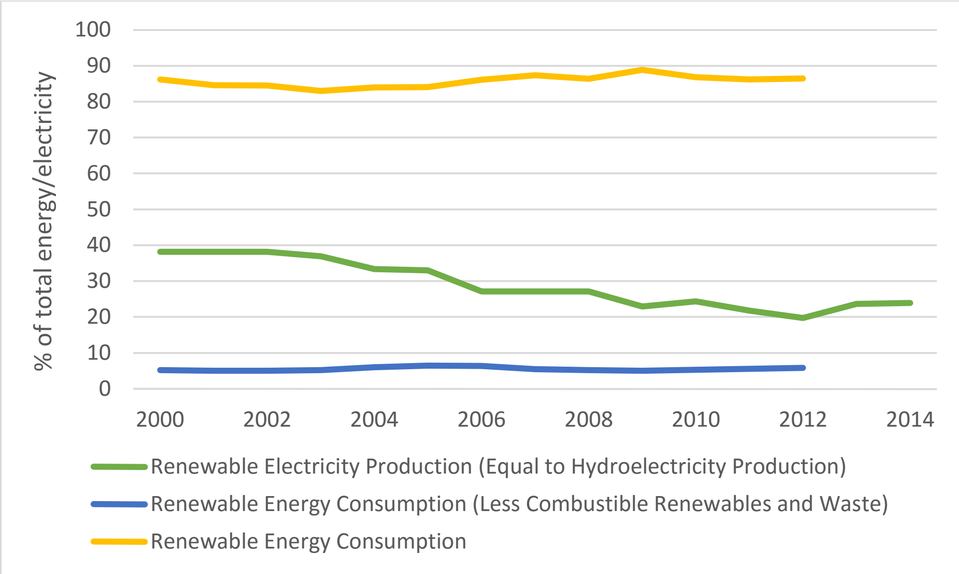

Figure 5.7 Renewable Energy Shares in Energy and Electricity in Nigeria (2000 – 2014)

Data : Enerdata [52] *and World Bank* [6]

On the other hand, RE contribution to total energy consumption has been high. Deducting combustible renewables and waste, this amount drops to between 5 - 6% from 2000 to 2012. This leaves a huge gap for the development of electricity and energy production from wind, small hydro, biomass and solar sources to meet the targets highlighted in the REMP.

5.2.2.5 Net Energy Import Dependency

This indicator measures energy security in terms of reliance on imports for meeting energy requirements. Despite the country's poor energy, Nigeria is still known to be a net energy exporter (Fig. 5.8) due to its vast oil deposits (the negative energy import graph depicts net exports). According to data obtained from the IEA ([50], the country does not import any form of energy asides finished oil products.

The graph shows a slight drop in the amount of energy exports over the years. This is due to a drop in production in some cases and an increase in local consumption in other cases [50].

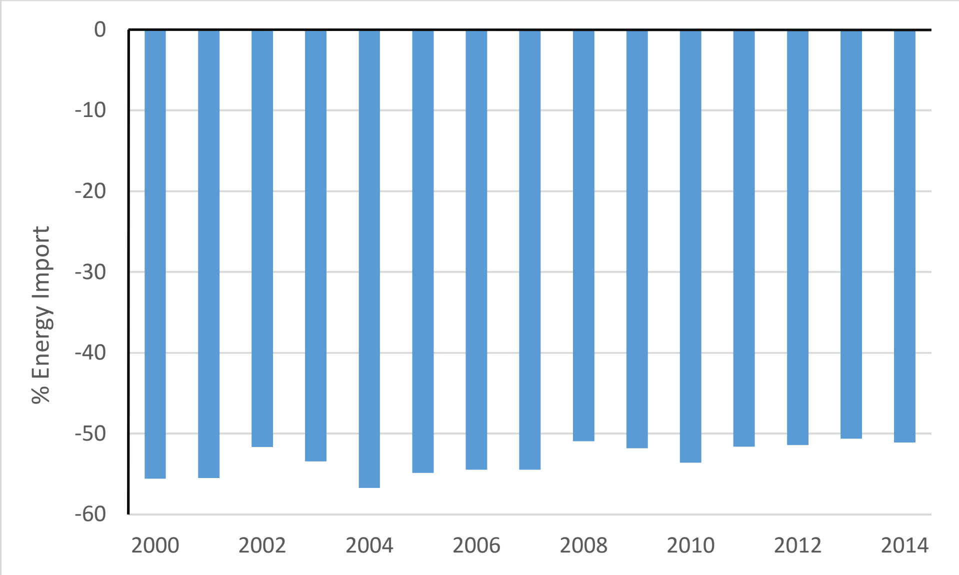

Figure 5.8 Nigeria's Net Energy Imports as a Percentage of Total Energy Production (2000 – 2014) *Data: Enerdata* [52]

However, the current energy security (in terms of self-sufficiency) could be threatened by over dependency on the finite fossil fuel resources, except there is an improvement RE development.

5.2.3 Environmental Dimension

5.2.3.1 Greenhouse Gas (GHG) Emissions from Energy Production and Use, Per Capita and Per Unit of GDP

This indicator gives an idea of the degree of environmental damage that results from energy use patterns. Unfortunately, availability of data for computing this indicator was limited to CO_2 emissions, while emission data for other gases are either unavailable or insufficient for analysis.

