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MODELS OF FINANCING RENEWABLE ENERGY FOR SUSTAINABLE DEVELOPMENT: AN AFRICAN PERSPECTIVE

Chijioke Kennedy Oji

Supervisor: Professor Kalu Ojah

Co-Supervisor: Dr Ogundiran Soumonni

A thesis submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, Johannesburg, South Africa in fulfilment for the requirements of the degree of Doctor of Philosophy (PhD).

September 2015

DECLARATION

I, Chijioke Kennedy Oji, declare that this thesis is my own original work, except as indicated in the acknowledgements, the text and the references. It is submitted in full fulfilment of the requirements for the degree of Doctor of Philosophy (PhD) at the University of the Witwatersrand, Johannesburg. It has not been submitted before, either whole or in part for any degree or examination at this or any other university.

Chijioke Kennedy Oji

18 September 2015

DEDICATION

To Terrence and Myles.

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ABSTRACT

Africa is challenged by the lack of stable modern electricity which is essential for economic and social development. Many African communities, especially in rural and sub-urban areas, are not connected to the national grid and thus constrained from developing and their continued use of traditional sources of exhaustible energy cause environmental pollution. Distributed renewable energy technologies can help to address the problem of modern energy provision in many of Africa's communities.

Finance plays a critical role in the development of renewable energy within countries. It bridges the gap in the development of renewable energy projects (REPs). Governments' efforts towards developing REPs for scaled-up renewable energy to impact the energy access challenge measurably have been inadequate. Thus, this dissertation focuses on increasing the financial contribution of the private sector in developing REPs, especially within rural communities. Models of financing REPs within selected African countries are analysed, with focus on financiers' perspectives and governments' ultimate goal in financing REP development. A key objective is to bridge the gap between private sector financiers and policymakers in government in this REP financing effort.

The study uses the mixed methodology approach to develop a framework through which REP development is related to the perspectives of financiers and policymakers as to enable reliable and useful research findings. Broadly, the results show that while REP financiers are mainly focused on the profitability of their investments, policymakers are mainly focused on the prospects for sustainable economic development. This divergence presents a key obstacle to the development of renewable energy within African countries.

Further, results show that traditional financing methods have been largely ineffective in promoting development of REPs in African countries, hence the need for innovative financing channels to increase REP development in Africa. Also, financiers of REPs in Africa consider renewable energy to be highly risky even when supported by government policies. The fledgling capital markets in many African countries need to be further developed to provide appropriate hedging mechanisms while financing small and medium scale REPs. This study also proposes financing models that amalgamate financiers into a small "financing consortiums" using project finance to fund localised renewable energy service companies (ESCOs) with expertise in finance and REP development; kind of models

that spread risk among a number of investors, thereby reducing the potential risks of investments while delivering on the objective of sustainable economic development.

TABLE OF CONTENTS

Chapter Page

DECLARATION ii

DEDICATION iii

ACKNOWLEDGEMENT iv

ABSTRACT v

TABLE OF CONTENTS vii

LIST OF TABLES xii

LIST OF FIGURES xiii

CHAPTER ONE: INTRODUCTION 1

1.1 Background of the Study 1

1.1.1 Renewable Energy Finance and Sustainable Economic Development 2

1.1.2 Renewable Energy Finance and Climate Change 4

1.1.3 Policy Mechanisms for Renewable Energy Finance 4

1.2 Purpose Statement 5

1.3 Research Questions 5

1.4 Objectives of the Study 6

1.5 Significance of the Study 7

1.6 Organisation of the Study 8

CHAPTER TWO: REVIEW OF THE LITERATURE 9

2.1 Introduction 9

2.2 Finance and Economic Development 9

2.3 Energy and Sustainable Development 12

2.4 Renewable Energy and Economic Development 18

2.4.1 RETs and Access to Energy 20

2.4.2 RETs and Poverty Reduction 23

2.4.3 RET Adoption and Energy Security 26

2.4.4 RE Development and Sustainable Employment 31

2.4.5 RETs and Increased Energy Efficiency 32

2.5 Climate Change Mitigation and Sustainable Energy Production 33

2.5.1 Adoption of RETs for Climate Change Mitigation 34

2.5.2 Policies for Climate Change Mitigation and RE Development 41

2.6 Barriers to Adoption of RETs 47

2.7 Policy Mechanisms Supporting Financing and Development of RE 51

2.8 Financing Mechanisms and Models for RE 60

2.9 The Conceptual Model 71

2.10 Summary of the Chapter 72

CHAPTER THREE: RESEARCH METHODOLOGY 74

3.1 Introduction 74

3.2 Research Design 74

3.3 Quantitative Research 78

3.3.1 Survey Instrument 78

3.3.2 Survey Administration 80

3.3.3 Chi-square Test 82

3.3.4 Profile Classification 83

3.3.5 Operationalisation of Variables 83

3.3.6 Hypotheses and Propositions 84

3.3.7 Validity and Reliablity 85

3.4 Qualitative Research 87

3.4.1 Research Instrument 87

3.4.2 Data Analysis 90

3.5 Population and Sample 93

3.5.1 Sampling Method 93

3.5.2 Access to Respondents 94

3.6 Timeframes for Data Collection 95

3.7 Ethical Considerations 95

3.8 Limitations of the Study 96

3.9 Issues for Further Consideration 96

3.10 Summary of the Chapter 97

CHAPTER FOUR: RESULTS FROM QUANTITATIVE RESEARCH 99

4.1 Introduction 99

4.2 Population and Sample for REP Financiers 99

4.3 Statistical Tests and Analyses for RE Financiers 103

4.3.1 Correlation Analysis (REP Financiers) 105

4.3.2 Results for Chi-square Analysis (REP Financiers) 107

4.3.3 Results for Profile Classification (REP Financiers) 111

4.4 Population and Sample for REP Developers 115

4.5 Statistical Tests and Analyses for REP Developers 118

4.5.1 Correlation Analysis (REP Developers) 121

4.5.2 Results for Chi-square Analysis (REP Developers) 123

4.5.3 Results for Profile Classification (REP Developers) 127

4.6 Summary of the Chapter 130

CHAPTER FIVE: RESULTS FROM QUALITATIVE RESEARCH 132

5.1 Introduction 132

5.2 Characteristics of Respondents 133
5.2.1 Kenya Respondents 136
5.2.2 Nigeria Respondents 137
5.2.3 South Africa Respondents 138
5.3 Data Collection Process 140
5.4 Presentation of Findings from the Study 141
5.4.1 Economic Development 144
5.4.2 RE Finance 148
5.4.3 RE Policy 156
5.4.4 Market Development 161
5.4.5 Energy Access 167
5.5 Summary of the Chapter 170
CHAPTER SIX: ANALYSIS OF FINDINGS 173
6.1 Introduction 173
6.2 Hypotheses and Findings 173
6.2.1 Hypothesis 1.1 173
6.2.2 Hypothesis 1.2 176
6.2.3 Hypothesis 1.3 179
6.2.4 Hypothesis 1.4 182
6.3 Other Research Findings 189
6.3.1 Traditional and Innovative Financing Methods 189
6.3.2 Value Measurement and Financing Objectives 191
6.3.3 Traditional Financiers and Smaller REPs 192
6.3.4 Innovative Financing and Economic Development 194
6.3.5 REP Financing and Sustainable Development 195

6.4 Summary of the Chapter 197
CHAPTER SEVEN: CONCLUSIONS AND RECOMMENDATIONS 198
7.1 Introduction 198
7.2 Summary of the Research 198
7.3 Financing and Policy Preferences 200
7.4 Contribution of the Study 202
7.5 Policy Implications and Reommendations 203
7.5.1 Energy Planning Paradigm 203
7.5.2 RE in Energy Frameworks 204
7.5.3 Policy Instruments for Off-Grid RE 205
7.5.4 Support for ESCOs 205
7.5.5 Investment Infrastructure for Smaller REPs 205
7.5.6 Approach to RE Policy Development 206
7.5.7 Financing Smaller Off-Grid REPs 206
7.5.8 Process Evolution for REP Developers 207
7.6 Limitations and Further Research 207
7.7 Summary of the Chapter 208
REFERENCES 209
APPENDIX A 242
APPENDIX B 244
APPENDIX C1 249
APPENDIX C2 257
APPENDIX D 265

LIST OF TABLES

Table Page

Table 2.1: HDI components and rankings for selected countries .... ……17

Table 2.2: Net installed capacity of electric power plants ……25

Table 2.3: Percentage of energy use to GDP, alternative energy and combustibles 28

Table 2.4: Electric power consumption between 1993 and 2009 (kWh per capita)... 30

Table 2.5: Impact of climate change on the temperatures of selected African countries . 36

Table 2.6: Per capita emissions of CO_2 by sector for selected African countries 39

Table 2.7: CO_2 emissions from fuel combustions between 1992 and 2010 40

Table 2.8: SME access to finance for selected African countries..... 64

Table 2.9: Financial inclusion indexes for selected African countries (2011) ..... …..66

Table 3.1: Details of time allocated for the interview process 95

Table 4.1: Frequencies and percentages for REP financiers..... 103

Table 4.2: Correlation of variables for REP financiers..... 106

Table 4.3: Chi-square statistics for number of projects variable (RE financiers)..... 108

Table 4.4: Chi-square statistics for total investment variable (RE financiers) 109

Table 4.5: Chi-square statistics for number of years in RE variable (RE financiers)..... 110

Table 4.6: Frequencies and percentages for REP developers 119

Table 4.7: Correlation of variables for REP developers (REP developers)..... 122

Table 4.8: Chi-square statistics for number of projects variable (REP developers)..... 124

Table 4.9: Chi-square statistics for total investment variable (REP developers) 125

Table 4.10: Chi-square statistics for number of years in RE variable (REP developers)126

Table 5.1: Summary profile of participating respondents (financiers)..... 135

Table 5.2: Summary profile of participating respondents (policymakers) 135

Table 5.3: Summary profile of participating respondents (REP developers) 135

Table 5.4: Summary characteristics of all respondents 136

Table 5.5: Description of Kenya respondents..... 137

Table 5.6: Description of Nigeria respondents 138

Table 5.7: Description of South Africa respondents..... 140

Table 5.8: Summary of the description of themes in RE development in countries 172

LIST OF FIGURES

Figure Page

Figure 2.1: Percentage ccess to electricity for selected African countries in 2009 21

Figure 2.2: Global carbon dixoide (CO_2) from fossil fuels (1990 – 2008)..... 38

Figure 2.3: Trend of validation for CDM projects (2003 – 2012)..... 69

Figure 2.4: World Bank financing for renwable energy projects 70

Figure 2.5: The conceptual model 72

Figure 3.1: Convergent parallel design of mixed methodology 76

Figure 3.2: An illustration of the main steps in the research design process..... 77

Figure 3.3: Step model of deductive category application 91

Figure 4.1: Distribution of RE financiers by geographical region..... 100

Figure 4.2: Distribution of REPs financed by respondents' institutions 101

Figure 4.3: Distribution of RE financiers according to type of financial institution 102

Figure 4.4: Decision tree for number of projects variable (RE financiers) 111

Figure 4.5: Decision tree for total investment variable (RE financiers)..... 113

Figure 4.6: Decision tree for number of years in RE variable(RE financiers) 114

Figure 4.7: Distribution of REP developers by region 116

Figure 4.8: Distribution of REP developers by REPs developed 117

Figure 4.9: Distribution of REP developers according to organisation type 118

Figure 4.10: Decision tree for number of project variable (REP developers) 128

Figure 4.11: Decision tree for total investment variable (REP developers) 129

Figure 4.12: Decision tree for number of years in RE variable (REP developers)..... 130

1.0 INTRODUCTION

1.1 Background of the Study

Financing renewable energy projects (REPs) is central to the initiation and fostering of renewable energy technologies (RETs) for sustainable economic development.[1] The provision of finance for investment in REPs has a profound impact on the level of adoption of renewable energy (RE).[2] Finance plays a pertinent role in bridging the gap between the provision of RE and the lack thereof. As a continent, Africa is greatly challenged by the issues of energy access and energy security. It can be argued that the challenge of access to clean energy sources is synonymous with rural African communities (Karekezi 2002, Liming 2009). This however is not to suggest that urban communities in Africa are in any way immune to the consequences of the challenge. As populations of countries increase, traditional energy sources are strained (Painuly 2001), bringing the issue of broadening energy access as well as its security to the forefront of the conversation for sustainable development in Africa.

Toke and Lauber (2007) explain that financing RETs and REPs presents a key opportunity for a country to respond to the problems of global warming and climate change. As countries increase their financial investments in the development of RE and support for REPs, they increase the chances of reducing their carbon emissions. Currently, most countries satisfy their energy needs from derivatives of fossil fuels, which when burned emit greenhouse gases (GHGs) that are harmful to the environment. GHGs like carbon dioxide, methane and chlorodifluromethane ($C0_2$, CH_4, and HCFC-22, respectively) are recognized to be responsible for climate change. The call by the United Nations Framework Convention on Climate Change (UNFCCC) for countries to reduce and control primarily the atmospheric emissions of greenhouse gases in a bid to respond to climate change has recently become even more resonant.

It has been established that widespread application of RETs has the potential to contribute to sustainable economic development by satisfying increasing demand for access to commercial energy while addressing the challenge of climate change (Krupa and Burch 2011; Spalding-

[1] In this study, REPs and RETs are used interchangeably. In most cases, RETs are used in situations referring to the adoption of renewable energy. Also, regarding the financing of renewable energy development, REPs are used.

[2] In this study, the concept of renewable energy is used in the context of renewable electricity generated from centralised or decentralised RETs, excluding energy or electricity generated from biofuels. Renewable energy and renewable electricity are also used interchangeably to mean the same thing.

Fecher et al 2005; Winkler 2005; Kose 2004; Akpinar et al 2008; Balat 2008; Shen et al 2011). However, many barriers exist in the process of financing RE; these barriers in turn impede both the adoption of RETs and consequent mitigation of GHGs. Gutermuth (1998) identified high interest rates environment, high cost of capital and lack of access to capital as some of the barriers to the adoption of RETs. The risk-averse behavior of investors is also a notable barrier in financing REPs.

Based on the characteristics of RETs (high upfront capital requirements, high risk, new and unfamiliar technology), investors tend to exercise increased caution when considering the funding of REPs (Wang and Chen 2010; Delina 2011; Painuly 2001, Beck and Martinot 2004). This in turn acts to stifle capital flows into REPs, impacting negatively upon the deployment of RETs. Komendantova et al (2012) link investor-related and risk associated problems with financing REPs, to low level of political stability, lack of support from government, complexity and corruption of bureaucratic procedures, and the absence of guarantees in the form of support policy mechanisms.

A number of countries have adopted policies aimed at promoting the development of RETs for sustainable economic growth and to help reduce the quantities of GHGs emitted during economic activities (ACPC 2011; REN21 2010). In developing RE policies, it is however important to align policy targets with economic objectives, while taking into consideration the actual stage of development the country finds itself in (Karekezi 2002). Especially with the RE sector, policy intervention plays an important role in stabilising the adoption of technologies. As a means to provide support for financing REPs, of the various policy options available to policymakers, the renewable energy feed-in tariff (REFIT) policy[3] is the most widely adopted and preferred by investors (Burer and Wustenhagen 2009; Hofman and Huisman 2012). REFIT policies aimed at increasing investment in RE can either be market-dependent or independent of the market (Couture and Gagnon 2010).

1.1.1 Renewable Energy Finance and Sustainable Economic Development

Financing is important for the widespread dissemination of RETs in Africa. It provides an opportunity for borrowers to obtain affordable credit over a suitable time frame, while

[3] The REFIT is a policy mechanism designed to accelerate investment in renewable energy. This aim is typically achieved by government offering long-term contracts, which essentially are guaranteed purchase agreements, usually between 15 – 25 years, to producers of renewable energy per kilowatt-hour (kwh). Payment is based on the cost of the energy generation over the lifespan of the technology (Munksgaard and Morthorst 2008; Jacobsson and Lauber 2006; Toke 2006; Kildegaard 2008).

creating a platform to invest in systems which bring about improvements in the quality of life for people. Thus, the availability of finance plays a critical role in promoting the penetration of RETs to help address the energy access challenge that is persistent in many African countries. Scholars have linked sustainable economic development and finance, suggesting that positive changes in the state of an economy are brought about by innovative financial interventions (Schumpeter 1911; McKinnon 1973; Shaw 1973).

RE development may be financed using a number of mechanisms. In this study, these mechanisms are broadly classified into two different categories, namely traditional financing, otherwise known as conventional financing and new or innovative financing (Shrestha 2007; Ma et al 2010; Konstantinos et al 2011). While these methods of financing may be applied in projects as the sole method for providing finance, variations of these methods may exist depending on the objectives for financing the project. Using traditional financing methods in the private sector, RE investment projects may be financed through equity or debt.

However, there is evidence that traditional financing methods are not suitable for financing REPs, especially given the challenge investors face in understanding REPs (Derrick 1998). There are: high level uncertainty with regards to making profits on invested capital, based on inherent risks associated with REPs; unpredictability of the tradeoff between the risk of investing and returns on investment; unfamiliarity with rapidly changing technologies; and the influence of policy on market dynamics (Shrestha 2007; Justice 2009; Wiser et al 1997; UNEPFI 2012). Traditional financing for REPs is commonly favored by commercial banks, multi-lateral institutions, investment banks, development banks and non-governmental institutions. In traditional financing, the predominant avenues which comprise models by which funds are channeled into REPs are project financing, corporate financing and lease financing. These models of financing are discussed in-depth in this study.

More recently, based on the barriers experienced in attempts to obtain financing the traditional way, some REP developers are turning to innovative models for financing. Some scholars have established that new innovative financing models present REP developers with more flexibility regarding repayments of loans (Saunders et al 2012), as the models are developed to better accommodate risks associated with REPs. Sakar and Singh (2010) explain that innovative financing models are better instruments for the widespread dissemination of RETs because they are designed to address, especially in rural areas, the issues of access to energy and inclusive sustainable development.

For increased adoption of RETs in African countries, revolving funds, credit co-operatives, renting schemes, utility leasing and hire purchase, are some innovative financing models that have been developed to increase access to energy (Konstantinos et al 2010). Other important innovative models include the Clean Development Mechanism (CDM), dealer credit model, consumer credit model, supplier credit model, energy service company model and the Global Environmental Facility (GEF) (Shrestha 2007; Derrick 1998; Enzenberger et al 2003; Martinot 2003).

1.1.2 Renewable Energy Finance and Climate Change

A core aim of this research is to establish the financing of REPs as an important aspect of efforts currently being made to reverse the effects of GHGs produced from fossil fuels. The GEF plays an important role in providing finance for RE production, so as to lower emissions and aid the transition of countries from high emissions of GHGs to low-carbon economies. For progress towards sustainable development, Africa in particular faces the interrelated problem of low access to energy and continued emission of GHGs (which occurs mainly through the burning of wood fuels) (Karekezi 2002; Foster-Pedley and Hertzog 2006; Gujba et al 2012).

A major barrier to the diffusion of RETs worthy of consideration is the lack of competitiveness in the market (Thiam 2011), a problem traceable to REPs being characterised by large capital requirements and upfront costs. Additionally, barriers may include high investment costs, profit anticipation by investors, the lack of platforms or models that are financial in nature. In other words, if RETs are to overcome these barriers and contribute to the mitigation of climate change, appropriate financing models to support the provisioning and widespread deployment, would have to be adopted.

1.1.3 Policy Mechanisms for Renewable Energy Finance

Policies to support the development of RE have been established in some African countries, and the most commonly adopted policy is the REFIT. Other policies to support RE development include renewable obligation (quota system or renewable portfolio standards), the RE auction system, credit incentives, tax cuts, subsidies, rebates and grants. While achieving the objective of inclusive economic development, the rising costs of fossil fuels, unpredictability of the oil market and the need to transit to a low-carbon economy, necessitate policy establishment for RE (Konstantinos et al 2010, Frondel et al 2010). However,

literature suggests that efforts at fashioning effective policies for disseminating RETs in order to counter emission of GHGs have not been convincing (Wiser and Pickle 1998; Yuskel 2008).

Given the patterns of energy use which is increasing rapidly, and population growth in African countries, the development of new, sustainable energy sources is imperative. RE is still in its infancy and thus needs the intervention of government in establishing investment support policies for its provision. The importance of policy, especially in nurturing growing industries cannot be overstated. Energy is considered a primary resource for sustainable economic development and the RE industry would only grow upon increasing investment support policies to coordinate anticipated growth.