Data obtained from the World Energy Council [106] shows that the CO_2 emissions in Nigeria has been relatively low compared to other countries and this trend has been maintained over the years (Fig. 5.9). However, this might not necessarily be an attribution to high EE, keeping in mind that the energy consumption per capita is also low and that the GDP has been rebased, which could also be an explanation for the low figures.

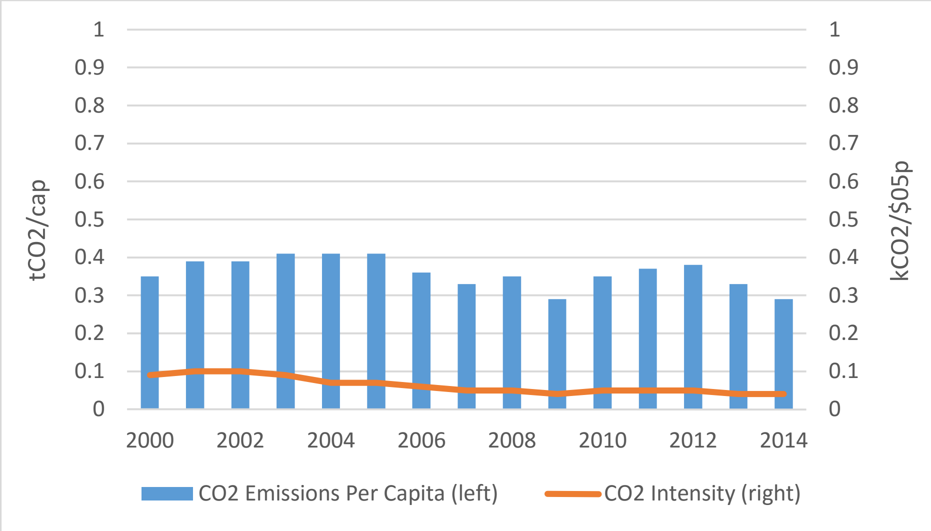

Figure 5.9. CO_2 Emissions From Energy Production and Use in Nigeria; Per Capita and Per Unit of GDP (2000 – 2014) *Data: World Energy Council* [106]

The trajectory of CO_2 emissions per capita as shown in the graph is very similar to that of energy consumption per capita (see Fig. 5.4), which shows that emissions increase with increased energy consumption. Thus, the real task here would be to maintain these low emission levels while increasing improving per capita energy consumption before any conclusive applauding statements can be made about the low emission levels.

Additionally, being an oil-producing country, several volumes of oil are spilled into Nigeria's coastal waters periodically during exploration. Between 2010 and 2014, the department of petroleum resources reported 3,663 oil spill incidences in which approximately 116,460 barrels of oil were spilled [113]. Gas flaring is also a common practice. In 2011 for example, Nigeria was responsible for one-tenth of the global gas flared [30] and was the 2nd highest gas flaring country between 2007 and 2012 [114]**.** Between 2010 and 2014, a total of 2.5 trillion SCF of natural gas was flared [47]. Inefficient cooking facilities in Nigeria cause over 90,000 deaths annually in Nigeria – due to poisoning from cooking smoke [115].

The energy policies have not been able to reduce these environmental impacts effectively, and as such can be adjudged as not sufficiently effective in delivering environmental sustainability.

5.3 Summary of Findings

Although beyond policy scope, there are several other factors not covered in this analysis (such as macroeconomic conditions, institutional structure and capacity, governance, infrastructural capacity, or even other government policies), which could have influenced these results, it is still evident that a lot of these policies have performed below par and have not been effective in achieving the set objectives. The findings from this analysis are summarised below:

- *The disparity in electricity access in Nigeria constitutes some sort of social inequity.* Policy performance has also hitherto proven poor, since it does not seem likely that the objectives of provision and extension of steady, reliable and affordable electric power to all Nigerians would be achieved by the deadlines.
- *Energy in Nigeria cannot be said to be affordable.* On the average about 35% of all monthly expenses are on electricity and other forms of energy.
- *RE policies have not effectively increased RE shares in energy/electricity production.* As at 2014, LHP still remained the only renewable source of electricity, contributing 23.9% to electricity production.
- *Quasi-efficient energy economy.* The seemingly low energy and CO_2 intensities are largely due to low energy availability and consumption rather than EE in itself, as most researchers still report poor EE in the country's energy use.
- *Energy security in terms of abundance of energy resources.* Nigeria is a net energy exporter which secures it from the risks of import dependency. However, its over dependence on fossil fuels still constitutes a major threat to this security.
- *Sub-optimal sustainability.* Evidence from this analysis shows that in the short-term, Nigeria's energy could be economically (and even probably environmentally) sustainable, there are no signs of social sustainability. In the long-term however, if energy generation and access increase, any sort of sustainability might be lost.
- *Poor monitoring and evaluation.* As far as is known, this study gathers that there are currently no nationally developed energy indicators for measuring policy performance and energy development progress in general.
- *Poor energy data collection framework.* Most of the energy databases in the country do not contain recent data, while some data are not collected at all, since there is no legal basis for collecting energy data in Nigeria. This research relied heavily on data from international energy databases.