1.2 Purpose Statement

The purpose of this research is, therefore, to investigate the suitability of particular financing models for the diffusion of REPs for sustainable development in Africa. Specifically, the research aims to identify and analyse how models used in financing REPs are selected in African countries. The research would also examine appropriate policies that would enhance the financing and development of RE. Finally, it also aims to analyse impacts of these policies on financial investment in RE development.

1.3 Research Questions

Flowing from the purpose statement, the following research questions are outlined to further guide the research process:

i. What financing models are suitable for the widespread diffusion of REPs?
ii. What elements of relevant policy mechanisms can be adapted to increase investment in RE development?

As the study topic implies, these questions focus on the development of RE in Africa. Although it has been established that finance plays a vital role in RE project development, there are various models for financing REPs. The first research question seeks to examine the suitability of financial models for the widespread diffusion of REPs. The RE industry in many African countries is still in its infancy; therefore establishment of appropriate support policies, can greatly enhance the adoption of RE. The second research question examines the

policy mechanisms adopted by countries to support the deployment of REPs; the focus here is on policies aimed at encouraging investment in RE projects. The impact of these policies on the development of RE markets in relation to financial investment in RE projects in African countries is also an important focus area of this study.

1.4 Objectives of the Study

The overarching aim of this study is to investigate the possible contribution of REPs in achieving sustainable economic development and mitigating climate change. More narrowly, the study aims to examine the impact of financing mechanisms on the adoption of RETs in African countries. In order to achieve this, the following broad objectives are set:

i. To examine the impact of the various financial models currently employed in the financing of REPs
ii. To analyse the risk profile of market-oriented financial mechanisms in relation to disseminating RETs
iii. To estimate the role of appropriate financing models in increasing access to RE for sustainable economic development
iv. To explore the extent to which finance plays a role in the dissemination of RETs to mitigate climate change

While there is evidence that RETs can play an important role in contributing to sustainable economic development (Painuly 2001; Fang 2011) and the reduction of GHGs that are known to cause climate change, not much research has been done to ascertain the impact of finance as a driver for the adoption of RETs – especially in the African context. The motivation for this research is based on the need to investigate the provision, access and affordability of finance for REPs as elements that influence the dissemination of RETs. Growth of a RE sector occurs through financing. Hence, in the absence of appropriate financing mechanisms needed to stimulate the adoption and dissemination of RET, the related challenges of sustainable economic development and climate change mitigation would suffer setbacks in terms of their impact and potential contribution. Put succinctly, the objective to reduce GHGs in the environment and foster sustainable economic development would not be addressed sufficiently.

In the quest for economic growth, the notion of sustainable economic development is heavily reliant on matters surrounding access to energy and energy sustainability. Broadly, the objective of this research is to provide a framework for the financing of REPs as to increase the impact of RETs as agents for climate change mitigation. This is done, taking into account the peculiar economic situations of African countries; thus, necessitating an investigation into market-enabling mechanisms for the development of a RE sector. It is acknowledged that consideration around appropriate financing is not the only issue affecting the adoption and dissemination of RETs. Therefore, to present a holistic picture of the background, the research also highlights the roles of entrepreneurs as REP developers, small and medium enterprises (SMEs), financiers and policymakers, as they relate to financing the diffusion of RE in Africa.

1.5 Significance of the Study

This study is relevant to the development of a RE markets and industries across the African continent. The development of RE markets in Africa can play an important role in addressing the issues of access to energy, energy security and economic growth. In analysing the impact of financing on the adoption of RETs, the research provides private sector financiers, non-governmental organizations and governments with information needed to engage on RE development for sustainable development.

The research highlights issues concerning bottlenecks private sector funders experience in financing REPs. It elaborates on the risks that are inherent in financing REPs and attempts to find methods by which these risks can be alleviated. The research also provides evidence for the selection of financing models that are best suited to the needs of financiers and REP developers. Results of the research provide an avenue for increased participation of private sector investors in funding REPs.

Furthermore, the research provides policymakers in government and non-governmental organisations insights into the issue of the applicability of financial models for RE development. This can help to influence RE policy design processes, and present policymakers with insights into the perspectives of financiers. The research also provides information on what established policies for financing REPs must aim to achieve in setting objectives for the development of REPs. The research contributes to the body of knowledge in this area in that it provides a method for analysing financial models and policies established to support the funding of REPs. This may be relevant to investors within the

private sector, governments and non-governmental organisations in the establishment of new policies to promote the development of RE in Africa.

1.6 Organisation of the Study

The rest of the study is organised as follows: chapter two elaborates detailed theories that surround the financing of RE. The chapter highlights RE finance-relevant concepts and examines hypotheses developed by scholars in the field. Additionally, the chapter presents evidence which suggests that finance is important for the development of RE markets. Also, policies to support the adoption of RE, especially, policies promoting the adoption of RE are analysed in the chapter. The impact of established policies on RE investment is also highlighted and areas that may be of interest pointed out as gaps in the literature are also listed.

In the third chapter, the research approach and method of analysis for the study is outlined. The appropriateness and suitability of the model for the research is also highlighted in the chapter. Furthermore, the chapter details the advantages of using one research methodology over another, based on the capacity of the research approach to provide answers to the research questions posed in the introductory chapter. In chapters four and five the data are presented, results are detailed and the models used are elaborated upon. In chapter six, the results of the research are discussed and findings from the study are systematically highlighted. In chapter seven, a summary of the study is presented, contributions of the study are highlighted and areas for future research building on the results of the study are detailed.

2.0 REVIEW OF THE LITERATURE

2.1 Introduction

This chapter highlights various themes, concepts and theories which play a critical role in the development of renewable energy (RE) across various countries and regions. The chapter begins with a description of the relationship between finance and economic development as studied by previous researchers. This section highlights the importance of finance in promoting economic development within countries, regardless of their locations or adopted economic growth models and policies.

Also, the literature on energy and sustainable development as researched by various scholars is presented. The review of literature in this section highlights the important linkage between energy and the objectives for sustainable development which many societies aspire towards as a holistic approach to broad development. Additionally, literature on RE and economic development is also reviewed in this chapter. The various dimensions through which developing RE can impact economic development positively in countries are highlighted. Furthermore, theories on economic development and RE as propounded by previous scholars are presented and reviewed.

The chapter also presents literature on the relationship between the production of sustainable energy and climate change mitigation. Again, important concepts, theories and policies relating these subjects are reviewed in view of the impact on RE development. In addition, a review of the literature on the barriers to the development of RE is presented. Important theories on the various classes of barriers to RE development are highlighted and a review of policy suggestions to eliminate these barriers is presented.

Also in this chapter, a review of the various policy instruments used by different governments to promote investment in RE development is presented. Here, the focus is mainly on the types of policy instruments used to promote the financing of RE in different countries. Finally, the literature on the financing methods used by financiers in financing RE development within developed and developing countries is presented.

2.2 Finance and Economic Development

The availability of finance is critical for economic development. Finance plays an important role in promoting economic-related interactions among elements of an existing economic

system. Over time, extended interactions may result in the upward movement of an economy, affording people the opportunity to earn higher wages for their labour (Elliot 1983). This in turn has a positive effect on the quality of life workers experience, ultimately impacting the process of economic development.

In conceptualising theories on economic development, Schumpeter (1911) explained that economic development comes from within a system and brings about qualitative changes or revolutions in an economic system. Furthermore, broadly linking finance and economic development, Schumpeter (1911) suggested that the economic performance of market-based economic systems is driven by the impact of revolutionary changes of economic development. According to Schumpeter (1911), the strategic stimulus for economic development is innovation. In this research, innovation in the financing of RE development is an important concept.

Economic development may also be achieved through investing in resources which may have contributed very little to a country's economic growth. Ranis and Fei (1961) and Smithies (1961) propose that underdeveloped countries engage a wide spectrum of their labour force, especially in rural areas. The authors suggest that this would increase industrial production activities and overall contribution to economic output. Hence, the role of finance in promoting economic development cannot be overstated. Entrepreneurial activity which drives the upward movement of an economy is made possible by the issuing of loans by financial institutions.

In many rural areas in developing African countries, financial innovation in the form lending activities carried out by community and microfinance banks is difficult to achieve. Laumas (1961) suggests that this is primarily due to the low penetration of financial institutions in rural areas. The author argues that due to lack of security regarding repayments, financial institutions are reluctant to lend money to people living in rural areas. Furthermore, Laumas (1961) and Singer (1953) suggest that local economic development in rural communities is stifled mainly because entrepreneurial activity is low as entrepreneurs have little or no collateral to offer banks for loans.

Scholars have suggested economic development is important for economic growth. In an attempt to apply Schumpeter's theory on economic development which states that service-oriented financial intermediaries are critical for technological innovation and economic development, King and Levine (1993) conducted empirical analysis on 80 countries.

Analysing economic data between 1960 and 1989, the authors concluded that economic growth is stimulated by financial development. Furthermore, the authors suggest that this occurs due to increasing rates of capital accumulation and efficiency of capital allocation.

Prior to this conclusion, Goldsmith (1969), McKinnon (1973) and Shaw (1973) established that economic development is dependent on the liberalisation of financial markets. Specifically, McKinnon (1973) and Shaw (1973) explained that a repressed financial system interferes with development by stagnating savings vehicles, reducing return on savings, promoting improper allocation of savings and discouraging investment due to unstable financial policies. However, Robinson (1952) and Lucas (1988) belonging to another school of thought, argue that financial development follows economic growth. At this point, it is important to note that the crux of this research however is founded on the premise that finance is an important factor in the engineering of economic development.

According to Yao and Yueh (2009), the development of financial markets is crucial for economic development. The authors argue that especially in developing countries, for financial markets to impact economic development positively, institutional arrangements must be put in place. Considering the authors' argument, the structuring of informal lending mechanisms which influences the flow of funds and puts capital in the hands of the entrepreneur is pertinent.

As previously established, entrepreneurs who are key agents of economic change contribute to the growth of an economy by driving development through constant innovation (Bittencourt 2012). The link between the provision of finance and economic development from this perspective becomes even clearer. Gries et al (2009) and Law et al (2013) emphasise the need for a policy approach that focuses on development of institutional factors to increase the impact of finance in achieving economic development in Sub-Saharan African countries.

King and Levine (1993) describe the concept of financial development as the level of sophistication of financial activity taking place within an economy. Established on the bank-based theory of financial development, Anwar and Sun (2011) suggest that depending on the level of openness of an economy, financial development can bring about economic growth. In agreement, Zhang et al (2012) explain that financial development is positively associated with the growth of an economy. The authors also suggest that based on the level of financial

activity occurring in an economy, the depth and size of a country's financial sector can trigger economic growth.

In their study, Yang and Yi (2008) oppose the view of Robinson (1952), calling for policies on financial reforms to be prioritised, following their conclusion that financial development causes economic growth. Lo Prete (2013) and Ang (2008) explain that financial development is associated with decreasing income inequality and higher output in economic development. Additionally, the authors argue that this is due to an increasing level of entrepreneurial activity that occurs as financial markets become more sophisticated.

Among scholars studying the relationship between financial development and economic development, there is a dominant view that the two concepts complement each other (Wolde-Rufael 2009; Anwar and Cooray 2012; Jalil et al 2010 and Greenwood et al 2013). According to Fung (2009), a mutually reinforcing relationship exists between financial and economic development. In terms of financing RE in developing African countries, when the level of sophistication of African financial markets is taken into consideration, the need for alternative financing mechanisms becomes evident.

Focusing on the conclusion of Laumas (1961) regarding the provision of finance for rural African populations, the need for innovative financing mechanisms becomes extremely necessary and even more pertinent. Appleyard (2011) highlighted the concept of community development finance institutions (CDFI) as a mechanism to overcome financial exclusion which many scholars conclude contributes to deepen the challenge of poor energy access in rural communities with African countries. CDFIs accomplish this by providing local sources of loans to micro, small and medium as well as social enterprises to drive economic activity. This research aims to investigate innovative means by which RE development can be financed for the purpose of impacting economic development in African countries.

2.3 Energy and Sustainable Development

The concept of sustainable development[4] is built on the principles of sustainability which focuses on the use and preservation of natural resources (natural capital) the earth is endowed with in much more responsible ways. The concept was introduced by the World Commission on Environment and Development (WCED – the Brundtland Commission) in 1987 and is

[4] This study adopts the definition of sustainable development which encompasses the social, economic and environmental dimensions of development as proposed by the World Commission on Environment and Development (WCED) – the Bruntland Commission of 1987.

defined as “development which meets the needs of current generations without compromising the ability of future generations to meet their own needs” (WCSD 1987; Kates et al 2005). The concept of sustainable development is based on three fundamental pillars namely the economic, social and environmental dimensions (Colgan 1997).

Largely, the concept of sustainable development can be qualified as an approach to promote economic and social development particularly for people with low standards of living, while highlighting the importance of preserving natural capital and the environment (Byrne et al 1998). In investigating appropriate financing models for the widespread dissemination of renewable energy technologies (RETs) for climate change mitigation and sustainable economic development, this research though acknowledging the importance of the social dimension, focuses more on the economic and environmental aspects of sustainable development for African countries.

Energy plays an important role in driving economic development (Bose et al 2012; Carley et al 2012; Balachandra et al 2010). Currently, the increasing population of many African countries necessitates the development of strategies to provide energy for increased engagement in economic activities, which overall impacts growth and development. An established theory for economic development follows that as people become more involved in economic activities, they are able to provide better for themselves and afford better living standards and these overall impacts the quality of life (Roseland 2000).

Especially for developing African countries, studies have shown that a positive interdependent relationship exists between the increased provision of energy and economic development and by extension, the overall economic stability of a country (Nkomo 2005; Kebede et al 2010). From an industrial perspective, it is also proposed that an increase in access to energy promotes the formation of economic clusters, which upon continuous interaction creates localised economic communities engaging in local economic activities, thereby advancing the agenda for inclusive economic development (Currid-Halkett and Stolarick 2011; Montana and Nenide 2008).

Many African cities are characterised by the rural to urban migration phenomenon. This is mostly due to the quest for increased participation in economic activities (Hope 2012). Energy production in urbanised cities is designed to cater to a fixed number of individuals at any given period of time, therefore an increase in the population within these areas results in the straining of energy production sources. In turn, strained energy sources in developing

African countries usually leads to the adoption of a rationing system of energy among localities (AfDDB 2010; UNEP 2011). This ultimately impacts economic development negatively as firms which are the main drivers of economic activities suffer from the effects of this system.

Consequently, broad economic objectives and targets for development are not met. RE has been advocated as a strategic option for increasing access to energy and promoting energy security for countries to realise their true economic potential (Gujba et al 2012; UN-Energy/Africa 2007; Agbemabiese 2012; Sovacool 2009 a; Sokona et al 2012). In addition to meeting the goal of providing energy for dispersed populations in rural areas, the production of RE meets the goal of environmental sustainability. Also, populations concentrated in urbanised cities benefit from increased economic activity aimed at impacting development (ARE 2012, UNEP 2011).

While many proponents of economic growth are of the opinion that practicing sustainable development is essential in nurturing natural capital, the extent to which the economic dimension of sustainable development should be supported has increasingly been questioned (Daly 2002). Gibbs (1996) argues that economic activity in the form of industralised production processes at firm levels results in the emission of greenhouse gases (GHGs). Incrementally, GHGs bring about environmental destruction; therefore in efforts to achieve economic development, environmental issues should form the core of factors widely relating to sustainable development.

However, in the research conducted by Gibbs (1996), the author does not elaborate on the use of alternative environmentally-friendly measures as an option to provide energy for firms to carry out production processes. RE as a platform for energy development adheres to the outlined rules for sustainable development. Mainly through the economic and environmental dimensions, the use of RE can contribute to development in local societies. Majorly, this is because RE provides energy for necessary economic activity while working to preserve the environment in the mitigation of climate change (Winkler et al 2009; Carvalho 2012; Yadoo and Cruickshank 2012).

As much as the concept of sustainable development is embraced and heralded as the responsible way to live, a number of debates have emanated from questions pertaining to the concept. These questions relate to the appropriateness of sustainability indicators for measuring development, probing the concept of sustainable development, the expression of

concerns about the broadness of the concept (Yu et al 2010). De Graaf et al (1996) attempted to provide direction for thinking about questions posed in balancing tradeoffs between economic development and environmental protection.

The authors proposed a strategy for the adoption of a socio-environmental systemic approach to sustainable development which would integrate economic and environmental approaches to sustainable development. More recently, Moldan and Dahl (2007) suggested that sustainable development should be understood as a dynamic and indefinable phenomenon based on issues pertaining to the four integrated pillars, which in agreement with the Brundtland report, adds in the institutional dimension (Karlsson et al 2007).

Over time, the concept of sustainable development has been understood to be a broader concept which in impacting the economic, social and environmental aspects of humanity ties together concerns for natural capital, economic development and social challenges humanity faces in aspiring towards growth. With reference to economic development and environmental sustenance, the aim of sustainable development is to have an economy in equilibrium reinforcing the necessary ecological support systems (Kronenberg and Bergier 2012). It is evident that if development as steady improvements in social progress across all classes of society is to occur, economic activity should be increased.

Essentially, economic development is engineered by economic interactions and interventions aimed at bettering the living conditions of people incrementally – specific reference to Africa (UNDP 2010). Marques et al (2009) suggest that a better understanding and consensus on the meaning and consequent engagement of the concept of sustainable development would be reached if events are quantified in socio-economic and cultural terms, using suitable parameters and indicators.

The Daly principles support the establishing of sustainable development indicators (Daly 1991) with little emphasis on the quality of life for people. Ronchi et al (2002) contend that the implementation of measurement indicators to monitor progress, taking into account the human welfare is necessary. Along with established indicators like the Human Development Index (HDI), they propose the Institute for Sustainable Development Italy (ISSI) index. The ISSI index is a multidimensional model for analysing progress with sustainable development based on the monitoring of welfare, environmental quality and resource use within a country. Regarding the practicality of operationalising the model, it is unclear how the authors would

attempt to reconcile interrelated conflicting development objectives to yield trusted results that reflect the realities of development within the country being analysed.

The concepts of economic progress and economic development are inextricably linked. With reference to the process of industrialisation at differing economic levels, growth of economic activity as a function of economic development is argued by the authors to be harmful to the environment. This therefore presents evidence that results of the model may be misleading.

There is consensus among scholars that monitoring sustainable development would provide insights on how individual elements in the economic, social and environmental pillars impact one another in the process of development (Bertinelli et al 2012; Boggia and Cortina 2012). However, there is no agreement on what indicators should be used to measure sustainable development (Quaddus and Siddique 2001; Islam et al 2003; Nourry 2008; Sinclair 2011). It is common practice for countries to develop their own indicators and measure results from the analysis of country-specific indicators with global indicators – many of which do not apply to all countries. Hence, the result of monitoring progress made in advancing sustainable development can be argued to be country-specific.

Haines et al (2012) suggest a new generation of indicators that integrates all dimensions of sustainable development needed to measure progress. A study on 131 countries carried out by Hosseini and Kaneko (2012) in an attempt to understand relationships between the economic, social, environmental and institutional pillars in order to make policy recommendations, showed that causal relationships exist among the pillars. The model showed that economic development is strongly related to social progress. Table 2.1 shows the relationship between the social and economic components of sustainable development in countries and the impact of this interaction on the quality of life.

Table 2.1: HDI components and rankings for selected countries in 2011

HDI listing for selected African countries

Rank	Country	HDI value	Life expectancy	GNI per capita	Non income HDI
148	Angola	0.468	51.1	4,874	0.455
118	Botswana	0.633	53.2	13,049	0.602
179	CAR	0.343	48.4	707	0.379
170	Cote d'Ivoire	0.400	55.4	1,387	0.412
187	DRC	0.286	48.4	280	0.399
106	Gabon	0.674	62.7	12,249	0.667
135	Ghana	0.541	64.2	1,584	0.633
143	Kenya	0.509	57.1	1,492	0.584
156	Nigeria	0.459	51.9	2,069	0.471
123	South Africa	0.619	68.1	3,940	0.604
152	Tanzania	0.466	52.8	1,328	0.523
161	Uganda	0.446	54.1	1,124	0.506

HDI listing for the highest ranked countries

Rank	Country	HDI value	Life expectancy	GNI per capita	Non income HDI
1	Norway	0.943	81.1	47,557	0.975
2	Australia	0.929	81.9	34,431	0.979
3	Netherlands	0.910	80.7	36,402	0.944
4	United States	0.910	78.5	43,017	0.931
5	New Zealand	0.908	80.7	23,737	0.978
6	Canada	0.908	81.0	35,166	0.944
7	Ireland	0.908	80.6	29,322	0.959
8	Liechtenstein	0.905	79.6	83,717	0.877
9	Germany	0.905	80.4	34,854	0.940
10	Sweden	0.904	81.4	35,837	0.936

Source: United Nations Human Development Indexes, 2012

Table 2.1 shows that African countries are lowly ranked on the HDI, suggesting that the quality of life is poor, as a result of slow economic development. This has negative impacts on the interaction between social and economic components of sustainable development. Upon considering the use of energy along with trends and patterns, the integrity of the environmental component may also be considered to be compromised in these countries. The relationship between the economy and the environment is an important consideration in the adoption of practices that promote sustainable development.

Halbert and Erbguth (1999) assert that sustainable development can only be truly achieved by balancing differing interests of the economy and environment. The authors argue that while the interdependence of the two pillars of sustainable development is evident, control measures in the form of the implementation of environmental laws such as economic incentives, specifically environmental taxes and subsidies are necessary to make progress.

In line with this thinking, Kroneberg and Bergier (2012) highlight the impact of financial instruments like the Polish Eco-Fund which finances eco-innovation projects as an example of balancing the economic and environmental needs of society in practicing sustainable development. However, with African countries, the situation differs greatly as many of the developing economies of Africa are classified by the World Bank as least developed countries (LDCs) with underdeveloped financial systems and markets (World Bank 2006). This further establishes an important fact that as important as environmental protection against climate change is, the priority for the governments in Africa is economic development (Winkler 2006).

Energy is established as an important production input for almost all economic activities in society. Energy contributes immensely to economic development in the overall transition towards increased progress in social development (Kauakou 2011). However, production processes may lead to degradation of the natural environment (Chiu and Chang 2009), ultimately retarding efforts made towards sustainable development. The increasing demand for energy based on population and economic growth, among other important factors, is increasingly viewed as a possible threat to the sustainable development of communities based on the current dominant forms of energy generation (Sovacool et al 2011 a).

For African countries, the impact of the lack of energy presents manifold challenges in the forms of energy security and the consequent inability to realise their true economic potentials. Many African countries are characterised by limited and inadequate energy supply. Low supply of energy results in stunted economic development, essentially working to deter countries further away from achieving the objectives of sustainable development. The environment and economy are equally important for sustainable development and the use of RE creates a system where the economy can function at optimum levels without causing damage to the environment, ultimately meeting the aim of sustainable development (Islam 1997).

2.4 Renewable Energy and Economic Development

RE is popularly defined as any energy source that is naturally regenerated over a short time scale, derived directly or indirectly from the sun, also from other natural movements and mechanisms in the environment (IEA 2011). For an energy source to be qualified as renewable, it must not be produced from fossil fuels or inorganic substances (Menz 2005). The ‘renewable’ component in the term RE highlights the practically inexhaustible nature of

energy to be produced from natural sources which basically are unlimited in supply, therefore possessing the inherent capacity to 'renew' itself (Omer 2008). RE is widely seen to be of strategic importance in efforts to spur economic development through the provision of energy to drive economic activities, while ensuring the integrity of the environment is maintained. This view is adopted in the light of the increasing awareness for countries to engage in economic and social practices that overall contribute substantially to the advancement of sustainable development (Omer 2008).

The concept of economic development broadly encompasses sustained and continuously evolving critical concerted actions in local communities that promote societal movement towards better standards of living and increased economic independence. Economic development is concerned with local competitiveness, development of human capital and infrastructure to impact economic growth. Economic development also encompasses environmental sustainability and social inclusion in aggregated efforts to provide better quality of life for people (UNDP 2011).

Economic development in Africa is often associated with interventions by government and non-governmental organisations due to historic participation (World Bank 2006; UNDP 2011). However, in recent times the private sector has become more effective, playing an increasingly important role in impacting the development of African economies. This has occurred especially with the development of the RE sector which in many African countries is still in its infant stage (Bazilian et al 2011 a; Gujba et al 2012; Bazilian et al 2012). The pertinent relationship between energy and economic development has been established as a complex linkage, yet an utterly necessary phenomenon.

The adoption of RE can provide profound macroeconomic benefits for African economies by impacting localised communities in efforts to accelerate economic development. Ultimately, this can occur by engaging in economic activities while prioritising efforts not to compromise the integrity of the environment. Studies have shown that the widespread application of RETs has the potential to better the economic prospects for African communities. RETs can benefit communities by increasing access to electricity through electrification programs, reducing poverty through alleviating the economic challenges of income and fuel poverty, thereby improving the living standards of people (Khennas 2012; Balachandra et al 2010). Also, the widespread adoption of RETs can contribute to resolving the critical issue of energy scarcity and security for developing African countries with growing populations. RET adoption can

help to achieve economic objectives through sustainable growth paths while reducing the impact of GHGs to mitigate climate change (Bazilian et al 2011 b; UNEPFI 2011).

A critical analysis of the social, economic and environmental benefits of RET adoption in relation to sustainable economic development is highlighted in the following subsections. Along with important potential contributions of RE to employment, job creation, skills development, entrepreneurship, and climate change mitigation, barriers to the widespread adoption of RETs are outlined and discussed.

2.4.1 RETs and Access to Energy

The challenge of access to energy in Africa is an important hydra-headed problem which has adverse impacts on economic development (Prasad 2011; Pachauri 2011; Nayaard 2010). Excluding South Africa, in 2008 only 26% of Sub-Saharan African households had access to modern electricity. Currently, an estimated 550 million people have no access to any form of modern energy (UNDP 2010). Among the continents of the world, Africa has the lowest electrification rate and this increasingly has had negative effects on intended progress towards achieving greater levels of economic development (Brew-Hammond 2010; UNDP 2011; Sokana et al 2012; Bazillian et al 2012).

Research shows that African households and businesses spend approximately $17 billion annually on fuel-based energy that is mostly hazardous to human health and the wellbeing of the environment (UNDP 2010). When people are unhealthy, they cannot contribute any form of capital – specifically labor, to advance objectives for economic development. The result of this is a lack of income, suggesting increased dependence on government for daily survival. The direct effect of this decrease in contribution to economic output is an increase in poverty levels and overall impediment towards economic development (Pachauri and Spreng 2011).

In most cases, the rural communities comprise the majority of the population in Sub-Saharan African countries. These communities mostly lack modern energy sources and rely on traditional use of firewood for energy (UNDP 2011). In 2008, firewood and charcoal accounted for 70% of energy consumption in Ghana and 81.7% of primary energy demand in Nigeria. Also, at this time, only 0.9% of the rural population had benefited from the rural electrification program aimed at increasing the access to modern energy to impact development (Agbemabiese et al 2012; Oseni 2012). Firewood is derived from trees and is responsible for substantially increasing deforestation and impacting the environment

negatively. These issues essentially make this form of deriving energy unsustainable (Reddy et al 2009). The burning of firewood and charcoal also results in the emission of CO_2 which is known to contribute to global warming (UNDP 2010).

Figure 2.1 shows the percentage of access to electricity in African countries which mostly, is significantly low. This in many instances leads to the consequent stifling of African economies over time as the potential for economic development is greatly reduced.

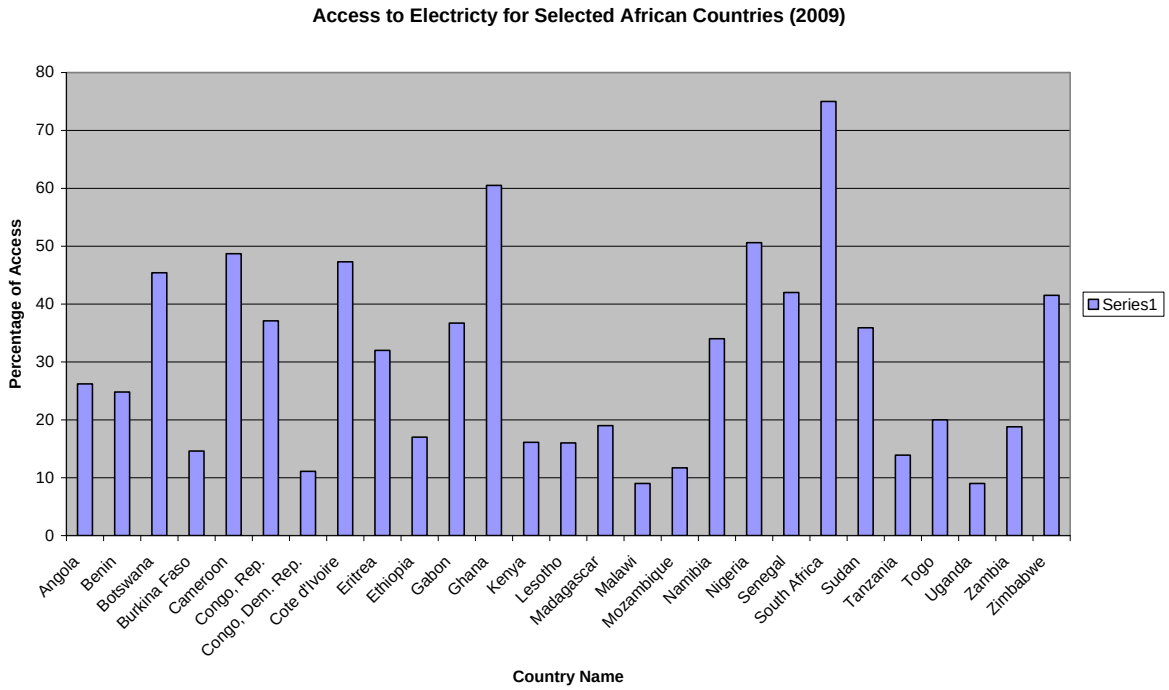


Fig 2.1: Percentage access to electricity for selected African countries (2009)

Source: World Bank Global Development Indicators, 2011

Rural electrification programs are intended to increase access to modern energy and as a result trigger economic development (Kanagawa and Nakata 2008; ARE 2011; Bhattacharyya 2012). However, geographical variations of dispersed populations, fragmented settlements and the lack of capital contribute to the failure of many energy development programs to deliver grid-connected electricity to rural dwellers (Parajuli 2011). RETs are suitable for delivering clean off-grid electricity to rural and urban communities. Due to the fact that RETs are decentralised, in efforts to increase access to electricity, the deployment of RETs can achieve deeper penetration into communities within shorter periods of time. This can rapidly

increase the potential for accelerated economic activity and impact economic development positively (Silva and Nakata 2009; Kemausuor et al 2011; Gurung et al 2011).

Sovacool et al (2011 b) in their report illustrate the feasibility of decentralised off-grid RETs in increasing access to energy through the Rural Electricity Access Project (REAP). REAP provided solar water heating systems (SWHS) and small-scale wind turbines to 40,000 nomadic herders between 2007 and 2011 in Mongolia. The implementation of REAP resulted in a significant decrease in the use of firewood and charcoal by the herders. Also, while bettering the process by which they carried out their economic activities, the herders' quality of life was improved. Consequently, this initiative assisted herders in contributing to the goal of achieving sustainable economic development.

Wickramsinghe (2011) suggests that community transition to RETs, among other factors, is impeded mainly by the lack of motivation and pressure to switch to RETs that provide cleaner energy options, financial risks associated with purchasing the technology, the lack of financing and institutional support. The process of arriving at this conclusion however excludes the communication of aggregated benefits for adopters of RETs, and consideration of financial incentives that may be offered by local authorities. These may be offered in form of reduced prices for the purchase of RETs and the acceptance of payment in installments, augmented products in the form of after sales services and technology maintenance at no charge if built into the payment structure.

Srivastava et al (2012) suggest that if people are aware of the potential benefits of RETs and are offered guarantees, transition to RETs would be accelerated. This in turn could eliminate the first-cost affordability challenge which Zerriffi (2011) suggests is the main problem associated with transitioning from the use of unsustainable environmentally destructive energy sources to the adoption of RETs for increasing energy access. Chaurey et al (2012) explain that when challenges concerning the usability of RETs are lowered, people become open to the benefits of using RETs, resulting in increased levels of technology adoption. Overall, this process helps to better living conditions and increase progress towards economic development.

Scholars have noted that access to finance is an important determinant for successful electrification programs which promote the transition from the use of hazardous and unsustainable energy sources to low-carbon or zero carbon technologies (Reddy et al 2009). In 2010, the UN Secretary General's Advisory Group on Energy and Climate Change

(AGECC) suggested that the international community works towards achieving universal energy access by 2030 (Bazilian et al 2012). Bazilian et al (2010) and Brew-Hammond (2010) suggest that the transition to RETs would require the unlocking, effective mobilisation and appropriate use of domestic and external financial resources. These resources would help to promote and sustain inclusive economic development through the increase of access to energy.

Similarly, Balachandra (2011) suggests the implementation of an integrated framework which includes financing, institutional and regulatory authorities as delivery mechanisms in the establishment of rural energy access can increase RET adoption. These institutions may function to lead, design and implement rural energy programs as RET-based interventions. Wang et al (2012) suggest that such institutions would be important in addressing the challenge of low access to energy and consequent exclusion from engagement in viable economic activities which results in increased income and energy poverty.

2.4.2 RETs and Poverty Reduction

Various definitions and phenomena are used to describe the state of poverty. However, in order to quantify and estimate the impact of poverty, a popularly adopted measurement is the number of people living below $2 dollars per day. People living under $1.50 dollars per day are considered to be in extreme poverty (World Bank 2006). 46% of the population of Sub-Saharan Africa lives below the $2 poverty line (Chen and Rvallion 2004; Lawson et al 2012). Reports by the World Bank (2006) and United Nations Development Program (2012) consider access to modern energy supply as an important factor that plays a fundamental role in increasing economic development and reducing poverty. This is due to the fact that energy is needed to drive economic activity and increase production output in enterprises (Schafer et al 2012).

Oseni (2012) and Nkomo (2005) suggest that access to energy must be linked to economic activity to drive development in order to bring about considerable reduction in the poverty levels of a given population. Lawson et al (2012) explains that poverty is strongly linked to the absence of energy for economic activities to spur income generation and trigger economic development. Proffering that there is no systematic path to poverty reduction, Donalson (2008) argues that income and economic growth does not necessarily lead to poverty reduction. Rather, the author suggests reduction in poverty levels comes as a result of

development that has been achieved and the policies that have been implemented because they impact livelihoods of the poor.

Modern economies are run by energy, hence it is accepted that energy use contributes to economic development (Khandker et al 2012). In general, connection to the centralised electricity grid poses a number of challenges, with the most notable being the high cost of connection and complexity of connection plans (Kooijman-van Dijk and Clancy 2010; Bhattacharyya 2006). However, although in the affirmative that RETs can contribute to poverty alleviation, with specific reference to solar photovoltaic (PV), Roberts (2008) argues that solar would not contribute to widespread poverty reduction due to its high cost. Importantly, Roberts' (2008) analysis does not highlight an understanding of the concept of economies of scale backed by policy intervention in the form of financial intermediation which can lead to a reduction in the price of RETs, and as such, render them more affordable.

The lack of modern energy disrupts the agenda towards economic sustainability, hampering development and impacting efforts to reduce poverty negatively (Wang et al 2012). Through a nationwide project to reduce poverty by increasing access to modern energy, Gurung et al (2011) explain that the initiation of a RET project which consisted of the diffusion of mini-hydro, micro-hydro, biogas and solar by the government of Nepal had positive impacts on socio-economic development. The authors concluded overall that the project resulted in an increase of the quality of life for rural dwellers.

The analysis also showed the project delivered environmental and economic benefits to the community. These benefits were in the form of a reduction in the burning of firewood which causes air pollution and an increase in the income of the households. This was based on the impact of RETs in providing energy for local enterprises, consequently resulting in an increase in productivity, which allows for the exploitation of market opportunities.

Sovacool et al (2012) and Sovacool (2012) suggest that for countries to achieve the widespread diffusion of RETs and contribute to poverty reduction, technologies must be designed to be easily operated with low maintenance costs, as this makes them cost effective and highly affordable. Schafer et al (2011) and Laufer and Schafer (2011) posit that integrating the needs of the users in development plans for RET implementation and linking energy supply to development programs alongside appropriate financing schemes for technology adoption can result in RETs contributing to poverty reduction. Participation of the

private sector is important in the provision of finance for the adoption of RETs by rural settlers in developing African countries (Bhide and Monroy 2011; Zhang and Fu 2011).

However, the energy systems of most developing African countries are based on channels by which energy is obtained from traditional sources. With rapidly growing populations, projected increases in economic activities and the need to maintain the integrity of the environment, traditional sources of energy are increasingly considered to be unsustainable in the long run. Table 2.2 shows the net amount of electricity-generating capacity from installed power plants in some African countries which is increasing consistently. The generated capacity is however still insufficient to deliver a platform upon which many African countries can realise their economic potential through the increased utilisation of electricity.

Table 2.2: Net installed capacity of electric power plants in selected African countries (kWh)

Year	Angola	CAR	Cote d'Ivoire	DRC	Gabon	Ghana	Kenya	Nigeria	South Africa	Togo	Uganda
1990	462	43	1182	2831	365	1187	723	5958	26392	34	159
1991	462	43	1187	2831	365	1187	829	5959	26392	34	169
1992	462	43	1187	3134	356	1187	805	5881	26392	34	169
1993	462	43	1187	3194	363	1187	805	5881	26382	34	177
1994	462	43	1187	3194	362	1187	808	5881	35528	34	180
1995	462	43	1190	3197	368	1187	793	5881	35528	35	186
1996	462	43	1190	3197	377	1187	793	5881	36563	35	189
1997	460	43	1190	3197	388	1187	867	5881	37175	55	189
1998	460	43	1192	2548	392	1164	867	5881	37848	55	189
1999	500	43	1208	2548	402	1202	942	5881	38517	48	191
2000	500	43	1268	2473	410	1202	1054	5881	39186	48	266
2001	500	43	1308	2473	410	1364	1148	5881	39221	48	266
2002	500	43	1366	2548	415	1529	1156	5881	39237	48	266
2003	500	43	1407	2568	419	1582	1207	5881	40037	48	312
2004	624	43	1448	2443	419	1730	1319	5881	41904	58	312
2005	830.6	41	1469	2443	420	1730	1380	5881	42011	68	448
2006	843.2	41	1499	2444	420	1730	1392	5881	42511	78	506
2007	1155	41	1510	2444	415	1935	1216	5881	42727	84	511
2008	1155	41	1516	2476	366	1981	1621	5881	43061	85	539
2009	1155	41	1516	2476	415	1970	1600	5881	43061	85	502

Source: World Bank Global Development Indicators, 2012

*CAR is Central African Republic and DRC is the Democratic Republic of Congo

The adoption of RETs can through the preservation of the environment contribute to reduction of poverty. This is especially true for poor rural populations whose main occupation is farming in areas volatile to climate change like Tanzania. Changes in the environment can lead to shortages in agricultural produce and consequently result in food security challenges (UNDP 2010). Ahmed et al (2011) explain that efforts like the use of solar systems to power irrigation can help prevent extreme volatility in climate conditions

which may lower production of crops. Unfavorable climate conditions may result in food scarcity and a situation whereby the already poor have to spend two-thirds of their income on food – a situation which would plunge the economically challenged further into poverty.

Grimsby (2011) suggests that energy equity should be the focus of all energy development activities if mass poverty reduction is to become a reality. In order to achieve the goal of energy equity, the author advocates for the implementation of policy to establish a 'ceiling' on energy use and the widespread adoption of RETs.

Additionally, Ahmed et al (2011) and Grimsby (2011) propose that policies to alleviate the challenge of equitable access to modern energy aimed at achieving energy security should be widened from the current national state to being globally regulated. In their argument however, the authors do not address the vivid issue of the impact of population and growing economies on energy use. It is estimated that Africa would contribute greatly to the global population in the next few decades and the increase in population would require increased energy use (UNDP 2011; AfDB 2010). This lends reason to the fact that energy equity may be better addressed at national level, considering the specific economic development objectives countries may have. Poverty reduction through increased energy access is a priority for many African countries, and individual countries have unique challenges in relation to security of energy provision.

2.4.3 RET Adoption and Energy Security

The broad concept of energy security relates to the development of reliable supplies of energy at reasonable prices to support economic and industrial growth. Balat (2010) suggests that the security of energy supply is a strategy to reduce hedge risks that are founded in the use, production and import of energy. With increasing awareness of the impact of fossil fuels on the environment, the concept of energy security was expanded to include a new paradigm focused on efforts to protect the environment. Scholars suggest that practicing this concept can contribute to mitigate the possible effects of climate change, while developing and using energy sources to fuel economic activity for growth (Nuttal and Manz 2008; Vivoda 2010).