6 POSSIBLE LESSONS FROM ESTONIA AND THE EU

"The price of failure is too high. Energy is the life blood of our society"

- The European Commission

With a renewable power per capita which is three times higher than anywhere else the world [116], the European Union (EU) is known as a leader in the transition to RE and in ensuring the sustainability of the energy sector. The 28 Member Countries have a unified energy policy framework which largely dictates the direction of energy policies at the national level. Most of the energy targets in the EU are projected towards 2020 and considerable levels of progress have been observed which indicates that these targets may likely be achieved as planned [116]. Regardless of this progress, the EU still faces some major challenges in the form of import dependency, narrow energy options, growing demand, high prices, marginal EE improvements and integration of energy markets [117].

Coming home to Estonia - a net energy importer which is reliant on fossil fuel for energy - developing RE, reducing energy intensity, ensuring energy security and the sustainability of the energy sector are major concerns in the country's energy policy landscape [118, 119]. The country's target of 25% RE shares in gross final energy consumption was achieved in 2011 and increased to 26.5% in 2014 [120]. The viable RE systems are wind power, small hydropower and combined heat and power production based on biofuel. The country's energy policy affairs are solely governed by the Ministry of Economic Affairs and Communications (MoEAC), and this responsibility is not shared with any other institution [121].

6.1 Legal & Regulatory Framework

The energy policy of the EU is governed by the 'Treaty on the Functioning of the EU' and the 'Euratom Treaty' (TFEU) [117]. While the latter applies specifically to nuclear energy, the former describes the objectives of the EU energy policy in: (i) ensuring the functioning of the energy market; (ii) ensuring security of energy supply in the Union; (iii) promoting EE, energy saving and the development of RE, and (iv) promoting the interconnection of energy networks.

In order to effect a common energy policy, some areas of energy policy were made a shared competence between the EU and the Member States under the TFEU [117]. This implies that when the EU decides to regulate, the Member States can only make decisions on other areas such as the energy mix and the conditions for energy production and consumption. The

European Commission ensures compliance with the energy legislations to the effect that defaulters may face penalties or legal actions.

In Estonia, the energy sector is regulated by a number of legislation, some of which include the Electricity Market Act, the Natural Gas Act, District Heating Act, the Liquid Fuel Act, the Liquid Fuel Stocks Act, and the Energy Efficiency of Equipment Act among others [122].

6.2 Energy Strategy

6.2.1 Energy Policies

The energy policies of the EU aim to address the three main objectives of economic competitiveness, security of supply and environmental sustainability [123]. To solve the energy challenges facing the EU, the policies focus on formulating an energy security strategy, developing a resilient and integrated energy market across the EU, development of RE, promoting EE and ensuring safety in energy production.

The RE Directive (2009/28/EC) [124] which set the policy framework for RE in the EU requires that 20% of the total energy consumption, and at least 10% of transport fuels must be sourced from renewables, through nationally-binding targets. The Directive includes provisions for the development of a National Renewable Energy Action Plan (NREAP) by each Member State.

The EE Directive (2012/27/EU) [125] establishes a set of binding rules for the achievement of 20% EE improvement by 2020, pursuant to which Member States are required to set national targets based on their energy-saving needs. The directive specifies among other things, requirements for renovating government buildings and purchase of energy-efficient buildings, services and products; development of national strategies and schemes to promote EE investments and end-use energy savings; and to provide smart grids, smart meters and accurate energy billing information to further encourage efficient use of energy. The Directive also includes provisions for the establishment of a NEEAP by Member States.

Due to the high import dependency of the EU and the narrow choice of suppliers, an energy security strategy was developed to ensure a stable and abundant supply of energy. Short and long term measures were established to reduce dependency on import, some of which include increased cooperation and solidarity between Member Countries; expanding the range of suppliers; improving EE, especially in buildings and industry; improving energy production within the EU and completing the internal energy market among others [126]. Pursuant to these various identified energy goals, the policies were summed up into a coherent long-term strategy with targets for 2020, 2030, and 2050 (Table 6.1), which represent a policy framework on greenhouse gas emissions, RE and EE.

In addition to the NREAP and the NEEAP, the main energy policy documents in Estonia are the 'Development Plan of the Estonian Electricity Sector (DPE) until 2018' and the 'National Development Plan of the Energy Sector (NDP) Until 2020', with the main policy thrust being the reduction of oil shale dependency and diversification of energy resources [119].

Table 6.1 Summary of the European Energy Strategy Targets

Year	Target
2020	▪ 20% greenhouse gas reduction. ▪ 20% share of RE in energy consumption. ▪ 20% EE improvement. ▪ 10% share of RE in the transport sector.
2030	▪ 40% reduction in greenhouse gas emissions compared to 1990 levels. ▪ 27% share of RE in energy consumption. ▪ At least 27% EE improvement, to be reviewed by 2020, and potentially raising the target to 30%, by 2030. ▪ Completion of the internal energy market by reaching an electricity interconnection target of 15% between EU countries by 2030, and pushing forward important infrastructure projects.
2050	▪ 80% to 95% reduction in greenhouse gasses compared to 1990 levels.