Xia et al (2011) suggest that the key to achieving energy security is for countries to diversify the energy mix, taking into consideration the social, economic and environmental impacts of choosing energy sources. The authors suggest that this would inform decisions on the technologies to be supported as well as the degree of support chosen technologies should

receive. Brathwaite et al (2010) suggest that the key to energy security for the United States (US) is to transform from an oil-dependent economy to a coal-based economy driven by coal-to-liquid fuels. The suggestion is based on the fact that coal is stable in price, and that the US has vast, abundant reserves of coal, so coal would therefore be important in reducing the country's dependence on oil, thereby advancing efforts towards energy security.

An assessment of the proposal put forward by Brathwaite et al (2010) shows that the analysis of benefits of a coal-based economy is incomplete. In their study, the authors focused only on the use of coal in the transportation sector; also coal like petroleum is a natural resource from the earth and is finite in supply. Sovacool et al (2011 a) suggest that a coal-based economy in which production of energy for economic activity is essentially derived from coal is not sustainable and would fail to meet the energy security needs of a country. Also, with specific reference to environmental conservation and protection of the ecosystems, the benefits of using RETs outweigh potential benefits of developing a coal-based economy.

Von Hippel et al (2010) explain that the emerging paradigm towards comprehensive energy security is based on consideration for the environment and the understanding of technology risks in the application of new technologies to increase energy supply. The authors assert that RETs can help manage increasing energy demand while addressing sustainable development issues like human poverty, the wastage of human potential and impoverishment of the environment. Umbach (2010) suggests that in efforts to ensure security of energy supply, the energy dialogue should be focused on improving economic competitiveness and environmental sustainability through the use of RETs.

Cherp (2012) suggests that a diversified energy mix is critical to achieving energy security. Cherp and Jewell (2011) developed a methodological framework for analysing enhanced energy security based on a measure of sovereignty, robustness and resilience of a country. However, the framework put forward by the Cherp and Jewell (2011) can be classified as incomplete as it falls short of considering the use of RETs as a viable option for increasing energy security. Bollen et al (2010), Lacher and Kumetat (2011), Asif and Muneer (2007) and Sebitosi (2008) highlight the importance of RETs in mitigating climate change and ensuring energy security.

Energy security is important for the protection of an economy against disruption of energy service supplies, which can impact economic activity by causing production to be lowered, retarding economic development for countries (Winzer 2012). RE can contribute to the

provision of long-term security in energy supply for developed and developing countries. This can be achieved while working to mitigate climate change and increasing energy access through a mix of decentralised RETs (Hinriches-Rahlwes 2013; Pode 2010). While Bazilian et al (2011 b) suggest that synergies exist between energy security and climate change, the potential for differing objectives also exists. In most cases, the desire for increased energy supply using resources that are locally abundant commonly overshadows climate change considerations.

Valentine (2011) explains that in the light of the emerging paradigm of enhanced energy security, a symbiotic relationship exists between RE and energy security. Therefore, the use of RETs eliminates the tradeoffs that may have existed between energy security and the abatement of GHGs. Table 2.3 shows the energy situation of selected African countries – Gross Domestic Product (GDP), alternative energy and the use of combustible renewable fuels.

Table 2.3: Percentage of energy use to GDP, alternative energy and combustible renewables for selected African countries (2009)

Country	**GDP per unit of energy use ($ per kg oil equivalent)**	**Alternative and nuclear energy (% of total energy)**	**Combustible renewables and waste (% of total energy)**
Angola	8.0	2.3	60.1
Benin	3.5	0.0	57.4
Botswana	11.4	0.0	23.6
Cameroon	5.6	..	..
Congo	0.8	2.9	93.7
DRC	10.1	2.0	51.1
Cote d'Ivoire	3.2	1.8	75.2
Eritrea	3.5	0.0	77.4
Ethiopia	2.2	1.0	92.0
Gabon	10.7	4.2	61.8
Ghana	..	6.4	69.8
Kenya	3.0	7.2	76.0
Mozambique	1.8	14.9	81.8
Namibia	7.3	7.2	..
Nigeria	2.9	0.4	84.9
Senegal	..	0.7	41.1
South Africa	3.2	2.4	9.8
Sudan	..	1.8	68.0
Togo	2.7	1.2	..
Tanzania	2.0	0.3	87.7
Zambia	2.1	11.2	80.9
Zimbabwe	..	..	65.6

Source: World Bank Global Development Indicators, 2011

Table 2.4 shows the amount of electric energy consumption for some African countries. As previously established, the data supports the concept of increasing demand for modern energy to meet economic development needs. However, the rate of electric power capacity installment is unable to satisfy the growing demand due to persisting challenges like the high costs of connection to the grid and high electricity prices which may be unaffordable for the poor. The use of RETs can provide opportunities for increasing energy access based on the capacity to provide decentralised energy to communities lacking modern electric energy.

Table 2.4: Electric power consumption of selected African countries between 1993 and 2009 (kWh per capita)

Country	**Year**																
	1993	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Angola	59.7	58.2	56.7	59.1	80.5	85.7	84.4	88.6	97.3	101.2	112.6	102.8	128.8	171.4	158.9	194.8	202.1
Benin	40.8	41.1	43.7	46.5	50.2	47.1	54.6	61.2	64.7	71.7	67.8	73.6	77.1	77.8	82.7	89.5	91.2
Botswana	856.5	893.0	867.1	891.7	954.5	1019.1	999.8	905.6	1133.6	1245.5	1315.7	1363.7	1421.3	1508.7	1533.0	1567.9	1503.3
Cameroon	185.6	162.8	156.1	161.9	171.9	169.5	174.9	173.4	164.0	154.5	167.3	193.4	188.3	249.4	255.3	270.5	271.2
Congo	96.9	95.6	102.7	98.9	90.1	88.4	90.6	91.6	90.7	85.2	85.7	83.9	85.3	97.4	101.2	97.8	103.8
DRC	158.7	142.9	150.0	153.0	127.9	109.9	69.0	95.3	104.8	116.1	116.1	107.3	120.2	129.8	130.2	141.5	146.3
Cote d'Ivoire	138.4	141.1	170.6	157.0	168.0	183.5	173.5	172.6	181.7	177.1	175.8	176.0	175.0	185.9	192.3	202.0	203.4
Eritrea	40.2	44.2	46.0	51.7	55.4	47.5	49.7	46.8	50.8	54.3	56.2	54.4	53.9	49.9	51.0	48.9	51.0
Ethiopia	23.2	23.6	24.0	24.5	24.0	23.9	23.1	22.9	26.9	26.6	29.1	31.5	34.4	38.7	41.3	43.0	45.7
Gabon	872.4	767.2	769.7	845.0	851.6	912.6	897.3	875.1	900.9	936.8	942.7	936.6	933.8	972.6	1002.3	1041.1	922.4
Ghana	336.0	336.2	349.8	362.4	387.9	275.4	342.6	330.3	336.5	311.3	225.3	220.2	246.6	298.2	247.1	266.7	265.1
Kenya	128.5	129.6	130.8	133.1	130.8	131.6	122.2	109.7	119.6	122.0	127.6	134.9	137.1	145.3	149.0	148.7	147.4
Mozambique	49.0	42.9	44.8	44.5	52.9	47.7	67.3	122.2	270.3	259.7	367.0	441.4	445.0	454.4	473.1	462.4	453.3
Namibia	1074.4	947.71	939.8	1011.7	960.1	1043.5	1102.0	1179.4	1214.6	1055.0	1091.9	1356.6	1415.8	1492.9	1490.9	1739.6	1576.2
Nigeria	98.7	93.6	89.7	84.4	80.7	75.8	74.8	73.6	74.7	103.6	101.0	122.6	128.4	111.1	138.3	126.9	120.5
Senegal	108.5	114.3	113.5	114.1	121.7	126.3	122.1	105.7	128.0	151.1	130.5	143.3	163.4	162.5	187.4	163.9	196.0
South Africa	4251.8	4330.7	4433.5	4521.7	4585	4455.4	4394.0	4416.5	4365.4	4527.3	4619.3	4651.6	4703.9	4796.9	4938.4	4759.4	4532.0
Sudan	44.3	45.7	45.1	45.6	42.8	41.5	61.5	63.4	53.3	62.7	66.4	67.1	79.3	88.4	95.6	104.0	114.2
Tanzania	51.9	49.3	56.9	61.5	56.6	60.4	56.1	58.1	60.2	62.7	55.2	63.6	69.6	69.4	82.0	84.3	85.6
Togo	72.3	80.8	104.2	107.6	108.9	109.5	116.3	97.8	101.7	98.9	106.1	111.0	113.5	113.0	107.2	110.4	110.8
Zambia	756.1	746.3	724.5	698.8	650.4	593.6	597.1	610.1	633.0	660.7	682.6	706.9	716.6	745.7	689.1	614.0	635.0
Zimbabwe	727.2	763.4	803.7	841.7	869.0	839.5	883.3	852.7	826.8	832.8	835.6	816.4	994.6	997.7	1019.6	1023.1	1026.2

Source: World Bank African Development Indicators, 2012

2.4.4 RE Development and Sustainable Employment

The deployment of RETs towards the developing a green economy can among other benefits, stimulate an increase in employment, thereby fostering the objective for sustainable economic development (Del Rio and Burguillo 2008; Wei et al 2010). The installation, operation and management of RETs require human effort and engagement of varying proportions of skilled and unskilled labor which may result in an increase in economic activity (Wei et al 2010). An analysis of the contribution of RE to employment in Greece showed that by 2011, RE had contributed 12% to the power sector. RE is projected to contribute approximately 40% to the energy mix of the country by 2020, and this would have a significant impact on employment levels (EC 2009).

An increase in employment levels holds significant economic benefits for any country. Tourkolias and Misragedis (2011) suggest that in contributing to economic development, the transition towards a green economy can also contribute to direct, indirect and induced employment. This occurs through strategies to ensure the widespread deployment of RETs across many industrial sectors, thereby acting as a vital stimulus for sustainable development.

Studies show that the increased use of RETs has the potential to provide economic benefits through the creation of employment opportunities while protecting economies from an over reliance on fossil fuels which are harmful to the environment and finite in supply. The installation of decentralised RETs uses localised human labor, ultimately creating employment opportunities for local inhabitants. This can greatly reduce the cost of installing technologies (Wei et al 2010). However, as Tourkolias and Misragedis (2011) suggest, the installation of RETs requires a minimum level of skill acceptable. In their analysis, however, Wei et al (2010) do not address the financial impact of training local inhabitants to take up opportunities the installation of RETs provides.

The training of local inhabitants carries a cost, and this ultimately brings about an increase in the cost of installation of RETs. In view of this however, the sustained benefits of deploying RETs greatly outweigh the cost of installation. The deployment of RETs can provide an increase in employment opportunities in developing countries (Vaghefpour and Zabeh 2012). Incremental penetration of local economies through widespread deployment of RETs positions the development of RE as a realistic sustainable path to economic development (Karakosta et al 2012). Lehr et al (2012) suggest that additional investment in RE would induce economic activity and increase employment. Furthermore, the authors propose that net

and gross employment of RE expansion in Germany would reach 150,000 and 600,000 by 2030.

Frondel et al (2010) however argue that the projected 400,000 employment opportunities that would be created in Germany by 2020 as suggested by some scholars, is unrealistic. The authors argue that the projections obscure broader implications for economic welfare by not accounting for the impact of new employment opportunities created. Based on studies conducted by Frondel et al (2010) and Alvarez et al (2009), Lesser (2010) suggests that the cost per RE employment opportunity created in Germany was estimated to be $225,000 and that for every employment opportunity created through the development of RE in Spain, two non-RE related employment opportunities were lost. The author also argues that when the total economic impact is taken into consideration, the cost of RE employment opportunities outweigh the overall benefits of developing a RE-based economy. Notably, in reaching this conclusion, Lesser (2010) does not take into account the impact of the environmental cost of the continued use of fossil fuels.

It is argued that an increase in the development of RE would bring about loss of employment opportunities in the fossil fuels industry. Scholars in support of this view suggest an increase in demand for RETs would result in a decrease in demand and consequently, production of fossil fuels (Frondel et al 2010). However Mathiesen et al (2011) and Moreno and Lopez (2008) suggest that based on an increase in investment, the further deployment of RETs would bring about an increase in employment opportunities. This, according to the authors would compensate for the loss of employment due to reduced demand for energy from fossil fuels. Lambert and Silva (2012) noted the challenge of determining the employment effect of RET adoption. The authors propose that in measuring the overall contribution of RE to employment, among other factors, labor intensity, cost increases for projects and availability of investments as well as necessary skills should be taken into consideration.

2.4.5 RETs and Increased Energy Efficiency

Energy efficiency broadly refers to the moderation of use of energy to carry out economic activities as the ratio between the quantity of primary energy consumed and the maximum quantity of energy that can be obtained. Ensuring energy efficiency is inextricably linked to the choice and adoption of specific technologies that reduce overall energy consumption through the minimum use of energy, while satisfying relevant energy needs (Oikonomou 2009). Due to a range of socio-economic challenges which include scarcity of energy supply,

perceptions of resource scarcity, environmental protection and high energy prices, energy efficiency has become an increasingly important policy objective for many developed and developing countries (Andrews-Speed 2009; Jackson 2010). However, mostly due to behavioral patterns stemming from an over reliance on fossil fuels, achieving high levels of energy efficiency has been extremely difficult to attain (Croucher 2011; Martinot 1998).

Sovacool (2009) suggests that policy objectives for increasing energy efficiency should focus on eliminating subsidies for mature conventional energy-generating technologies. Also, pricing energy accurately and promoting RETs through the establishment of a feed-in tariff would help to ensure an increase in energy efficiency. Dixon et al (2010) and Sebitosi (2008) explain that the implementation of policy to support the deployment of RETs is important in addressing the issue of energy efficiency. The authors base their argument on the fact that decentralised RETs mitigate power losses which are typical of conventional fossil fuel-based energy-generating technologies.

According to Cappers and Goldman (2010), expanding energy efficiency through the promotion of RETs is a cost effective strategic approach to foster energy independence. Essentially, the demands of sustainable development can be met while reducing dependence on energy imports and promoting energy security. Mancisidor et al (2010) suggest that the deployment of RETs would provide increased sustainable benefits for economic development when deployment objectives are based on reaching the goal of ensuring energy efficiency.

2.5 Climate Change Mitigation and Sustainable Energy Production

Climate change presents a truly global challenge; its impacts include global warming through the emission of environmentally hazardous GHGs and forced migration of displaced populations due to rising tidal levels. There is consensus among industry experts and academic scholars that these impacts may result in an increase in poverty levels for communities. As a result of increasing atmospheric temperature, drought and decrease in agricultural produce may pose challenges for communities dependent on agriculture (Poortinga et al 2011). Based on the unavailability of resources to adapt to climate change, environmental economists believe that the African continent would be most impacted by climate change.

This conclusion stems from the continent's weak adaptive capacity, geographical exposure and reliance on climate-sensitive sectors. In the case of agricultural production which in

Africa is mostly rain-fed and represents an important economic sector on the continent, Africa would be greatly challenged by climate change. (Heltberg et al 2009; Roudier et al 2011). Changes in the environment may bring about market distortions, affecting the overall availability of affordable food and impacting negatively on efforts to increase economic development. DeWitt (2008) proposes that in tending towards sustainable development, mitigating climate change is critical and should be treated not only as an environmental challenge but also as a challenge for economic development.

Energy as a critical input for economic development is essential for modern human activities. Economic development is made possible through the process of production which thrives on adequate supply of energy. (Halsnaes and Garg 2011) explain that an increase in supply and access to modern energy linked to economic activities creates increased economic interactions which in turn spur economic development. Energy enhances the productivity of other production factors which makes it critical to increasing economic development. However, in the current development of energy systems which drive and support economic activities, most energy production processes from which modern energy is derived are known to be harmful to the environment and hence, unsustainable (IEA 2011).

Synergies exist between increasing energy security and climate change mitigation (Halsnaes and Markandya 2011). However, using an example of the Medupi coal plant developed in South Africa, Bazilian et al (2011 b) suggest that especially in developing African countries, the two policies have conflicting objectives arising from imperatives to increase energy access. This is due to the fact that economic development is the main objective for developing African countries (Halsnaes and Garg 2011). As much as energy is needed, consideration for the environment is necessary. Hence, energy production activities intended to bring about development should be executed in ways that are sustainable.

2.5.1 Adoption of RETs for Climate Change Mitigation

Mitigating climate change is increasingly seen as an important global challenge that requires the engagement of different strategies to preserve and protect the environment (Aitken et al 2011; IPCC 2012). According to the IEA (2011) by 2030, energy consumption is expected to increase by 53% and energy-related emissions by 55%. Production of conventional energy from fossil fuels is popularly regarded as the main cause of GHG emissions. O'Neill and Hulme (2009) explain that one-third of the carbon emissions in the United Kingdom (UK) are from personal and domestic activities. The authors argue that changes in individual lifestyle

decisions can contribute to climate change mitigation. Furthermore, the authors explain that cognitive, psychological and social barriers prevent people from practicing "lifestyle decarbonisation"[5] and then evolving to the level of "carbon capability".[6]

These authors argue that practicing these concepts results in the mitigation of climate change through reducing personal and domestic emissions. In their analysis however, the authors do not offer theoretical approaches to undertaking lifestyle decarbonisation and carbon capability. Yadoo and Cruickshank (2012) suggest that the increased domestic use of RETs can contribute to climate change mitigation by decreasing demand for conventional energy from fossil fuels. This, the authors suggest, can have significant impacts overall on energy production.

The adoption of RETs provides an opportunity for climate change mitigation. RETs are low carbon technologies that emit little or no GHGs. Thus, energy production using RETs is seen as a systematic strategy for sustainable development (Karakosta and Askounis 2010; IPCC 2012). Beg et al (2002) explain that especially for developing African countries, synergies exist between climate change policies and the development of RE. They suggest that locally instituted energy access policies can influence adoption of RETs to mitigate GHGs.

Yuskel (2010) suggests that the mutually reinforcing synergy between the deployment of RETs and establishing policies for climate change mitigation can provide developing African countries with options to progress on sustainable development paths. Karakosta et al (2010) suggest that the key challenge for climate change mitigation is the adoption of affordable low carbon RETs in order to avoid lock-in into older conventional technologies. According to Kotcioglu (2011), conventional technologies cannot sustain the current rapid development processes in developing African countries; consequently they do not provide options for sustainable futures. Table 2.5 shows the historical and projected impact of climate change in the form of increased temperatures for African countries.

[5] Lifestyle decarbonisation refers to the willingness of citizens within a country to change things they do regularly that contribute to increasing carbon emissions and adopt more responsible habits to lower personal and domestic emissions.

[6] Carbon capability is the term given to the phenomenon wherein people have progressed from irresponsible behavior that yields volumes of carbon into the atmosphere to consciously making efforts to lower their emission levels. It is essentially the operationalisation of lifestyle decarbonisation.

Table 2.5: Impact of climate change on temperatures of selected African countries

Country	Tmean (H)	Tmin (H)	Tmax (H)	Tmin (P)	Tmax (P)
Angola	21.5	14.8	28.3	2.09	2.69
Botswana	21.5	13.6	29.4	2.45	3.28
Cote d'Ivoire	26.4	21.1	31.6	1.80	2.39
Cameroon	24.6	19.1	30.1	2.07	2.39
Ethiopia	22.2	15.5	28.9	2.11	2.52
Gabon	25	20.9	29.2	1.81	2.23
Ghana	27.2	22.1	32.3	1.84	2.41
Guinea	27.2	22.1	32.3	2.02	2.57
Kenya	24.7	18.9	30.6	1.94	2.15
Mali	28.2	20.9	35.6	2.50	3.10
Mozambique	23.8	18.5	29.1	1.88	2.41
Niger	27.1	19.4	34.9	2.35	2.79
Nigeria	26.8	20.8	32.8	2.02	2.49
Senegal	27.9	20.8	34.9	2.04	2.67
South Africa	17.8	10.6	24.9	1.94	2.74
Togo	27.1	21.8	32.5	1.90	2.46
Tanzania	22.3	16.7	28	1.93	2.21
Uganda	22.8	16.6	29	2.06	2.29
Zambia	21.4	14.5	28.3	2.14	2.71
Zimbabwe	21	14.2	27.8	2.20	2.89

Source: World Bank Climate Data, 2011

*(H) is annual average historical data between 1961 and 2000 and (P) is projected annual averages from 2045 to 2065

Governments of developing African countries are focused on increasing access to energy for economic development while making efforts to diversify the energy mix to ensure security of supply. In executing efforts to increase development, environmental issues may not be considered. Since the priority for African countries is development, much attention may not be given to the overarching environmental impacts of development. Kaygusuz (2012) suggests that the vast deployment of RETs can help alleviate the challenge of energy access and security. The author also suggests that the deployment of RETs would help to promote environmental sustainability.

Zidansek et al (2012) suggest that climate change impacts can be reduced significantly by decreasing the burning of fossil fuels, as well as reducing overall reliance on conventional energy. Furthermore, Kaygusuz (2012) and Zidansek et al (2012) propose the widespread use of biofuels as a viable option for energy production. However, an analysis of this proposal shows that at optimum levels, the widespread use of biofuels may neither be feasible nor sustainable for developing African countries. This is based on issues relating to food security and logistics of transporting biofuel inputs, especially in rural areas.

Brazil has thrived on the production of ethanol from corn and cane sugar as biofuels. The country however faces the dilemma of exploiting opportunities for economic development through the production of clean energy and securing food sources. According to Finco and Doppler (2010), Brazil faces the challenge of food security based on the effect of the use of crops on local food production; problems for biodiversity linked to the cutting down of native forests and the appropriate allocation and use of land this purpose. Furthermore, the authors explain that the energy required to operate biofuel plants is currently higher than the energy derived from the production process. Thus, in its current state, widespread production of biofuels may not be a viable source of energy production for developing African countries.

There is growing consensus to reduce the emission of GHGs, and a target for global emission reduction by 50% by 2050 has been set (Carvalho 2012). Yuskel (2012) suggests that a new technological, institutional and financial framework supporting the development of a RE economy is needed to mitigate climate change. The use of low-carbon RETs currently provides the most effective and efficient measures for alleviating dependence on energy derived from fossil fuels. This contributes immensely the transitional process onto sustainable development paths (Yuskel 2012).

Meaningful reduction of GHGs would require significant investment in the development of an economy driven by energy produced from renewable sources. Oyedepo (2012) and Shafiulla et al (2012) explain that the use of RETs can address the conflicting issues of increasing access to energy for economic development and climate change. The authors highlight the benefits of using RETs along with barriers to RET adoption. However, the authors do not mention the challenge of financing and innovation in policy establishment as barriers to the adoption of RETs. Addressing these issues creates a conceptual link between the adoption of RETs for economic development and climate change mitigation based on mutual benefits that may be derived.

Pegels (2010) suggests that transforming economies to RE-driven systems provides an enormous challenge as most countries are heavily reliant on fossil fuels for energy production. South Africa has the world's sixth largest coal reserves, hence, is able to provide cheap electricity to drive economic activity. However, the consequences for the environment are evident as in 2005 the country was responsible for 1.1% of global carbon emission which equaled 40% of the emissions in Sub-Saharan Africa. Pegels (2010) suggests that a shift in energy production would not be due to the lack of coal but rather based on total consideration

for the environment. Yadoo and Cruickshank (2012) suggest that in order to achieve the goals of sustainable development, the current trajectory of energy production and usage has to be reversed. Panwar et al (2011), advocate for the substitution of conventional technologies and adoption of RETs to impact development in a sustainable manner.

Legget and Ball (2012) and (Keles and Bilgen 2012) explain that climate change presents a risk to civilization, obscuring the development of sustainable paths. Schaffer et al (2012) suggest that the rate of deployment of RETs by countries provides an indication of the level of readiness to substitute fossil fuels with RETs, in efforts towards sustainable development. Bazilian et al (2010) suggest a paradigm shift in which climate change policy would be addressed explicitly as a subset of energy policy. The authors also propose a change in focus of climate change strategies in which the wider objective of establishing a low-carbon economy prevails over emissions of GHGs. As Fig.2.2 shows the global emission of CO_2 is constantly increasing.

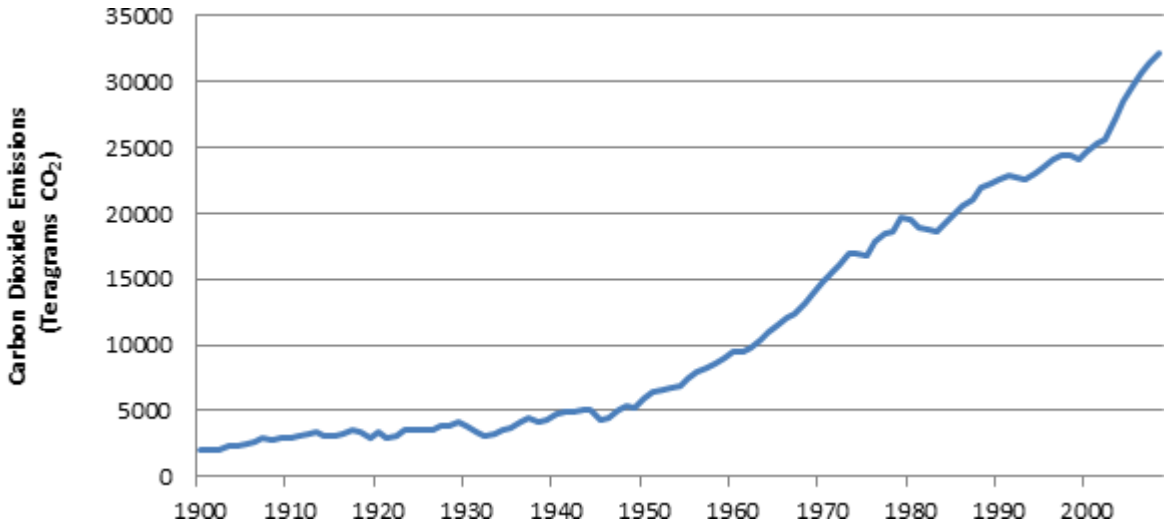


Fig 2.2: Global carbon dioxide (CO_2) from fossil fuels (1990 – 2008)

Source: United States Department of Energy, 2008

Table 2.6 shows the emission of CO_2 from selected sectors in African countries which overall is low. However, increased economic activities using energy derived from fossil fuels may trigger higher volumes of GHG emissions, effectively obscuring the path to sustainable development for African countries.

Table 2.6: Per capita emissions of CO_2 by sector for selected African countries (2010)

Country	Total CO_2 emissions from fuel combustion	Electricity and heat production	Other energy industry own use	Manufacturing industries and construction	Transport total	Road transport	Other sectors	Residential
Angola	871	121	14	139	393	355	203	67
Benin	509	12	..	16	354	354	126	126
Botswana	2 293	573	..	617	1 001	980	102	39
Cameroon	257	62	22	18	136	129	18	18
Congo	411	20	..	13	351	340	27	27
DRC	46	..	..	16	11	11	19	5
Côte d'Ivoire	294	135	10	25	65	53	59	20
Ethiopia	94	38	..	4	26	26	25	9
Gabon	65	..	..	16	32	32	16	9
Ghana	1 761	470	22	681	397	397	192	92
Kenya	389	89	4	57	201	185	37	22
Morocco	269	51	6	58	116	110	38	24
Mozambique	107	..	..	19	72	66	15	5
Namibia	1 458	128	..	120	772	726	437	..
Nigeria	290	67	37	24	120	98	43	11
Senegal	440	152	3	78	162	154	45	31
South Africa	6 938	4 757	45	990	764	710	382	181
Sudan	314	62	11	53	155	154	33	18
Tanzania	133	33	..	20	68	68	13	12
Togo	195	4	..	14	152	152	24	24
Zambia	150	2	4	60	50	34	33	..
Zimbabwe	722	425	4	91	94	87	108	7

Source: International Energy Association Online Climate Database, 2012

Even though African countries are mostly reliant on traditional sources of energy to drive their economies, the level of GHG emission on the continent, though increasing, is considerably low. This can be attributed to lower levels of economic activities in industries responsible for GHG emissions. This provides Africa the opportunity to grow sustainably, using RETs to increase energy access and impact overall development. Table 2.7 shows the CO_2 emissions from fuel combustion which in comparison to developed countries is low.

Table 2.7: CO_2 emissions from fuel combustion between 1992 and 2010 for selected African countries

Country	Year																		
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Angola	4.0	4.3	4.2	4.0	4.2	4.4	4.0	4.9	5.1	5.6	6.1	7.7	9.1	7.2	9.1	10.6	12.8	14.1	16.6
Benin	0.2	0.2	0.2	0.2	0.9	1.1	1.2	1.3	1.4	1.7	2.0	2.3	2.4	2.7	3.2	3.7	3.8	4.2	4.5
Botswana	3.4	3.4	3.2	3.3	3.0	3.2	3.9	3.9	4.2	3.9	4.0	3.9	4.1	4.4	4.4	4.4	4.5	4.3	4.6
Cameroon	2.3	2.4	2.6	2.5	2.4	2.6	2.7	2.4	2.8	2.7	2.9	3.0	3.0	2.9	3.1	4.1	4.3	4.8	5.0
Congo	0.6	0.6	0.5	0.5	0.4	0.3	0.3	0.3	0.5	0.6	0.5	0.7	0.8	0.8	1.0	1.1	1.3	1.5	1.7
DRC	2.3	2.2	2.0	2.1	2.0	2.0	2.1	2.1	1.7	1.5	1.6	1.8	1.9	2.3	2.4	2.6	2.8	2.9	3.1
Côte d'Ivoire	2.7	2.9	3.0	3.2	3.8	4.7	4.7	6.5	6.1	6.1	6.2	5.1	5.5	5.8	5.8	5.7	6.5	6.1	5.8
Ethiopia	1.5	1.9	2.1	2.4	2.6	2.8	2.9	2.9	3.2	4.0	4.2	4.6	4.8	4.5	4.7	5.3	5.7	5.7	5.4
Gabon	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.5	1.4	1.6	1.7	1.8	1.8	2.1	2.0	2.4	2.3	2.5	2.7
Ghana	2.8	2.8	3.0	3.3	3.6	3.7	5.5	5.9	5.1	5.5	6.8	6.3	5.9	6.4	7.8	8.2	7.4	9.1	9.5
Kenya	5.4	5.3	5.3	5.6	6.0	5.9	6.0	6.3	6.8	6.5	6.2	5.6	6.3	7.2	8.2	8.3	8.6	10.2	10.9
Morocco	22.1	22.8	24.9	26.0	25.6	26.8	27.4	29.0	29.4	32.0	33.1	33.0	36.6	40.1	40.5	42.1	43.5	42.7	46.0
Mozambique	1.1	1.3	1.1	1.1	1.1	1.2	1.2	1.1	1.3	1.3	1.4	1.7	1.7	1.5	1.6	2.1	2.0	2.2	2.5
Namibia	1.2	1.4	1.6	1.7	1.9	1.9	2.0	1.8	1.8	2.2	1.9	2.0	2.1	2.5	2.5	2.5	3.6	3.3	3.3
Nigeria	40.8	37.3	31.5	31.1	34.3	39.0	34.0	37.1	42.0	48.3	50.4	48.0	48.6	55.2	50.3	47.2	49.6	42.3	45.9
Senegal	2.3	2.3	2.3	2.5	2.6	2.9	3.2	3.5	3.6	4.0	4.0	3.8	4.5	4.7	4.4	5.0	5.1	5.3	5.5
South Africa	245.4	252.0	257.6	274.5	284.8	299.1	306.3	289.5	296.7	282.4	293.4	319.4	336.1	329.2	329.7	355.2	387.1	368.8	346.8
Sudan	4.6	3.3	4.8	4.6	4.4	5.3	4.9	5.3	5.5	6.3	7.8	8.6	9.3	9.2	11.0	12.0	12.4	13.5	13.7
Tanzania	1.7	1.7	1.8	2.5	2.8	2.6	2.4	2.2	2.6	2.8	3.2	3.3	3.8	5.1	5.6	5.5	5.8	5.6	6.0
Togo	0.4	0.3	0.6	0.6	0.9	0.7	0.8	1.1	1.0	0.8	0.9	1.1	1.0	1.0	0.9	0.9	1.1	1.1	1.2
Zambia	2.7	2.4	2.1	2.0	1.7	2.2	2.1	1.7	1.7	1.8	1.9	2.0	1.9	2.1	2.0	1.4	1.6	1.7	1.9
Zimbabwe	17.8	16.4	15.3	14.8	14.2	13.2	13.4	15.2	12.7	12.2	11.7	10.5	9.7	10.4	9.9	9.9	7.9	8.4	9.1

Source: International Energy Association Online Climate Database, 2012

2.5.2 Policies for Climate Change Mitigation and RE Development

The impact of climate change is predicted to alter living conditions and human existence significantly. Thus, the need for the establishment of efficient and effective policies for the mitigation of climate change is pertinent (IPCC 2012). Larsen et al (2012) suggest that neither mitigation nor adaptation strategies alone can bring about the total avoidance of climate change. The authors suggest that in efforts to reduce the impact of climate change, mitigation and adaptation strategies should be engaged complimentarily.[7] This research however, is focused on the adoption of mitigation strategies to reduce emission of GHGs.

The Intergovernmental Panel on Climate Change (IPCC 2012) suggests that in developing climate change mitigation policies, synergies between environmental and key national socio-economic objectives should be exploited. Antonio and Oliveira (2009) explain that the linking of climate change policies to other development policies should be an important consideration for governments. Lutsey and Sperling (2008) suggest that local governments should be handed greater autonomy in developing climate change policies as they are more innovative and responsive to local economic and environmental circumstances.

At local government level, climate change mitigation policies may include vehicle GHG standards, fuel standards, efficiency standards and renewable energy portfolio standards (RPS) (Bureau 2011). Bart (2010) suggests that in developing cities through road expansion, governments encourage increased emission of GHGs as more automobiles would ply roads. For this reason, the author proposes that governments should establish policies to regulate the use of automobiles. The author however fails to acknowledge that road expansion is an attribute of economic development which may be linked to an increase in overall economic activity. Keles and Bilgen (2012) explain that the development of a broader policy to support research and development of renewable electricity-powered technologies is essential to build synergies between economic development and the reduction of GHGs.

Differing individual attitudes by governments impacts overall agenda for establishing climate change policies. Tjemstron and Tietenberg (2008) and Rusche (2010) draw parallel analysis comparing obligation to protect the environment through the establishment of climate change

[7] Mitigation strategies are policies and actions taken by governments, businesses and society at large to counteract the impacts of climate change and global warming, while adaptation refers to the policies and actions mainly taken by governments and civil society to adjust to the consequent effects of climate change and global warming. The two strategies have different approaches but are widely regarded as complimentary in efforts to achieve sustainable development.

policies in the European Union (EU) and US. The authors find that the decision of individual regions to develop policies to reduce global GHG emission is driven by economic interests linked to industrialisation derived from the burning of fossil fuels. Tubi et al (2012) suggest that attempts to explain differences in commitment to develop and foster climate change policies have been largely unsuccessful.

The authors also suggest that the issue is compounded by the perception that the negative effects of climate change are futuristic and not urgent. The authors conclude that establishing mitigation policies would require substantial changes in behavioral patterns that would affect the dynamics of a functional economy directly. Parthan (2010) suggests that the development of emissions trading schemes using base and cap models and carbon taxes as policies among countries, represents the significance of climate change mitigation.

Leung et al (2009) explain that emission trading is a market-based system that provides flexibility of choice in meeting emissions targets in a cost-effective manner. The merits and demerits of an emissions trading system (ETS) inextricably linked to the design and potential impact has been the focus of several scholarly debates. Rosendahl (2008) suggests that auctioning or distributing emission allowances in a lump-sum manner while operating a closed system based on a review of current emission allocation can make an ETS more cost effective. The author suggests that this can create some level of certainty for participating economic sectors. Sandoff and Schaad (2009) suggest that the inherent freedom and flexibility of the ETS forces institutions make informed decisions in balancing investment in GHG abatement and the trading of allowances.

According to Bohringer and Rosendahl (2008), the decentralised structure of the EU ETS among different countries and sectors opens up space for policy innovations. In contrast, Hoffman et al (2008) explain that that the level of flexibility experienced with current ETS models has brought increasing uncertainty based on the lack of knowledge of policy direction. The authors argue that this creates obstacles in the development of long-term strategies.

In establishing an ETS, an understanding of the impact of tradeoffs between objectives for global environmental effectiveness, promotion of dynamic economic efficiency and overall equity should form the foundation of developing the system (Lennox and Van Nieuwkoop 2010). Anger (2008) suggests that an international ETS within which an established joint trading system is operated represents the optimal future of climate change policy. In relation

to the development of an international ETS, Silva and Xhu (2009) highlight the complexity of a local ETS and the impact on industry dynamics. The authors also explain that countries that refuse to ratify the Kyoto Protocol may benefit from a greatly developed international ETS. This is based on the fact that the environment would be considered much safer to live in.

Massetti and Taveni (2012) suggest that climate stabilisation through the implementation of an international ETS should be preceded by the development of regional institutions and emission reduction policies. The authors explain that an international ETS would allow for increased cooperation between developed and developing countries in efforts to reduce GHG emissions. However, countries and regions have immediate priorities. Thus, levels of commitment to developing local and regional ETSs to be aggregated into a global ETS may differ greatly.

De Cian and Tavoni (2012) suggest that the establishment of an international ETS has been restricted based on claims that access to international carbon credits may undermine innovative efforts to reduce GHG emissions locally. The authors suggest that the major developed Organisation for Economic Cooperation and Development (OECD) countries agree to be the main buyers on the international ETS. This proposal however, still may not solve the problem of differing economic and climate stabilisation objectives as countries have to be in agreement to implement suggested policy proposals.

Furthermore, Leung et al (2009) explain that the lack of a hierarchy to ensure compliance and prevent countries from reneging on agreed emissions reduction obligations presents a challenge for the establishment of an international ETS. Holtsmark and Sommervoll (2012) explain that targets for emission would be set differently in anticipation of trading which outweighs gains as international emissions trading would lead to increased emissions and reduced efficiency.

The performance of the ETS as an instrument and policy for climate change mitigation is continuously questioned. Streimikiene and Roos (2009) suggest that the ETS has not been able to deliver cost-effective GHG emission reduction. In the case of energy generators, the costs of emission reduction through the purchase of permits are transferred onto the customer through an increase in the final cost of energy consumed (Jaehn and Letmathe 2010; Chappin and Dejkema 2009). Rousse (2008) proposes the involvement of individuals in the ETS through the creation of an institution to amalgamate and trade certificates of emission reduction.

The author suggests that this would accelerate advancement towards maximum GHG abatement. Chang and Wang (2010) explain that in efforts to reduce GHG emission, a clear understanding of the role an ETS among a hybrid of energy-related policies forms the foundation of a successful ETS (Eichner and Pethig 2008). Lee et al (2008) suggest that a combination of an ETS, policy to comply with adoption of RETs and the implementation of a tax on carbon would accelerate the reduction of GHG emissions.

Wang et al (2011) suggest that the specific design of a carbon tax is important in determining the overall impact of the policy on the reduction of GHGs. The authors suggest the levying of varying carbon taxes on different sources of energy from fossil fuels taking into consideration the amount of carbon emitted from the power generation process. In analysing the possible impacts of a carbon tax on the Chinese economy, the authors point out that most developing countries consider economic development a more pressing priority over GHG emission reduction. Thus, ideally, a tax on carbon should balance objectives for economic development and the effect of development on carbon emissions.

Bureau (2011), in a study conducted in France suggests that the distributional effect of a tax on carbon is regressive when expressed as a proportion of income. Results of the study showed that the poorest of the population would lose 6.3% of their income in payments towards carbon taxes. Li et al (2012) suggest that the loss of income in funding emission reduction through the implementation of carbon taxes is expensive and it presents severe challenges for economic development in any society. Callan et al (2009) and Gonzalez (2012) however explain that when revenue from a carbon tax is used for social benefit and provision of tax credits, it has the capacity to improve the living standards of individuals.

Giblin and McNabola (2009) and Dissou and Eyland (2011) explain that the impact of implementing a tax on carbon presents a challenge for economic development. The authors suggest that the main drawback of a carbon tax is that it increases the cost of abatement policy significantly. Lu et al (2010) suggest that the implementation of a carbon tax can help reduce GHG emissions but would bring about minimal negative impacts on economic growth in China. Zhao et al (2011) conducted research on 21 OECD countries and suggested that implementing a carbon tax has negative impacts on the international competitiveness of energy-intensive industries.

Wittneben (2009) explains that an internationally coordinated carbon tax may be a quicker and more cost-effective way to reduce GHGs globally. The author suggests that the carbon

market created under the Kyoto Protocol is expensive and has not been successful in reducing carbon emissions globally. Hyder (2008) supports the development of an international carbon tax system to provide funds necessary to finance the development of RETs in order to ensure sustainable supply of energy.