Data: European Commission Website [123, 127, 128]

6.2.2 Key Mechanisms

6.2.2.1 National Targets

Upon setting a binding target for the union, the Member States commit to pursuing their own national targets based on the different potentials of each country in terms of resources and energy markets. Examples include the RE targets which are broken down into nationally binding sub-targets based on the starting point of each Member State, and EE where Member States are required to establish indicative national targets and raise the minimum requirements based on their energy saving needs [129, 130].

Estonia has set 2020 energy targets which include an increase in RE shares to 25% of final energy consumption, maintaining final energy consumption at the same level as 2010[7], and ensuring that emissions do not increase beyond 11% outside the emission trading directive scope compared to the 2005 level [131]. These targets bear the implication of reduced energy consumption, improving EE and developing RE capacity across sectors.

6.2.2.2 National Action Plans

All EU countries are required to develop national energy action plans detailing how they intend to meet their energy targets based on the peculiarity of the energy landscape in each country. These plans include targets for energy improvements on the different policy objectives including RE and EE, reflecting sectoral plans as well as policy measures for achieving them. For EE, these action plans must be drawn every three years [132].

Pursuant to the above requirements, the NREAP (up to 2020) and NEEAP were developed in Estonia, detailing the country's aforementioned energy targets and policy mechanisms for implementing them.

6.2.2.3 Cooperation Mechanisms

Due to the differences in the energy potentials of the EU Member States, the policies make provisions for cooperation between members and even third countries, towards the achievement of their energy targets. The development of the internal energy market makes this possible through statistical transfers, joint projects and joint support schemes under the RE directive [133]. Subsequently, Member States are required to publish forecasts on the use of cooperation mechanisms, six months before their NREAPs are due [124].

Forecasts for Estonia show that the national target of 25% share of RE in gross final energy consumption by 2020 will be achieved and even surpassed by 1% without the support of any cooperation mechanisms, and with a surplus of about 259 – 323 ktoe available for transfer to other Member States [134, 135].

6.2.2.4 Obligation Schemes and Alternative Measures

These schemes require energy providers to employ certain measures towards the achievement of the objectives set in the respective directives. For example, the EE directive requires energy companies to reduce end-use energy consumption by 1.5% of annual sales [125]. Alternative

[7] In 2010, the final energy consumption was 2866 Mtoe. Maintaining this same value by 2020 implies an 11% reduction from projected levels.

policies measures such as energy taxes, financial incentives and energy labelling schemes among others may also be implemented to this effect [136].

According to Estonia's NEEAP [137], 9468 GWh of energy savings is estimated to be achieved during the obligation period (January 2014 - December 2020), with the exception of the transport sector. Furthermore, during this same period, energy and CO_2 taxes, as well as funding schemes would be implemented as alternative policy measures, and additional financing and EE obligation schemes would be introduced. The energy and CO_2 taxes would also be modified to offset any deficits in the overall energy savings for the obligation period.

6.2.2.5 Voluntary Schemes

These measures encourage voluntary activities towards the achievement of the energy policy goals, outside the scope of legislation. An example is the sustainability criteria applied to biofuels which ensures environmental sustainability in biofuels production [138].

In Estonia, bilateral voluntary agreements are established between companies and the Ministry of Environment in which the latter informs and involves the former in legislation changes, while the former is in turn, expected to implement voluntary measures (which may sometimes be more stringent than those specified in mandatory measures), in order to improve environmental performance [139].

6.2.2.6 Support Schemes

These public intervention activities aid energy markets and encourage investments in SE. In the EU, they are designed, taking into account the maturity of each RET and are mostly used to reduce costs and impacts on power markets, and to facilitate RE production and integration into the energy mix [140]. Examples include FITs, feed-in premiums, quota obligations and tax exemptions.

In Estonia, a number of measures, including investments supports are used to support RE generation. They include FITs, premium tariffs, investment subsidies and investment support, with FITs and premium tariffs being the foremost [141, 142]. These measures have largely been effective in achieving the country's RE targets far ahead of time, and those particularly aimed at producing electricity from renewable sources have been the most effective; bringing about an increase in the generation of electricity from biomass, biogas and wind. Investment support schemes were designed for the 2007-2013 and 2014-2020 subsidy periods with over €490 million budgeted for RE and EE projects between 2014-2020 alone [143].

6.2.2.7 Other Mechanisms

A range of fiscal measures are in place for GHG emission reduction such as excise duties and pollution charges. In Estonia, taxes on shale oil and excise duty on gas and electricity have been introduced in the past, some of which exceed the minimum levels specified by the Directive for the taxation of energy products and electricity (2003/96/EC), while pollution charges also apply to owners of combustion equipment which cause air pollution [139]. Fuels containing biofuel are however exempted from this excise duty, to the extent of the portion of biofuel contained in the fuel. Other measures include the certificate of origin issued to electricity producers, which certify that the electricity is generated from renewable sources [144], as well as the emission trading scheme (ETS) which works in tandem with the other mechanisms towards the achievement of the requirements provided in the Directives.

6.3 Relevant Lessons from Estonia and the EU

Without disregard for the disparity in the level of development, macroeconomic conditions, infrastructural capacity and energy landscape between both countries/regions, some relevant lessons have been identified - consequent upon this study - which Nigerian policymakers can adopt to improve the effectiveness of energy policies and promote SE.