Creating an international carbon tax system is hampered by the complexity of establishing and maintaining the system. The varying interests of countries and prioritised objectives for social progress may pose critical barriers in developing and implementing such a system. Zhixn and Ya (2011) suggest that carbon taxes have the potential to spur development of RETs. They explain that the policy should be implemented by individual countries in order to reduce administrative ambiguity and target differing objectives for RET development accurately.

The merits of a carbon tax as a market instrument and policy for GHG emission reduction include transparency and ease of application domestically, lower operating costs, revenue generation, public acceptability and dynamic efficiency in encouraging the use of RETs (Pope and Owen 2009; Hammar and Sjostrom 2011; Bristow et al 2010; Andrew et al 2010). However, Lin and Li (2011) and Li et al (2012) highlight the slowing of economic development, decrease in social welfare, erosion of competitiveness of energy intensive industries and increase in carbon leakage as defects of the carbon tax. Timilsina et al (2011) and Galinato and Yoder (2010) propose a policy approach in which funds from carbon taxes are used solely for the financing of RET development. The authors explain that this would provide a solution to the challenge of GHG emission reduction.

Mandell (2008) explains that the establishment of an ETS and carbon tax may play an important role in advancing RET adoption. Karakosta et al (2010) suggest that the key challenge for increasing adoption of RETs lies in accelerating the technology transfer process. Lund (2011) however, explains that the transfer of technology for developing RETs as climate change mitigation solutions is heavily dependent on adequate financing for continuous innovation. In agreement, Tsoutsos et al (2008) and Gebremedhin and Granheim (2012) suggest that increased adoption of RETs can help to realise emission reduction targets set in Greece and Norway respectively. The authors highlight that innovation of financial models is critical, if the benefits of adopting RETs for climate change mitigation are to be derived.

There however are concerns about the potential of RETs to provide energy on a sustainable basis. According to Banos et al (2011) natural sources from which RE is derived may be affected by climate change. Thus, the potential of RETs to mitigate GHG emissions may be reduced. De Lucena et al (2009) suggest that biodiesel and hydropower as sources of RE generation in Brazil would be in particularly affected by climate change. The Brazilian economy relies heavily on RE; in 2007, the country generated 47% of its energy from renewable sources.

Pasicko et al (2012) suggest that by 2050, the impact of climate change would result in an increase in wind power along the coastal areas of Croatia and 10% reduction of hydropower. Sailor et al (2008) suggest that there is a high level of uncertainty regarding the impact of climate change on the production of RE. A report by the IPCC (2012) suggests that the goal of climate policy is to preserve the environment through a reduction of GHG emissions. Strengthening climate policy may lead to a reduction of GHG emissions which consequently provides more stable environmental condition. This increases certainty for the generation of energy from renewable sources.

Winkler et al (2009) developed models to ascertain the impact of investment in RETs for climate change mitigation in South Africa in 2050. The authors suggest that the cost of RETs would be reduced offering higher contribution to GHG mitigation as emission reduction would become more cost-effective. Schaffer et al (2012) however, explain that the critical challenge of assessing the impact of climate change on social and economic development is the basis upon which scenarios are built and the validity of assumptions made in the process.

Caspary (2009) suggests that in adopting RETs for climate change mitigation the cost competitiveness of technologies should be taken into account. The author explains that modern biomass, small hydrogen and geothermal all have cost paths that are competitive with conventional power generation sources in Colombia. However, the author suggests that regardless of the cost structure solar PV would not be competitive as a RET for GHG reduction within the next 25 years. In the analysis of the uncompetitive nature of solar PV, Caspary (2009) does not highlight the possible impact of these innovative financing and policy establishment on the evolution of technology.

Arent et al (2011) explain that the use of RETs presents viable options in the short and long term for the mitigation of climate change. The authors suggest that the adoption of appropriate financing models for technology dissemination and the implementation of

support policies are critical for adoption of RETs. Painuly (2001) and Beck and Martinot (2004) explain that despite the evident benefits of adopting RETs various barriers currently exist to impede the dissemination of RETs.

2.6 Barriers to Adoption of RETs

Barriers to the adoption of RETs represent potent challenges for the development of a RE economy. An economy driven by small and large scale RETs has the potential to meet the objectives of sustainable development (O'Keeffe and Haggett 2012; Jefferson 2008). Barriers impeding the use of RETs may be specific to a particular technology, area or region (Painuly 2001). Mirza et al (2009), Mondal et al (2010) and Komendantova et al (2012) broadly classify barriers as policy and regulatory challenges. Many other scholars categorise barriers in relation to the technological, economic, financial, institutional challenges opposing the widespread adoption of RETs (Beck and Martinot 2004; Oikonomou et al 2009; Surendra et al 2011; Bhattacharya and Kojima 2012; Zhang et al 2010; Lee and Shih 2011).

Sovacool (2009) suggests that in society, socio-cultural challenges act as barriers to RET adoption. According to the author, some of these challenges include competing social values and cultural attitudes concerning social welfare, which could result in the development of psychological barriers. Verbruggen et al (2012) suggest that barriers to RE development are contextual and evolve continuously.

Mainly from the financial perspective, Painuly (2001) and Beck and Martinot (2004) broadly highlight barriers to RET penetration. The authors highlight high investment requirements, high upfront capital costs for investors, high transaction costs, and long payback period as some barriers for investors. Linking challenges to imperfect capital market conditions in developing countries, the authors also mention the lack of access to capital and credit to consumers, lack of financial institutions as critical barriers to RE development. Finally, the authors highlight institutional challenges such as the lack of regulatory frameworks, low participation of the private sector, and a lack of research and development culture as some of the various barriers that impede the adoption of RETs.

Oikonomou et al (2009) suggest that the main barriers to the adoption of RETs in Greece and the Dodecanese Islands are legislative and administrative. The authors suggest that the lack of national policy for RET development and the absence of integrated national strategy to evaluate the impact of RETs on development are important institutional barriers. The authors

also highlight the lack of data to forecast future energy generation potential, limitations in the grid infrastructure and limited access to the grid as primary technical barriers.

Mezher et al (2012) also explain that the main barriers to the development of RE in Abu Dhabi are technical and institutional in nature. According to the authors, this is based on the perception of technical risks with renewable energy projects (REPs) developers may encounter such as maintaining and operating installed technology. Also, the absence of appropriate policy frameworks to increase access to transmission systems comprises an important institutional challenge.

Sovacool and Drupady (2011) examined the outcome of the Small Renewable Energy Power (SREP) program in Malaysia, an initiative developed to promote energy access especially in rural areas through the use of RE sources localised within the country. In this case, involvement of the government guaranteed political support. However, the project faced technical, economic and financial challenges based on the lack of technical understanding of local product conversion processes on the part of contracted engineers. SREP was initiated by the Malaysian government for the development of small scale REPs between 2001 and 2010. By 2005 the program had not met 3% of its original goal and the project was abandoned.

Krupa (2012) suggests that involvement in the development of REPs presents a viable opportunity for economic integration of the Aboriginal people of Canada mainly located in the rural areas of the country. Additionally, the author explains that clarity in the form of policy establishment to protect the interests of project developers and the lack of financial acumen present significant barriers for the development of REPs.

From an innovations perspective, Verbruggen et al (2010) explain that disruptive transformation in all energy systems are inevitable, if the potential of RE is to be tapped. The authors suggest that the limited knowledge regarding RETs poses as a critical barrier to the adoption of RETs. Himri et al (2009) suggest that the lack of knowledge networks to create platforms for conversational engagements among stakeholders on project development presents barriers to the adoption of RETs. Negro et al (2012) propose the setting up of knowledge infrastructures to close the knowledge gap existing between higher institutions and businesses.

Al-Badi et al (2009) suggest that the financially uncompetitive nature of RETs based on the high overall costs creates barriers to diffusion of technologies, thereby hampering potential

contribution to economic development. Furthermore, the authors explain that the lack of adequate finance for REP development and support by the Oman government for generating conventional energy, pose important financial and economic barriers to the development of RETs. Mirza et al (2009) explain that fiscal and financial barriers in the form of difficulty in obtaining financing for REPs based on the lack of knowledge of REPs, high risk perception and uncertainty regarding resource assessment of RETs, lack of lending facilities particularly for small scale projects, all comprise barriers to the adoption of RETs in Pakistan.

Gurung et al (2012) and Surendra et al (2011) suggest that in developing REPs in rural areas of Nepal, high initial capital costs, high transaction costs, inadequate rural credit systems, inadequate financing for projects constitute the main financial and economic barriers to RE development. Nolan and Nuri (2009) suggest that the main barriers to the application of RETs in Turkey are also financial and economic in nature. The authors suggest the main barriers are the lack of appropriate financing structures and the failure to quantify economic development benefits provided by RETs. According to a report by the UNDP (2011), the impact of RETs on economic development may not be physically tangible. However, the results of developing RE are evident in the improvement of quality of life and living standards which can be measured and quantified appropriately.

Although barriers to RE development present significant challenges for the adoption of RETs, there is a possibility that barriers can be entirely removed or at least reduced. Stapleton (2009) explains that the successful implementation of REPs depends on addressing a number of interlinking factors that represent the root causes of barriers to RET adoption. The author proposes the creation of energy policies focused on economic development and capacity building through the involvement of local industries in REPs. These, the author suggests are measures that can be taken to remove barriers to the development of RE.

Richards et al (2012) suggest a multi-dimensional analysis of barriers and the interaction between them would highlight an understanding of how barriers work to impede the growth of RE. From an innovations perspective, the authors propose a systems-based approach for the identification of barriers. The authors explain that challenges to RE development can be solved by tackling barriers as a holistic sum to create solutions for knowledge barriers hampering the development of RE. Analysis of the work of Richards et al (2012) using a framework for barrier identification and categorisation as proposed by Painuly (2001) shows that barriers to RE development exist at different levels. Also, the impacts of barriers are

determined by the level of influence on external drivers impacting actual barriers. This makes it difficult to 'lump' barriers together in order to create holistic solutions.

Challenges relating to financing and the development of policy present significant impediments for the adoption of RETs. REPs are driven by financial investment which in turn is dependent on the development of policy to support investment. Based on the development of appropriate institutional frameworks, the establishment of policy to support financing can open up channels for adequate investment in REP development. Sahir and Qureshi (2008) suggest the development of an integrated strategy for energy planning and establishment of consistent government policies would help to provide increased levels of certainty for investors. The authors argue this may result in increasing financial investment in REPs.

Kinab and Elkhoury (2012) suggest that increasing the effectiveness of national financing mechanisms would contribute to alleviate barriers to RE development. The authors suggest an overall strategy that involves the private sector and adoption of innovative financing schemes. Also, the authors suggest the formation of public-private partnerships to promote funding, and developing policy to support independent power producers (IPP) solely focused on generating energy from renewable sources.

Martin and Rice (2012) explain that removing barriers to RE development requires progress in establishing long-term financial incentives to willing investors in the form of developing policy to guarantee return on investment. Al-Badi et al (2011) explain that policy to support low tax regimes can create incentives for investment in the form of developing positive investment climates.

Komendantova et al (2012) and explain Pegels (2010) that barriers associated with investing in developing RE in developing countries present a network of interrelated risks that influence the decisions of investors. Leach et al (2011) suggest that the risk of unstable prices of generated energy increases the overall risk profile of REPs for potential investors. Apak et al (2012) suggest that financial risks occur at every phase of REPs and this affects the willingness of investors to expand investment portfolios into diversified REPs. Komendantova et al (2011) highlight political corruption and inefficient bureaucracies as the main risks associated with financial investment in REPs.

Masini and Menichetti (2012) propose that the behavior of investors should be critically understood in establishing policies for RE development, as this impacts the success of instituted policies. Holburn (2012) suggests that risks can be eliminated by increasing the autonomy of regulatory agencies as these institutions have greater levels of interaction with investors. Based on this, the author suggests that agencies can design and develop more effective policies to support investment. Alagappen et al (2011) propose continuous innovation in policy establishment to support RE development and lower the impact of risks.

2.7 Policy Mechanisms Supporting Financing and Development of RE

Various policies have been established to promote the development of RE through increasing financing activities. The focus of policies has been to lower the risk profile of RE investments, in a bid to encourage continued investor participation. Rationales for supporting RE development through policy establishment include high costs of RETs and the high risk associated with REPs (Beck and Martinot 2004).

However, with developed countries, based on concerns for the environment, a reduction of GHG emissions presents an important reason for supporting RE development. Other reasons include increasing levels of energy security by reducing dependence on conventional energy and mitigating climate change. Thus, support policies for financing RE may be established on this premise (IPCC 2012; UNEP 2011).

The situation however is different with developing countries. With developing African countries, policy establishment to support the financing of RE development is strategically linked to economic benefits. These benefits may be in the form of increased energy access and overall economic development. In Africa, these are targeted possible outcomes of policy support for financing RE development (Karekazi 2002; UNEPFI 2012). Consequently, these differing objectives give rise to differing opinions on RE policy development among academic scholars and policymakers.

According to a report by Renewable Energy for the 21st Century (2011) 119 countries had established policies to promote the local development of RE. Sebitosi and Pillay (2008) and Geller et al (2004) highlight the importance of policies to support RE for sustainable economic development. Beck and Martinot (2004) classify RE promotion policies as price-setting, quantity-forcing, cost reduction, public investment and market facilitation policies.

Popular support policies to promote the development of RE are also categorised as economic or direct.

Direct policies include the renewable energy feed-in tariff (REFIT), renewables obligation (RO), renewable portfolio standards (RPS), competitive bidding, targets, economic incentives (tax credits, subsidies, capital grants and loans). Conversely, research and development incentives, educational programs and awareness campaigns, positive discriminatory rules for increased access to grid all comprise non-economic or indirect support policies (UN-Energy/Africa 2007; Liou 2010 UNECA-ACPC 2011; and Xingang 2012; Batlle et al 2012).

Reports by United Nations Environment Program Finance Initiative (UNEPFI 2012) and United Nations Environment Program (UNEP 2011) suggest that linking the objectives of the policy to its design is paramount for policies to exert desired impacts on developing RE. Also, prior consideration for how a RE policy would be financed can play an important role in determining the success levels of policies. According to Del Rio (2012), outcomes of developed policies are influenced by the design elements. These elements may include technology-specific fixed tariffs, degression, floor prices, reduction and duration of support for particular RETs. The author suggests that attention to policy design elements is critical for the success of developed REFIT policies.

Ross et al (2012) argue that based on its inappropriate design, the REFIT in Australia has not produced encouraging results for investment in RE in Australia. Hsu (2012) and Mosher and Corscadden (2012) suggest prior economic evaluation of policy potential in relation to desired benefits. Finon and Perez (2007) propose frequent reviews on the impact of policy on renewable electricity production as a measure of investor participation in designing REFIT policies.

Among scholars, REFIT has been upheld as the most effective policy in promoting RE development in numerous countries (Tukenmez and Demireli 2012; Huber et al 2007; Cherni and Hill 2009; Aguolucci 2008; Xingang et al 2012; Martinot 2004; Wujayatunga 2014; Erturk 2012; Doherty and O'Malley 2011). This is based on its ability to attract investment by reducing risk levels for investors while offering increased security for investment.

REFIT also guarantees return on investment conveyed in long-term power purchase contracts (Mabee et al 2012). Baris and Kucukali (2012) attribute the low levels of adoption of RETs in Turkey to a poorly designed REFIT policy. According to the authors, the policy provides low

secure guarantees for the purchase of energy generated from renewable sources. In their opinion, this increases perceived risks for investors and ultimately discourages investment.

Burer and Wustenhagen (2009) and Hofman and Huismann (2012) highlight the importance of REFIT for investors by surveying 60 professionals from private firms in Europe and North America that invest in RETs. The authors conclude that REFIT is the most preferred policy instrument that guarantees investor security and continued financial investment.

Wustenhagen and Bilharz (2006) suggest that consistency in policy development and the expertise of policymakers in the area of RE are critical factors for the success of a REFIT policy. Menanteu et al (2003) conclude that REFIT would produce higher rates of RET adoption and spur RE development much faster than other policy instruments. However, the authors explain that regardless of the policy instrument selected to promote RE, government plays an important role in promoting RE development within countries.

Mezher et al (2012) conducted an analysis of policy instruments adopted for the development of RE in 61 countries in order to develop policy proposals for RE development in Abu Dhabi United Arab Emirates (UAE). To meet its target of 7% of generated energy from renewable sources by 2020, the authors propose a combination of REFIT and RPS for accelerated deployment of RETs. Wang and Cheng (2012) also indicated the impact of policy combinations, suggesting a combination of REFIT with appropriately designed tariffs systems and RPS to promote RE development through financial investment in Taiwan. Using the EU as an example to illustrate the increasing diversification of REFIT designs, Fouquet (2013) suggests that RE policies must be adapted to local economic conditions, if they are to achieve proposed objectives.

Batlle et al (2012) highlight the importance of REFIT designs in promoting investment and impacting renewable electricity prices. The authors propose that elements that comprise the design of the REFIT policy should be carefully selected in line with objectives for encouraging investor participation. Couture and Gagnon (2010) evaluate the design and models of REFIT policy adopted in the EU and conclude that the structure and design of REFIT models impact investors' perceptions of the risks associated with the policy.

This, according to the authors this affects investors' investment decisions directly. The authors suggest market-dependent (dependent on electricity prices) REFIT models create better incentives for investment security based on the ability to predict future cash flows. The

authors conclude that this creates an environment for stable lower risk investment conditions for risk-averse investors and this helps to increase financial participation by encouraging non-traditional investors.

Trypolska (2012) buttresses the importance of REFIT design in achieving its projected objectives by conducting research on the impact of REFIT on RE development in Ukraine. The author explains that high tariffs brought about an increase in electricity generated from renewable sources. However, the lack of economic incentives to purchase higher priced renewable electricity resulted in an overproduction and under-consumption scenario.

Wiser and Pickle (1998) suggest that economic incentives such as tax reductions or exemptions can help to lower generation and transmission costs of renewable electricity. The authors explain that this can help to increase affordability and impact end consumers, compelling them to increase purchase of renewable electricity.

Schallenberg-Rodriguez and Haas (2012) analysed coexisting fixed and premium REFIT policy options in Spain to evaluate their performance in terms of contributing to RE development within the country. The authors explain that since the premium REFIT policy option is based on market demand, it can encourage the production of RE during peak periods. In their opinion, this can lead to overcompensation if electricity prices rise sporadically; hence the authors propose a cap and floor system for the policy to mitigate risks. Upon analysing the fixed price REFIT policy system, the authors propose its implementation to encourage less mature RETs reach points of market penetration.

Ayoub and Yuji (2012) examine REFIT policy options for promoting RETs in Japan. The authors propose a least cost REFIT model to increase investment in RE development. The least cost REFIT model takes into account the cheapest RET mix to achieve established objectives. An analysis of the model however shows that the model is based on the current prices of RETs and ignores the future potential of single or a mix of technologies in achieving its established objectives. Lund (2009) suggests that the technology learning process can increase market penetration of RETs by reducing costs. Application of this theory may result in differing outcomes in the model.

The German REFIT policy is popularly cited as a successful model for REFIT design (Frondel et al 2009; Schaefer et al 2012; Dong 2012; Trypolska 2012). Munoz et al (2007) identified the addition of modular premiums and profitability thresholds as critical elements

for the success of REFIT policy design in the EU. The authors however do not establish how the addition of these policy innovation characteristics promote the development of RE through increasing investment flows.

Stevanovich and Pucar (2012) analysed the capacity of the Serbian REFIT policy to attract investment by studying investment requirements and outcomes in relation to the policy. The authors found that the current design of the policy is not suitable to attract investments based on low renewable electricity tariffs. Thus, the authors proposed a system of net metering and increasing renewable electricity prices in line with conventional electricity as additional policy design elements.

Rickerson et al (2013) explored the performance of REFIT policies adopted globally. Their results showed the policy is the most effective in promoting RE development through increasing investor participation. The authors suggest that 75% of solar PV capacity and 45% of wind capacity installed globally was possible due to the establishment of REFIT.

Focusing on developing countries, particularly Tanzania, the authors propose the adoption of the global energy transfer feed-in tariff (GETFIT). GETFIT is designed to increase private sector financing of REPs to eliminate financial and economic barriers hampering the penetration of RETs. The authors however do not demonstrate how GETFIT would be incorporated into the Tanzanian RE policy design system to provide a template for its adoption by other developing African countries.