6.3.1 Policy Coordination

In Nigeria, it is obvious that most of the documented policies were framed parallel to one another, by different government agencies without proper coordination. Several of such instances were unearthed in Chapter Four. Also, old policies are sometimes not effectively repealed by new ones, leaving different implementing organisations in pursuit of different objectives.

Compared with Nigeria, it is observed that the level of policy coordination in Estonia - and by extension, the EU - is considerably higher. In the EU, there are fewer policy documents addressing specific themes. This makes it possible to focus more extensively on each theme, and later synthesize them, resulting in more comprehensive documents and a cohesive strategy. This makes for a focused approached in the pursuit of energy objectives. A good example of this is the 2020 Climate and Energy Package with which the EU pursues both climate and energy goals hand-in-hand. Although, this strategy has been criticised by some researchers, in the sense that an improper selection of mechanisms could be counter-productive [145], there are still a lot of positives that Nigeria can take from this. Also, when new policies are formulated, they repeal old ones, especially when provisions overlap, thereby avoiding policy conflicts and inconsistencies. Examples of these abound [124, 125].

6.3.2 Mechanisms and Measures

In both countries/regions, measures for policy implementation are similar to certain extents. However, In Estonia, feed-in premiums (FIPs) which are advanced version of FITs are used. The European Commission [140] proposed the use of FIPs as a better alternative because they facilitate a more active participation of RE producers, expose them to market price signals and are more appropriate for commercial energy markets, to mention a few..

A variable premium system is used in Estonia, in which a maximum support cap is established, and the amount of premium is inversely proportional to changes in market prices, up to the maximum amount when no premium will be paid, thereby effectively preventing generators from enjoying more support than necessary at the expense of end-users [122].

The above description represents the production-focused nature of most of the incentives in Estonia and the EU in promoting SE, compared with the investment-oriented approach in Nigeria (since FITs are still widely used in Nigeria). Nigeria can learn from this, and experiment with FIPs. Also, lessons abound in keeping up with the evolution of various mechanisms, and in adopting and adapting them to Nigeria's energy market.

6.3.3 Legislative Framework

This study observes that the energy policies of the EU are backed up by strong legislative support in the form of binding targets and requirements. Asides the obligations of each Member State to meet their national targets in accordance with the overall EU targets, there are also certain provisions and requirements pursuant to the directive which demand compliance. E.g. requirements to publish national action plans and forecasts on the use of flexible cooperation mechanisms. In Nigeria, on the other hand, there's the lack of a strong legal framework and there are really no obligatory requirements.

6.3.4 Monitoring and Evaluation

Although Nigeria's energy policies identify the need for and even contain provisions for monitoring and evaluation, they contain no concrete specifications or requirements for conducting such programmes. This is in contrast to the stance in the EU where progress towards national RE targets for instance, is measured every two years, with Member States being required to publish national progress reports and make projections of expected annual progress towards the achievement of the targets. In 2014, the European Commission was to assess the feasibility of achieving the 2020 primary energy savings target and propose mandatory national EE targets as required, and Member States would also have to publish annual national EE progress reports [130].

The ODYSSEE-MURE project provides a comprehensive database of EU and national EE policies and measures that have been implemented in the Member States of the European Union. In Estonia, national energy indicators have been developed which make it possible to monitor progress in GHG emission reduction and overall development of the energy sector [23, p. 21]. However, there are unfortunately no known energy databases, energy data organisations or national energy indicators in Nigeria. As stressed in Chapter 5, these are very expedient for monitoring and evaluation.

There are rays of hope however, as the Member States of the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) arrived at a consensus concerning the establishment of a Monitoring Framework in September 2015 [146]. This resolution places an obligation on ECOWAS Member States to publish reports on progress towards achieving the regional targets. An indicative list of indicators was also proposed for March 2016. As at the time of conducting this study, it is not known whether these provisions have been implemented.

6.3.5 Strategic Planning

The EU has an overarching energy strategy that outlines its main policy thrusts. This strategy focuses on energy security, EE and RE among other things. The strategy focuses on specific targets for 2020, 2030 and 2050 with the implication that each sub-strategy stands on its own, allowing for meticulous execution and implementation of targets. It also allows for timely assessment and necessary amendments of future targets based on the level of progress recorded in implementing present targets, without a necessary change of the overall strategy.

In Estonia, as it is in other EU Member States, implementation plans are often drawn up for specific periods of time, to achieve certain goals. Examples of this abound in the implementation plan for years 2010-2013 of the NREAP up to 2020; The National EE Programme for 2007–2013; National Long-term Development Plan for the Fuel and Energy Sector Until 2015; The Development Plan of the Estonian Electricity Sector for the Period 2008 to 2018; The National Development Plan for the Use of Oil Shale for the Period 2008 to 2015; The Development Plan for Enhancing the Use of Biomass and Bioenergy for the Period 2007 to 2013; and The Energy Conservation Target Programme for the Period 2007 to 2013 among several others [139, 147]. The synthesis of these implementation plans would definitely facilitate and possibly fast-track the achievement of the central national strategy.

This is not the case in Nigeria. Although, implementation plans are often drawn up for most energy policies in the form of Masterplans (e.g. the REMP and the NEMP), they usually cover the whole timeframe of the policy and are not broken down to allow for periodic focus on specific sectors or energy matters. This could in part, explain why progress has been slow and monitoring has not been effectively conducted. There is a lot from Nigeria to learn in this regard.

6.3.6 Regional Cooperation and Coordination

In West Africa, just like in the EU, there are regional coordination efforts for energy development across Member States. The solidity and effectiveness of such efforts is however, the major differentiating factor. Although, regional coordination on energy matters has been existing within ECOWAS since the late 90's, not until 2010 was the ECREEE established to develop a regional market for RE and EE. Collaboration with Member States began in 2014 to mainstream the region's RE and EE policy documents (both produced in 2012) into National Policies and Action Plans [55].

Compared to the EU, the level of coordination and cooperation in the ECOWAS region is more or less limited to support – as the ECOWAS aids Member Countries in developing policies, targets and national energy action plans. Evidence from a number of ECOWAS energy policy documents [36, 55, 148] suggest that Member States are not bound to formulate targets in accordance with the regional policies; to the effect that some countries have formulated certain energy targets that other countries have not. For example, while EE is an integral focus of the ECOWAS energy policies, most of the Member Countries do not have an EE policy, while those who do, have not fully applied it [148, p. 27]. Another example is the regional renewable heating and transportation targets which have only been incorporated into the national policies of a few Member States [55, p. 16].

Although, each country can retain its autonomy as far as energy administration and design of the energy mix is concerned, some aspects of energy policy should be declared as a shared competence as is the case in the EU, and mandatory targets should be formulated for each country with respect to the peculiarities of the energy landscape in each country.

With respect to the above issues, it is needless to say that there are several other benefits which EU Member States derive from regional cooperation that are out-of-reach to ECOWAS countries. Examples include the emission trading scheme and other cooperation mechanisms discussed in section 6.2.2.3.

6.3.7 Policy Thrust: Biofuel Policy as a Case in Point

To observe the patterns of policy focus between both countries, the biofuel policies are used as an example, to outline the major differences and highlight lessons to be learnt for Nigeria.[8]

The EU Biofuels Policy is implicit in the provisions of the RE Directive (2009/28/EC) and Fuel Quality Directive (2009/30/EC). The targets include to source 10% of transport fuels from RE and to mandate fuel producers to reduce the greenhouse gas intensity of their fuels by 6%, both by 2020. Impliedly, the major focus of this policy is to achieve sustainability and reduce emissions from fuel consumption – evident in the emphasis placed on the sustainability criteria for biofuels which set an additional target of 35% greenhouse gas reduction through the use of biofuels. This greenhouse gas saving is expected to increase to at least 50% by 2017 and to at least 60 % for biofuels produced from new installations. The sustainability criteria also include that biofuel feedstocks should not be grown on land with high biodiversity value or high carbon stock. Feedstock should be produced keeping in mind environmental quality standards.

In the case of the Nigerian Biofuel Policy, no express concerns are shown for the environmental aspects of biomass production or source of feedstock, and no emphasis is placed on achieving sustainability. Although there are intentions to reduce tailpipe emissions, ozone pollution, particulate emission, and to replace toxic octane enhancers in gasoline, there are no specific targets which the policy seeks to achieve, nor solid policy provisions for implementing them. While this is a common occurrence with most of the Nigerian energy policies considered in this study where no serious commitments are made to achieving policy objectives, it also suggests that a higher importance is placed on volume and scale of production than on clean/sustainable production. This is not surprising however, considering that the underlying aim of the policy is to develop and boost the agricultural sector. It clearly states that *"The Policy shall link the agricultural and the energy sector, with the underlying aim of stimulating development in the agricultural sector"* [94, p. 7].

The EU Biofuels Policy furthermore promotes the production and use of advanced biofuels - otherwise known as second generation biofuels - by assigning double credit to this type of biofuel typically produced from lignocellulosic biomass, agricultural residues, industrial waste and generally, non-food sources. In late 2015, the Estonian government passed a bill for

[8] Other policies would have been compared in-depth as well, but for time and space constraints.

promoting heavy investment in biomethane, which could subsequently result in its use for public transportation by 2017 [149]. This will effectively reduce pressure on food and ILUC impacts.

Although, the EU Biofuels Policy initially did not tackle ILUC impacts, an amendment was made through the (EU) 2015/1513 Directive [150], addressing these impacts. On the other hand, since the Nigerian Policy seems to be built around the agricultural sector, it places emphasis on the production of biofuel from agricultural feedstock and does not consider the resultant effect on food prices nor makes any reference to ILUC impacts.

This is not to say that the EU (biofuel) policy is flawless, seeing that it has also drawn debate from several quarters in the past, although, most of the criticisms are centred around general biofuel matters. Kampman et al. [151] argued that the sustainability criteria, if too stringent could limit biomass availability for use in producing EU biofuels, thereby causing price increases. Didier [152] also raised concerns about the special support for advanced biofuels, stressing that they do not always have a higher performance rating in reducing greenhouse gas emissions compared to conventional biofuels.