In the US, REFIT is not the policy of choice selected to promote and develop RE. Rather, a combination of RPS and other economic policies are adopted at the level of state government. Wiser et al (1998) investigate the capacity of RPS to promote the development of RE in the US. The authors conclude that RPS is more suitable for mature RETs. Additionally, the authors propose that for less mature RETs with higher costs of electricity generation, RPS should be used in combination with supporting policies like systems benefit credit (SBC) (Wiser et al 2000). This view is shared by Valle Costa et al (2008) who investigate RE policy development in Germany, the Netherlands and the UK. These authors suggest a combination of RPS with a system of tradable green certificates (TGC) for accelerated adoption of RETs in Brazil.

Lagniss and Wiser (2003) and Wiser et al (2005) explain that the main advantage of the RPS is its capacity to spur competition among market participants generating electricity from

renewable sources. The authors also suggest the alignment of policy design with its objectives in terms of streamlining the eligibility of RETs and clarifying policy rules. Kim et al (2012) assessed the willingness of households to pay for renewable electricity generated under the RPS in Korea and found that households were more willing to pay when tariffs were lower.

This suggests that regardless of the competition among renewable electricity generators RPS supports, the design of the policy should promote renewable electricity tariff reduction to be successful within the country. Kung (2012) found that when designed appropriately, RPS is capable of impacting renewable electricity prices through the lowering of capital costs associated with electricity production.

Stockmayer et al (2012) investigated a number of approaches adopted by state governments in the US to develop cost control mechanisms in different variations of RPS. The authors conclude that clarity of rule, consistency in application and transparency for customers are key elements of successful RPS models. Martinot (2004) suggests that in addition to RPS, policies such as the public utility regulatory policies act (PURPA), investment tax credit (ITC), production tax credit (PTC) and net metering contribute to the increased development of RE in the US.

The UK's adopted policy, RO, is popularly suggested to be ineffective in financing the development of RE (Walker 2012; Wang 2010). Toke and Lauber (2007) explain that the policy, as well as the trading of renewable obligation certificates (ROCs) has not been successful in increasing the penetration of RETs within the country. Zhou (2012) examined the impact of the buy-out fund, a peculiar feature of the UK RO policy on RE development in the country. The author explained that the RO is more effective with the buy-out system as it directly encourages production of renewable electricity.

However, the case is not the same without the buy-out system as it is suggested that the market responds to the penalty price for not meeting RE targets. The RO, established to help achieve a target of 15.4% of renewable electricity as a percentage of overall electricity generation by 2016 was replaced by a carbon price floor system in 2013 and REFIT with contracts of difference in 2014.

Zhang (2008) suggests that consideration for the impact of the mix of RE policies should form fulcrum of decisions regarding what policies should be adopted. Ghezloun et al (2012)

studied the policy framework for RE development in Algeria and Tunisia. The authors suggest that the most common policies employed are tax reductions and rebates on RETs, reflecting the challenge of adequate financing for RE development within the African continent.

Chattopadhyay and Chattopadhyay (2012) suggest that most RE policies are focused on the development of wind and solar technologies which have increased penetration in most countries within the last decade. The authors suggest that the efficiency of policies is largely dependent on the design of the policy in relation to the economic state of the country. From an analysis of climate data the authors suggest that the current policies are not sufficient to meet India's target of 3% of RE purchase for all states by 2020. In conducting their analysis, the authors used climate data over the last three decades, not the actual data showing the development progress of RET adoption in India. This could mean that the authors based India's capacity to meet its RE targets on its ability to reduce emissions. These two issues, though related are very different.

Marques and Fuinhas (2012) conducted a survey of 23 European countries using panel data between 1990 and 2007. The authors argue that rather than through public policies, RE development is specifically driven by incentives and subsidies labeled by the authors as financial compensations. Wiser (1998) suggests that there is not a single policy option that can deliver desired benefits for RE development, rather a combination of policies may be more efficient. Winkler (2005) suggested a combination of the RPS with features of the competitive bidding system as an option for policy implementation to spur RE development in South Africa.

Verbruggen and Lauber (2012) assess the performance of RE support policies using institutional feasibility, efficiency, efficacy and equity as important performance measurement criteria. The authors conclude that for the development of RE, well-designed REFIT policies are better instruments than RO. Lipp (2007) and Brennand (2001) highlight important lessons for RE policy development. The authors suggest commitment to policy objectives through political convergence and policy design as important elements for the success of RE policies. From an innovations perspective, it is argued that for RE policy to be successful, policies should be located within the energy policy of a country.

Also, scholars suggest that policy innovation can bring about the evolution of technological regimes at regional levels to impact research and development investment (Tsoutsos and

Stamboulis 2005; Peidong et al 2009; Portman 2010). Lund (2009) suggests that concentrating on increasing investment in research and development can bring about significant levels of growth for RE. However, in adopting the conclusion for an innovation-focused policy, the author excludes the economic analysis of the impact of research and development on RE development.

Couture and Gagnon (2010) explain that the effects of policies are weighed on the tradeoffs between the economic costs and benefits of the policy to society. Moreover, Beck and Martinot (2004) showed that challenges limiting the penetration of RETs cannot be solved by focusing on eliminating a category of barriers.

As noted by UNEP (2011), support policies for RE development may focus on particular technologies based on the abundance of its renewable source. Wind and solar constitute the most abundant forms of RE with technologies argued to have reached or nearing maturity (Saidur et al 2010; Solangi et al 2011; Lema and Ruby 2007; Schaefer et al 2012; Peters et al 2011; Wiser et al 2011). Hence, the impact of support policies in developing technologies is a necessary point of focus.

Lewis and Wiser (2007) conducted a cross-country analysis on the development of large wind turbine manufacturing, focusing on 12 countries. The authors found that countries with policies to support RE development had more stable RE markets. The authors also inferred that this is pertinent in developing country-wide competitiveness to support growth of the global RE industry.

In conducting research on the impact of the PTC on investment, Baradale (2010) highlights the sensitivity of investors to policy duration finding that expiration and short-term renewal of the policy causes high levels of fluctuation in wind investments in the US. The author concludes that the downturn in investment is not due to wind energy being perceived as unviable. Rather, that uncertainty of policy duration drives volatility in wind investments.

Dong (2012) analysed the effectiveness of REFIT and RPS in promoting wind capacity across 53 countries which altogether had 99.5% of the total global wind capacity. The author suggests that REFIT is a better policy instrument for the promotion and development of wind energy. The research however lacks insight the structural and economic reasons for adopting one policy over the other. This, according to Couture and Gagnon (2010) is a major consideration in policy development and implementation.

Burns and Kang (2012) investigate the potential of the Solar Renewable Energy Credit (SREC) policy to promote and increase the adoption of solar PV within the home-generated renewable electricity market in the US. They find that the policy can bring about a much higher penetration of solar PV when greater certainty regarding the price of SREC persists. To this effect, the authors suggest an input design of price floors for the policy and explain that this would offer more security in the process of generating renewable electricity.

Timilsina et al (2012) suggest that the various markets for solar PV are driven by fiscal and regulatory incentives in the form of financial and policy support. The authors however explain that innovation in policy design is necessary to reduce costs and improve the capacity of solar PV to compete with conventional technologies.

Bird et al (2005) highlight the importance of policy design in financing the development of RE. The authors suggest that policy support to promote the increase of tax and financial incentives for developers is critical for the development of RE. Cherni and Kentish (2007) examined the policy landscape for financing RETs in China. The authors found that policy to execute the financing of RET is complicated by few numbers of low interest loan programs to support RE development and the lack of domestic and international finance mechanisms.

Hashim and Ho (2011) explain that local policies and financing schemes like the Renewable Energy Fund (REF), Green Technology Financial Scheme (GTFS) and the Renewable Energy and Energy Efficiency Scheme (REEES) played pivotal roles in increasing access to finance for RE development in Malaysia.

Sullivan (2011) and Luthi and Prassler (2011) examined local policy support for financing RE and the impact on investment. The authors concluded that policies should promote incentives for investment in RE by minimising risks for investors, especially taking into consideration the scale of the investment. Batlle (2011) explains that policy support for tariff regulation is an important aspect of financing RE development. The author suggests final consumers of RE pay the costs of energy generation, without intervention from government. An analysis of this policy proposal however shows that this is not suitable for the development of RE. Especially in Africa, if implemented, the policy would potentially seclude low income households in need of energy. Farher (1998) suggested that in developing countries, policy support for micro credit financing can result in increasing the adoption of RETs.

The challenge of financing the development of RE is compounded by policy instability, especially in Sub-Saharan Africa where only nine countries have targets for RE generation (UNEPFI 2012). Liu and Tan (2011) investigated policy for financing RE in China. The authors proposed the establishment of policy to promote a special funds system that guarantees investors and developers to solve the challenge of financing RE. Luthi and Wustenhagen (2011) suggested that in determining the risk-return profile of an investment, investors evaluate risks in accordance with the stability of established policies. Danica (2011) proposes differentiation of cost categories as a policy in order to reach acceptable prices of electricity generated from renewable sources and encourage continuous financing of REPs.

2.8 Financing Models and Mechanisms for RE

Various models and mechanisms have been developed to alleviate the challenge of financing RETs to increase adoption and spur economic development (Zhang et al 2012; UNEP 2011; CanREA 2006). The success of existing models and mechanisms are however dependent on prevalent economic conditions within implementing countries (Kaifeng et al 2012; Liming 2009). A report by Climate Policy Initiative (CPI 2011) suggests that the stability of capital markets in developed countries provides easier access to finance for REPs. In these countries, traditional financing methods – debt or equity (mezzanine finance, project finance, venture capital and pension funds) are the main financing instruments (Justice 2009; Olmos et al 2012).

Also, in developed countries, mostly large scale REPs are financed with the objectives of promoting energy security and protecting the environment (UNEP SEFI 2005). The same however cannot be said for developing African countries which are characterised by unsophisticated financial systems with underdeveloped capital markets (Von Frustenberg and Fratianni 1996). African countries have entirely different motivations for promoting RET adoption. In Africa, RET promotion is largely a strategic option implemented by governments, to foster economic development (UNEPFI 2012). In this case, the apparent need for innovative financing models and mechanisms to impact end-users of RETs to foster anticipated development becomes even more important.

Maquieira et al (2012) analyse the concept of corporate finance (debt and equity) in relation to its feasibility as an instrument for development in emerging market economies. The authors suggest complexities such as low market liquidity, lack of market development and high transaction costs are prevalent in the capital markets of developing countries. Thus,

underdeveloped capital markets do not conform to the assumption of capital market efficiency, and financing decisions using debt or equity becomes very risky (Donovan and Nunez 2012; Eberhard and Shkaratan 2012; Mehl and Reynaud 2010; Ojah and Pillay 2009).

The case for debt financing of REPs presents a different picture in developed countries based on the efficiency of developed capital markets. Ludeke-Freund and Loock (2011) investigate the debt finance market for solar PV in Germany, focusing on the factors that drive financial institutions to invest in REPs. The authors find that investors are biased towards established solar PV brands and provide debt capital for projects using these brands. According to the authors, investors perceive established solar PV brands to present less technology challenges. In making financing decisions, for investors, this is translated into increasing guarantees for debt repayments.

Also, Loock (2012) suggests that RE investment fund managers prefer to provide debt capital for service-oriented RET development firms over lowest cost or best technology firms. In analysing the financing decisions of innovative firms Casson (2008) found that innovative firms prefer debt financing over equity financing as they retain more control and ownership when projects are financed with debt.

The choice of appropriate financing models for funding REPs may differ from one country to another based on existing investment cultures. However, the size of a REP may in itself determine the appropriate model of financing (Borgonovo et al 2010; UNEP SEFI 2005). In developed countries, it is popularly suggested that project finance is the most preferred model for financing REPs (Mills and Taylor 1994; Kann 2009; Groobey et al 2010).

Megginson (2010) suggests that project finance is a viable model for obtaining long-term low-cost financing for capital intensive energy projects especially in relatively risky countries. This is because project finance offers the ability to obtain funding for projects without expecting co-insurance of the project's debt from government or private investors. Also, creditors share greater portions of expected risks from ventures.

In this assessment however, Megginson (2010) does not highlight the impact of the stability and robustness of capital markets on obtaining financing. According to Beck and Martinot (2004), developed capital markets are more likely to find solutions to eliminate barriers to financing REPs.

Project finance is mostly used to finance projects that are self-funding and self-liquidating, providing a distinct category of financing where a project is legally distinct from its sponsor. Thus, the project does not appear on the firm's balance sheet, bearing no impact on debt to asset ratio and risk as assumed by project sponsors (Farrell 2003). Sterling (1994) suggests that risk alleviation is crucial in capital allocation and project financing.

Nikolic et al (2011) studied the energy industry in Serbia in relation to the adoption of project financing models. The authors conclude that successful implementation of project finance depends greatly on appropriate consideration of all possible risks a project may encounter during it economic life. Pollio (1998) suggests that risk management rather than capital constraint is the main reason project sponsors and developers choose project financing over existing debt structures.

Sorge (2004) analysed the nature of credit risk in project finance and suggested that longer periods of debt maturity allocated to projects, makes project finance a more attractive option for developers to finance their projects over other syndicated loans. Kleimeir and Versteeg (2010) explain that increased levels of project financing may also impact economic growth and development positively. The authors investigated the impact of project finance in 90 countries and found the impact of project finance to be strongest in developing countries based on the impact of infrastructure on communities. Furthermore, the authors suggest that project finance compensates for the lack of domestic financial development in developing countries where capital markets are inappreciably unreliable.

An analysis of the conclusion reached by Kleimier and Versteeg (2010) however calls into question the reliability of lending structures for REP development, based on the imperfections of the capital markets prevalent in developing African countries. This suggests that if sustainable economic development is to be achieved by promoting RETs, other more innovative and effective financing models and mechanisms should be considered (James 2012; Wholgemuth 2000).

In providing guidance for engaging more innovative models for financing REPs, Daube et al (2008) compare project finance and the forfeiting model in terms of suitability to finance REPs in Germany. The forfeiting model is based on the assumption that project developers would sell some part of their stake in the project to financial institutions, giving up some part of their equity to finance the project. The authors find, in agreement with Borgonovo et al (2010) that project finance is more suitable for complex, capital-intensive and risky projects,

whereas the forfeiting model is mostly used when projects are considered to have manageable risks. An analysis of this comparison shows that the transferability of the forfeiting model is based on a high level of capital market development and sophistication which is currently lacking in many African countries.

Venture capital as a model of financing can play an effective role in promoting the creation of enterprises (Ojah 2011). Especially in developing African countries, these enterprises may be involved in the development of RE (Bottazzi et al 2008; Winton and Yerramilli 2008). Bertoni et al (2008) analysed 538 high technology start-up firms in Italy and concluded that venture capital positively impacts new technology-based firm development. Schertler and Tykvova (2012) investigated the economic factors that drive cross-border capital inflows in Europe and North America. The authors found higher expected economic growth, market capitalisation and favorable environments for venture capital intermediation to be the drivers of capital inflows.

The involvement of venture capitalists however presents a different challenge in developing African countries (Ojah et al 2010). With a combination of the high level of unfamiliarity regarding risks inherent in REPs and economic challenges impacting the investment climate in many African countries, many venture capital and private equity investors may perceive the risks associated with investing in RE as unacceptable. This in turn could lower the inflow of capital for REP developers, resulting in the retarding of RET adoption. Especially for smaller institutions seeking to establish operations in financing REPs, access to finance poses as a major challenge (UNEPFI 2012). Table 2.8 shows the barriers that increase the difficulty in accessing finance for small and medium enterprises (SMEs) in African countries.

Table 2.8: SME access to finance for selected African countries

Country	Loan market share (%)	Minimum amount business loan (% of GDPPC)*	Fees business loan (% of min loan)	Minimum amount of SME loan (% of GDPPC)*	Fees SME loan (% of min loan)	Days to process business loan applications	Days to process SME loan application
Cameroon	81.3	16393.6	81.3	947.9	81.3	12.9	9.3
Ethiopia	85.3	981.6	0.6	878.7	0.6	14.5	14.5
Gabon	..	0.0	100.3	0.0	100.3	15.0	15.0
Ghana	68.7	1044.3	1.3	1448.0	1.5	19.0	29.2
Kenya	47.6	193.7	1.5	166.4	2.1	5.6	5.6
Madagascar	74.5	17.2	3.5	17.2	3.5	18.6	15.4
Malawi	59.7	306.0	1.3	1929.3	1.0	15.3	3.7
Mozambique	40.3	28.6	0.7	28.6	1.0	25.8	25.8
Nigeria	29.3	0.0	1.3	81.7	4.1	8.2	11.4
South Africa	69.3	15.9	0.6	15.9	0.6	2.7	4.1
Uganda	46.8	7039.0	1.5	3141.1	2.2	5.1	4.4
Zambia	34.4	..	2.2	..	2.4	10.6	8.3
Zimbabwe	43.4	263.49	2.5	240.1	2.5	7.9	3.9

Source: IMF SME Access to Finance Survey, 2007

*GDPPC is gross domestic product per capita

Based on the high level of complexity and risk associated with REPs, in developing countries RE development is traditionally funded by governments, using public finance. This is normally carried out through direct funding or by providing support for state-owned conventional electricity utilities to develop REPs. Development banks, bilateral and multilateral institutions also traditionally fund REPs (Delina 2011; AfDB 2010; Foster-Pedley and Hertzog 2006; Zhang and Maruyama 2001; Foley 1992).

However, Sklar (1993) suggests that financing initiatives by traditional financing sources in developing countries are not sufficient for the widespread dissemination of RETs. The author explains that these structures use financial approaches and paradigms mainly focused on large projects, inconsistent with approaches for technology decentralisation. Foley (1992) suggests the development of financial models and mechanisms that take into account the state of capital markets in developing countries to increase penetration of RETs

.The implementation of financing models and mechanisms that bypass challenges in the capital markets of developing African countries requires high levels of financial innovation and concise focus on the economic situations of end-users of RETs (Monroy and Hernandez 2008; Gujba et al 2008). Zerriffi (2011) and Glemarec (2012) suggest increased focus on direct finance options using a mix of end-user financing models to target individuals in need of modern energy services.

The authors suggest the adoption of this financing model for rural communities where grid connection is absent based on high costs associated with connecting dispersed communities to the grid. Furthermore, the authors suggest implementing dealer and supplier credit models, consumer credit models or third party financing (through microfinance institutions (MFIs) and commercial banks) as financing options for rural communities.

Additionally, the authors suggest fee-for-service model, rental models, revolving funds and credit schemes as financing solutions to reduce high upfront costs associated with the purchase of RETs. The rationale for advocating these models and mechanisms is that by increasing access to finance for rural dwellers, affordability of technologies can also be increased (Thiam 2011; Mainali and Silveira 2011; Sonntag-O'Brien and Usher 2004; Painuly et al 2003; Reiche et al 2000; Derrick 1998).

Gujba et al (2012) explain that most financing mechanisms for RE development in Africa targets small or large scale projects without a focus on end-user initiatives. To address this, the authors propose a framework to assist investors in the RE industry in Africa. The authors suggest that the focus of investment should be on end-user finance for individual households, business finance for micro to small and medium enterprises and small scale project finance for aggregated community development. Monroy and Hernandez (2008) and Nygaard (2009) propose that financial mechanisms for RE development in developing countries should be adapted to the characteristics of decentralised systems of energy production. The authors suggest this would increase the viability of financial mechanisms and make RETs affordable.

Based on challenges related to accessing finance for RE development on capital markets, MFIs are instrumental in providing capital to finance the purchase of RETs in rural areas of developing African countries. MFIs operate to promote development through establishing inclusive financial systems (Bystrom 2008 and Ojah and Mokoaleli-Mokoteli 2010). Bystrom (2008) suggests implementing a collateralised debt obligation as a means to commercialise microfinance and increase the impact of lending by MFIs to spur economic development. Monroy and Hernandez (2005) explain that the development of productive and innovative micro financing schemes is critical to the success of rural electrification projects using RETs.

Affordability of technology is critically linked to adoption of RETs. Hence, Rao et al (2009) propose an energy-MFI framework in India. The authors propose for the model to be transferred to other developing countries as an intervention to increase access to finance and affordability of RETs. Table 2.9 shows the level of financial inclusion for selected countries.

Critical understanding of saving, borrowing and repayment patterns is important for model success.