Estonia on the other hand, has not made significant progress in achieving the targets of the biofuel policy. As at 2014, the share of renewables in the energy consumption of the transport sector was just 0.2% and the average annual value between 2005 and 2014 was 0.18% [153]. This has been attributed to poor demand for biofuel and regardless of this, the government still plans to meet the 10% target by introducing a biofuels blending obligation; through electric vehicles; and biogas use in transport [122].

Regardless of these setbacks, the energy policy terrain in Estonia and the EU encompasses a wealth of examples which can be emulated in Nigeria, taking into account the peculiarities of its own National context, to improve the progress of SE development. Care has to be taken however, to avoid exact duplication of the approaches used in Estonia and the EU, but rather adapting them, in order to avoid policy failure.

7 CONCLUSION AND RECOMMENDATIONS

7.1 Answers to Research Questions

In providing answers to the questions posed at the beginning of this study, each of the questions were explored in separate chapters, while the final one is addressed in this chapter.

7.1.1 Question 1 - Policy Gaps

In exploring the first research question on policy gaps in Nigeria's energy policies, this study identified instances of policy conflicts, overlaps, inconsistencies, ambiguity and poor coordination. Energy matters are scattered under several headings in diverse white papers, and are either treated as a secondary issue or provided with weak regulations. Furthermore, many of the mechanisms designed to expedite policy implementation are generic rather than specific, and do not respond to technology maturity. Implicitly, the study also reveals that policy orientation is more skewed towards RE than EA or EE, and that in achieving these three objectives, related environmental concerns are not sufficiently expressed or addressed. Thus, one cannot but doubt whether in pursuing SE, environmental sustainability is being improved at any greater rate than what already obtained under the fossil fuel regime.

7.1.2 Question 2 - Policy Performance and Effectiveness

In dealing with the second research question on policy performance and effectiveness, the study reveals poor policy performance in promoting SE and in achieving specific policy goals. RE is underdeveloped, EA is still very poor and progress is slow. The analysis also showed that if the current trends continue in a business-as-usual manner, many of the policy targets would not be achieved by the deadlines. Moreover, the paucity of energy supply and higher EA in the urban areas compared to rural areas underline social inequity and impedance to economic development. Coupled with the adverse environmental effects of a fossil-heavy energy economy, the 'pillars of sustainability' in Nigeria's energy sector seem to be falling apart.

7.1.3 Question 3 - Lessons from Estonia and EU Energy Policies

In addressing the third research question, the comparison of the energy policies in both countries/regions outlines the differences in policy orientation, mechanisms and practices. The underlying principles that have brought about progress in the EU were also identified and lessons on proper policy coordination and orientation, strategy formulation, monitoring and evaluation, legislative support for policy, regional cooperation and coordination, and policy mechanism design emerged from this comparison.

7.1.4 Question 4 - Recommendations

In answering the final research question on policy and practice options to be proposed for securing SE in Nigeria, key recommendations are presented in section 7.3.1.

7.2 Conclusion

In line with the objectives of this study, energy policies have been analysed extensively; policy effectiveness evaluated; and lessons outlined.

The major argument of this study is not about the existence of energy policies, but how they are positioned to address the key issues of energy sustainability, and how effective they are in bringing about positive changes. As this study already pointed out, the promises of RE and EE are already manifesting in EU countries and focus is already on achieving energy security.

There are several approaches which a country could adopt to facilitate SE development, as already identified and elaborated in this study. Thus, the conclusion is that production-inducing mechanisms are more effective than investment-inducing ones. The latter are usually only effective to the extent of reducing entry barriers of clean energy projects, while the former can be positioned to effectively promote continuous and sustainable production of energy - which is usually the aim of policy. Also, it is essential for support mechanisms to be technology-specific and responsive to technology maturity, since the amount of support required would usually reduce as the technologies approach market maturity.

Nigeria, is an oil-rich country whose major earnings come from crude oil exports. It may therefore not be an easy task to phase out the fossil-fuel regime in favour of RE. There may be in fact, some reluctance on the part of the major industry players to fully effect the desired changes for fear of the resultant economic effects. What must be understood, however is that Nigeria's RE portfolio can be developed to levels sufficient enough to generate export earnings, given that the country's potentials in this regard have already been proven beyond reasonable doubt. The Biofuel Policy in Nigeria is aimed at a gradual phasing out of fossil fuel by implementing a blending mandate, but progress on achieving this is not known.

It is evident that as a developing country, there have been commitments to securing the sustainability of energy production and consumption in Nigeria. What is doubtful, however is the adequacy and appropriateness of these commitments, the will to follow through on policy promises, and whether or not energy production and consumption in the country can be adjudged to be sustainable yet. This study uncovered an abundance of policies which altogether represent several commitments to improving EA, increasing RE shares and improving EE. However, the problematic issues of concern are the main thrusts of these policies, what provisions they contain and how they interact with one another in achieving the overall energy vision.

The benefits of having a coherent, cohesive policy, with a strong legislative backbone, accompanied by a deliberate strategy have been observed in the EU. The impacts of regional cooperation and monitoring framework have also not gone unnoticed. Findings from this study suggests a lack of coherence among the industry players involved in energy policy making in Nigeria; pointing to laxity in enforcing policy mandates and a lack of will to follow through on policy promises. These have effectively stalled progress to the effect that the only RE resource that the country can boast of is LHP, while EA and EE are nothing to write about.

7.3 Recommendations

7.3.1 Recommendations for Policy and Practice

Following from the policy gaps identified in this study, the following are proposed for improving Nigeria's energy policy:

- *Aggregation of all energy policy statements into a comprehensive and coherent energy strategy.* While it is possible to have more than one energy policy, they should interact synergistically in achieving energy objectives, and could also be harmonized with climate change policies. The benefits of this would also extend to eliminating or at least reducing policy conflicts and inconsistencies.
- *Formulation of cross-sectional policies.* Policies should be designed to cater for all energy-related matters across sectors. Statistics have shown that the residential sector is the most energy consuming sector in the country, and though there are policies to provide modern energy services for cooking, there are really no specific policies focusing on EE in the residential sector. Additionally, most energy policies focus on the electricity industry neglecting others such as transport and agriculture etc.
- *Assembly of an effective legislative and regulatory framework.* There is the need for comprehensive laws and regulations guiding provision of (rural) EA, RE and promoting EE in order to ensure success. The energy policies do not currently enjoy sufficient legal backing, as the enforcement of policy provisions is not strong enough. Energy producers should be obligated to produce from renewable resources, and EE and performance requirement standards should be upheld.

- *EA should be declared as a pressing issue of policy imperative and treated accordingly.* EA in Nigeria should be taken very seriously, considering the very poor situation. Without expanding EA to energy-deprived areas, any further energy improvements would only benefit those who already have access to energy. This would further widen the rural-urban gap and hamper social sustainability.
- *Adequate policy attention should be given to underdeveloped RE resources.* Policies to fully exploit the range of RE resources in the country should be designed, with special attention to the underdeveloped geothermal, wave, wind, small hydropower and even solar energy.
- *Design of market-oriented policies and mechanisms,* which would not only promote increased investment in SE projects, but also drive energy technologies to market maturity and encourage optimum operation and clean energy production. Feed-in premiums should be designed to replace the FITs. Incentives should be given for energy efficiency, especially to heavy energy users. Furthermore, disincentives should be used to discourage production and consumption of fossil fuels by taking account of environmental externalities, thereby indirectly promoting RE and EE. The range of incentives currently in use should also be made more effective, operational and investor-friendly as financial barriers to entry still exist.
- *Development of a sound institutional framework.* While the REA sees to the expansion of EA, there is a need to establish agencies with RE and EE mandates. Furthermore, the current institutional set up leaves room for duplication, side-lining and overlapping of roles and responsibilities. A clear framework with clearly defined roles and responsibilities should be established to circumvent this.
- *Review of the Biofuel Policy.* There is a need to expand the scope of biofuels in Nigeria beyond the current policy provisions. The policy should be developed to accommodate advanced biofuels and more sophisticated biofuel production technologies. Attention should also be given to ILUC effects and other environmental aspects of production.
- *Diversification of funding sources for SE projects.* This study observes that the bulk of funding responsibilities for SE projects rests on the Federal Government. However, this in itself is not 'sustainable'. More efforts should be made to attract private participation.
- *Development and expansion of data collection capabilities.* As a matter of policy imperative, energy data collection has to become an integral function of energy institutions in Nigeria. Although, there are energy agencies with data collection responsibilities in Nigeria, energy data collection has no legal basis, and is not

mandatory. There should be mandatory policy obligations binding the relevant institutions to regularly obtain and store energy data. This will enhance monitoring and evaluation possibilities.

- *Development of energy indicators.* In accordance with the aforementioned recommendation, data availability would be of no consequence without the necessary indicators needed to exploit these data. National energy indicators should be developed for assessing and monitoring progress in achieving objectives. This will subsequently inform future decision making.

7.3.2 Recommendations for Future Research

In line with the scope of this study as described in Chapter One, more attention was paid to policy content, while policy process and institutional framework were not a major focus. It is possible that an analysis of these other themes would provide a different picture other than the one presented in this study. Therefore, this study recommends an analysis of the energy policy processes and institutional framework in Nigeria to get a better grasp of how SE in Nigeria can be improved upon. Comparison could also be made with other countries outside the EU.

Also, because the major aspects of energy development explored in this study converges on the objectives of the UN's SE4All initiative, further research is required to unearth other crucial aspects or energy matters which might have been overlooked in this study. The social, environmental and economic implication of various SE options and approaches should also be explored in greater details.

The EISD used for assessing policy performance in Chapter Five of this study were developed based on considerations for the feasibility of data collection and availability in developing countries. Yet, many of the indicators could not be computed due to lack of data, thereby limiting the extent and quality of analysis. For instance, this study set out to also evaluate policy efficiency using a different set of indicators, but there was no data on the parameters required for computing these indicators. It is therefore suggested that subject to data availability, other indicator sets for assessing energy development should be employed.

Since data unavailability was a persistent challenge of this study, it is assumed that if energy data are available in Nigeria at all, then, they are perhaps not published on the internet. This study therefore proposes for future study, a trip to the energy agencies in Nigeria for a possible access to the country's energy database.

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