Table 2.9: Financial inclusion indexes for selected African countries (2011)

Country	Bank account (rural)	Bank account (urban)	Loan from financial institution (rural)	Loan from financial institution (urban)	Saved at financial institution (rural)	Saved at financial institution (urban)	Saved using savings club (rural)	Saved using savings club (urban)
Angola	33.8	56.5	7.6	9.0	13.4	23.9	6.8	10.3
Benin	8.5	34.4	3.5	11.8	5.37	27.5	14.3	30.9
Botswana	21.7	49.2	4.8	7.2	13.3	23.4	14.6	13.2
Burundi	6.9	24.6	1.6	7.3	3.2	4.9	1.9	0
CAR	1.7	10.6	0.4	3.1	1.2	8.3	8.1	18.7
Cameroon	14.1	17.3	4.6	3.5	9.3	12.4	30.7	36.1
DRC	2.3	10.5	1.1	3.6	1.2	2.7	6.4	17.7
Djibouti	8.0	13.7	4.1	4.6	3.5	3.2	6.1	7.05
Gabon	7.5	26.2	0.5	3.4	3.2	12.1	4.9	11.4
Ghana	25.1	52.4	4.8	10.5	13.0	33.0	16.5	5.5
Guinea	1.6	10.4	2.1	3.3	0.9	5.5	5.1	9.1
Kenya	37.8	75.9	9.7	9.4	20.1	46.9	19.1	21.6
Lesotho	14.4	36.2	3.0	3.1	6.3	14.5	13.9	23.9
Malawi	15.1	30.4	8.6	14.5	7.2	18.4	10.2	6.5
Mozambique	40.0	39.2	5.8	5.7	15.8	22.8	23.2	22.4
Niger	0.8	8.7	1.0	4.2	0.8	4.04	9.0	8.6
Nigeria	22.9	58.6	1.8	3.1	18.2	46.9	45.0	42.1
Rwanda	31.4	42.4	8.5	7.4	18.8	11.2	3.9	6.8
Senegal	4.5	8.9	3.2	4.2	2.5	6.7	5.8	3.9
Sierra Leone	12.8	26.1	5.6	8.2	13.0	20.5	9.7	12.9
South Africa	46.3	67.7	6.8	12.7	18.0	29.7	12.8	14.7
Sudan	7.0	6.7	1.4	2.0	3.1	3.5	8.6	8.7
Swaziland	27.5	41.5	11.3	13.5	16.5	33.1	7.5	20.6
Tanzania	14.2	40.5	6.6	6.3	10.1	25.0	11.7	1.9
Togo	7.1	19.6	3.3	5.1	2.9	5.6	3.2	4.5
Uganda	20.2	26.9	8.9	6.0	16.3	14.6	19.0	12.5
Zambia	22.4	13.8	6.9	0.6	12.2	8.5	8.3	1.15
Zimbabwe	40.3	37.7	4.7	5.1	16.8	18.3	10.3	12.6

Source: World Bank African Development Indicators, 2011

The potential of the energy-MFI framework for increasing RET adoption as proposed by Rao et al (2009) is expanded in a report by the ARE (2011). The report highlights the one-handed dealer credit model (Grameen Shakti or Bangladesh model) and the two-handed dealer credit model. In the one-handed model, MFI officials are trained by energy experts from RE companies to promote simple energy solutions sold together with loans. While the two-handed model involves a partnership between MFIs and RE companies where the MFIs provide loans and the RE company develops and manages products. The one-handed model has been replicated in Tanzania and Uganda while Zambia adopted the two-handed model to promote RE development.

The report also suggests that microfinance is a useful tool in reducing sensitivity of market price of RETs. This is achieved through the provision of small loans that take expenditure on other forms of energy by households into consideration to ensure repayments of loans. Furthermore, the report suggests that adapting financing schemes to depreciation and loss of value is an important design element for financing RETs at rural levels. In applying these models, customers gain ownership of the technology at the end of the repayment period (ARE 2011).

The fee-for-service and leasing models work differently to promote RET penetration in rural communities. Energy service companies (ESCOs) are the driving forces behind these models as they provide equipment and maintenance for customers (Natarajan 2012). In these models, the equipment is owned by the ESCO and end-users pay a fixed fee to the company every month. Depending on contractual arrangements, ownership of technology may or may not be transferred to end-users (ARE 2011). These models have been adopted in Honduras, India and Morocco.

Revolving funds may also serve as a model for financing RET adoption in developing African countries. Also, based on its design, a revolving fund becomes a revolving financial tool due to loan repayments which affords members the opportunity to borrow funds for specific needs (UN HABITAT 2006). However, Milligan (1994) suggests that some factors work against the success of a revolving fund. According to the author, confusion between credit and subsidies, lack of clarity on ownership of the fund, inefficiency in risk allocation, low or non-existent interest rates, high administrative costs and neglect for loan guarantees are possible reasons why revolving funds fail.

Headen et al (2010) highlight the concept of Property Assessed Clean Energy (PACE) financing – a mechanism for financing RE development in the US. With PACE, RE installations are financed through assessments on a property owner's real estate tax bill and local government bonds are secured in the process. The arrangement allows borrowers and sponsoring local governments the liberty of not pledging credit. RE improvements are paid for through the bond issue tied to the assessment on the property tax bill. The mechanism however caters only to industrial and commercial property owners. An analysis of this mechanism reflects a dependence on advanced capital markets and highly institutionalised systems which are lacking in many African countries. This suggests there may be difficulties in adopting the mechanism for RE development in Africa.

Enzensberger et al (2003) investigate the success of closed-end funds as a mechanism for financing REPs – especially wind farms in Germany. The authors suggest that the mechanism has been successful in promoting the increase of RE capacity within the country. In the closed-end funding model, project sponsors invite the immediate community to participate in financing REPs. In the process, participants become limited partners in ownership of specific projects.

An analysis of this comparison shows that the transferability of the forfeiting model is based on a high level of familiarity with RE and its potential impact in society. Also, the investment culture of countries may play an important role in determining the level of success RE development may have by adopting this model. In view of this, taking the financial wellbeing of individuals into consideration, the forfeiting model may not be suitable for the widespread dissemination of RETs especially in rural African communities.

The Clean Development Mechanism (CDM) is commonly cited as a financial mechanism with the potential to bring about an increase in the dissemination of RETs in developing countries (Pechak et al 2011; Diakoulaki 2007; UNEP SEFI 2005; Duic et al 2003). Lokey (2009) posits that in Mexico, the RE sector is the most likely to take advantage of CDM financing. This is based on increasing demand for clean electricity. The author also suggests that the flexibility of the mechanism in funding projects may help to promote transition to low-carbon economies.

Schroeder (2009), however, does not share the same views regarding CDM financing for RE projects in China, citing high project costs and the proof of additionality as the two main barriers in utilising the CDM for RE development in China. The author explains that the proof of additionality may lead to the disqualification of more mature RETs. Furthermore, the author suggests that CDM financing does not contribute much to the development of RE within the country. Fig 2.3 shows the trend of validation for CDM projects globally.

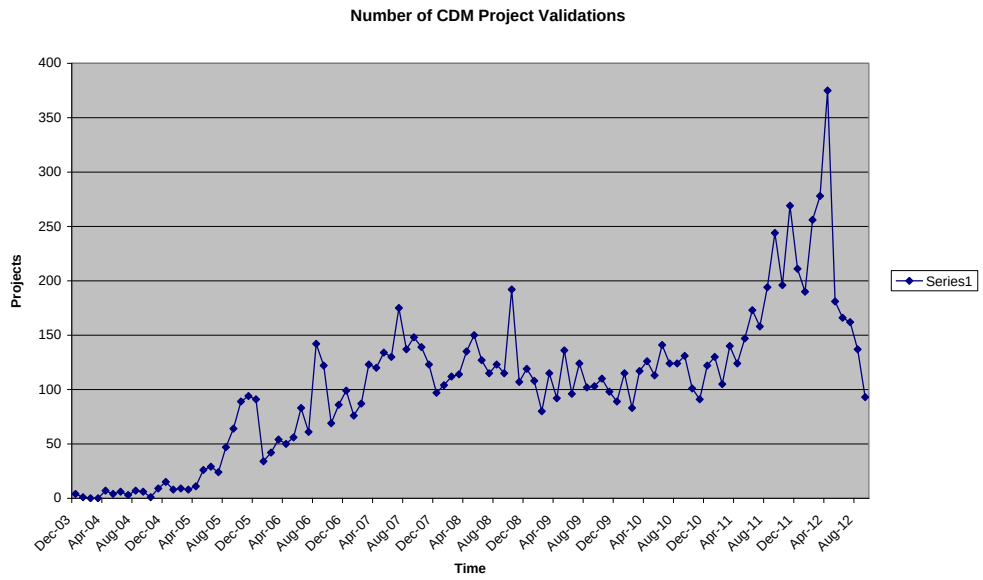


Fig 2.3: Trend of validation for CDM Projects (2003 – 2012)

Source: UNFCC CDM Project Development Records, 2012

Wang and Chen (2010) agree that dilemma of additionality presents barriers for the use of CDM to finance REPs in China. The authors highlight low proportions of certificate of emission reduction (CER) credit revenues on investment and the lack of incentives for technology transfer as the important barriers for utilising the CDM. A report by the UNEPFI (2011) suggests that the CDM has not been able to meet expectations in ensuring growth of low carbon technologies in African countries and estimated that by 2012, Africa would supply only 3% of CER volumes. A report by UNEPFI (2011) and Lloyd and Subbarao (2009) highlight complexity in implementation of projects, risk structure of projects, lack of bankable projects and institutional barriers relating to the lack of transparency by governments as the causes of low levels of CDM finance penetration in African countries.

Del Rio (2007) acknowledges the potential of the CDM to provide local economic, social and environmental benefits to host countries. However, the author suggests that for REPs, competition for financing with other CDM options that present cheaper means of GHG emissions reduction without affording opportunities for sustainable development pose barriers to financing. Nautiyal and Varun (2012) and Zovodov (2012) suggest that the CDM in its current form is not a reliable tool for developing RE and propose a review of the policies upon which the CDM was established. Especially for developing African countries,

the World Bank has been an important and reliable source of finance for RE development. Figure 2.4 shows the increase in funds channeled into financing REPs by the World Bank.

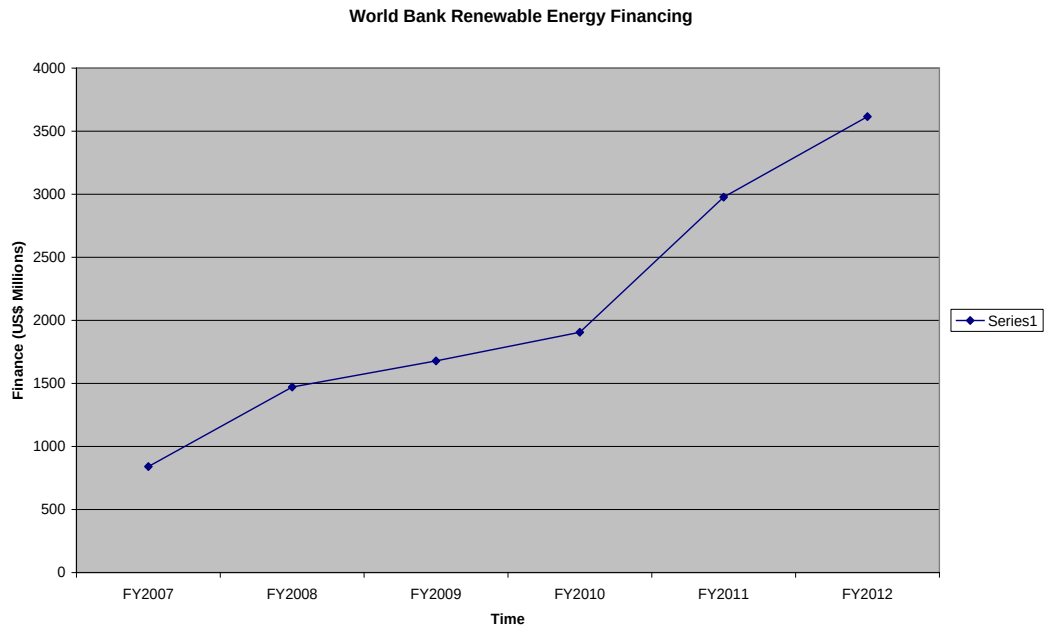


Fig 2.4: World Bank financing for renewable energy projects

Source: World Bank Energy Finance Database, 2012

Huang et al (2012) and Kubert and Sinclair (2009) and Gutermuth (1998) suggest that public finance mechanisms in the form of tax reductions, subsidies, rebates and loans alone cannot deliver the desired impact necessary for RETs to become competitive. Thus, the need for private sources of finance especially in developing African countries is even more pertinent (Liang and Reiner 2009). Mathews et al (2010) highlight the importance of private sector in unlocking long-term financing for REP development and suggest that this plays an important role in the transition to a low-carbon economy. Aguilar and Cai (2010) investigate the prospects for increasing private investment in RE in the US. The authors find that the primary drivers behind lending in the capital market system are investment security, portfolio diversification and estimated returns on financial investments.

Brunschweiler (2006) examined the factors influencing credit allocation to RE firms in developing and transition countries. The author found that RE development depends on the

quality of financial intermediation and the financing needs of firms. Lagniss (1996) and Chowdhury and Charoenngam (2009) suggest the standardisation of legal frameworks for energy investments to facilitate the transfer of capital and increase the level of transparency for potential investors willing to invest.

While the capital markets of many African countries are underdeveloped, consideration of the proposals by the authors can serve as an important factor in building local African capital markets to foster private sector financing. Wiser et al (1997) and Wholgemuth and Painuly (1999) examine the dilemma between the profitability of RETs and financing REPs. The authors highlight the need for innovative financing mechanisms to drive the penetration of RETs and increase private sector investment in REPs. The following section presents a brief summary of the conceptual model developed for this study.

2.9 The Conceptual Model

The model is a conceptual representation of the research problem which highlights the methods by which REPs are financed. It aims to determine the impact of these methods on the dissemination of RETs. In the model, financiers' choice of either traditional or innovative financing methods is influenced by the impact of policy as it relates to investment, trends in the RE sector. As is expressed in the literature, it is assumed that trends may either originate from the market or from particular RETs.

The model also suggests that, risks associated with RE investments affect financiers' decisions on which method of financing to adopt. Risks may be institutional, technological, economic or financial. Furthermore, it is assumed that from the financiers' perspective, the viability of a financing method is dependent on the performance of the investment made using the financing method and this in turn impacts the overall dissemination of RETs. Hence, the model assumes that the choice of financing method impacts, and is directly related to the financing of REPs and dissemination of RETs in semi-urban and rural African communities. The chapter is summarised in the following section.

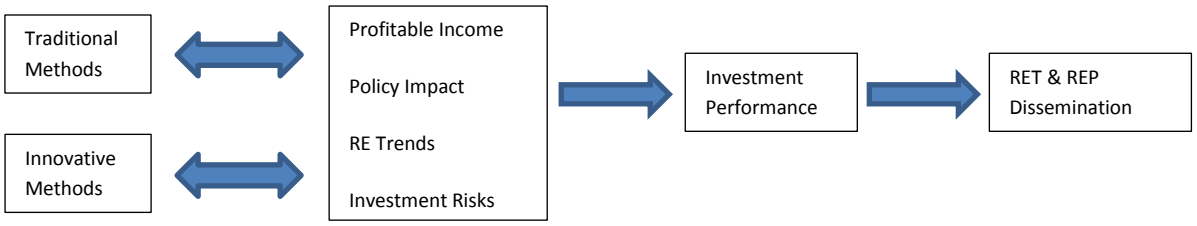


Fig 2.5: The conceptual model

2.10 Summary of the Chapter

This chapter presented literature on various aspects of RE development across different regions of the world. The chapter began with a review of the literature on the relationship between finance and economic development and then progressed to highlight the relationship between energy and sustainable development. A review of the literature on RE and economic development was also presented in this chapter. Specifically, the impact of developing RE on economic development as theorised by various scholars was presented.

In addition, this chapter also highlighted the relationship between RE development and climate change mitigation which according to some scholars is a better option for many African countries with developing economies. Concepts on the barriers to the development of RE were also presented with barriers to RE financing being the main focus. Policies to help eliminate barriers to financing the development of RE were compared and their impact on RE development was presented. The chapter concludes with a review of the literature on the methods of financing RE development within various developed and developing countries.

Theories from the literature suggest that innovative financing models can play an important role in promoting the widespread dissemination of RETs in developing African countries. This suggests the need for further implementation of innovative financing mechanisms to impact communities through increasing access to energy to ultimately promote economic development. This may be achieved by utilising combined sources of finance from public and private sources to fund the development of RETs.

The current situation regarding the development of capital markets in African countries presents significant challenges for adopting selected models and mechanisms for financing RE development. Also, legislation pertaining to investment security plays an important role in providing support for the development of capital market in the journey towards appreciable levels of capital market sophistication. Thus, this rules out mechanisms and policies like the ETS, carbon taxes and to some extent debt financing instruments as source of financing the

development of RE to foster adoption of RETs for economic development and climate change mitigation in Africa.

The focus of African governments is on development, hence in some manner; in the view of some governments, this provides a justification for situations like the Medupi coal-fired plant in South Africa (Bazilian et al 2011 b). It however is crucial to recognise the importance of adopting sustainable development paths for African countries currently experiencing rapid growth. The widespread adoption of RETs provides an opportunity to experience development while achieving the objectives of sustainable development.

The benefits of developing RE have been highlighted in terms of its social, economic and environmental contributions in view of the varying objectives of sustainable development. However, to achieve these objectives, the challenge of financing RE to promote inclusive economic development in Africa would have to be addressed. This study seeks to evaluate the various models for financing RE based on compatibility with current economic situations in Africa. Appropriate financial models and mechanisms can help to spur widespread adoption of RETs as well as and the rapid development of REPs across the African continent.

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter begins with a background on research design as a fundamental part of the entire research process, detailing studies conducted by scholars on this subject. The selected research method for this study is also presented as a part of the research design process and justification for the selection of the method is given. Furthermore, features of the appropriate design of the selected methodology are emphasised and these are then related to the study. The main steps in the research design process as structured for this study are then presented.

Additionally, the two research approaches used in this study are expanded on and these are explained to point out their appropriateness for this particular study. Features of the research instruments used in the research are also explained to highlight consistency with the research objectives. Their capacity to collect data through which the research questions would be answered is also presented. In addition, the techniques through which data collected for the study are analysed are also detailed. Information on the population and sample is presented and the specific sampling method used is explained. Ethical considerations regarding the research, limitations of the study and issues for further consideration are also highlighted.

3.2 Research Design

The research design and methodology structuring phase is a fundamental step in the development of a good scientific study (Black 1999). Several scholars have highlighted the importance of this phase as a critical point in determining the outcome and results of studies. It is known that well-articulated research designs help to reduce measurement errors associated with specific methodologies. This helps to increase the reliability of results produced from research (Harwell 2011; Creswell 2002).

Research scholars such as Williams (2007) suggest that methodologies should be selected on the basis of appropriateness in order to gather evidence in the form of data needed to answer research questions posed. This chapter outlines the research design process and methodology as a framework developed to address the research questions, while converting the conceptual model to empirical steps where data is collected for analysis.

This section also describes the steps taken in developing the design phase of the research. Research design encourages critical thinking in developing a logical plan to deduce facts and

conclusions from initial questions upon which the research is founded (Yin 2003). In this research, empirical investigation is based on the need to explore the two main research questions posed in the introductory chapter. The conceptual framework discussed in the literature review is developed from theory surrounding the research questions. The aim is also to investigate the hypotheses detailed in this chapter.

In selecting a research method, consideration for one which greatly minimises the shortcomings of individual methods while increasing the chances for robustness in the research was prioritised. Hence, a research design which employs the use of qualitative and quantitative research methods (mixed methodology) was selected. The choice of this methodology is based on the complexity of the study. The said complexity is mainly regarding the number of variables to be analysed and the challenges consistent with the nature of the research as an emerging field of study in Africa. This presents a major difficulty in obtaining data. Based on these conditions, mixed methodology is considered the most suitable research approach to adequately address the research questions.

Since the financing of renewable energy (RE) for African markets is a fairly under-researched field, it is necessary to obtain and analyse both quantitative and qualitative data. This is in order to present the different views of the various stakeholders on the emerging topic as a holistic concept. Also, the two types of data provide better chances for robustness of results. The premise of mixed methodology follows that quantitative and qualitative methods used augment each other and essentially 'plug' loopholes inherent in either of these methods (Creswell and Plano Clark 2007; De Leslie 2011).

In studying research problems, mixed methodology also provides more comprehensive evidence than either quantitative or qualitative methods do, helping to increase reliability of the results obtained from the study (Johnson and Onwugbuzie 2004; Tashakkori and Teddlie 2010). Finally, considering practicality and pragmatism as approaches for this research, the use of mixed methodology helps to provide answers to questions that cannot be answered by the use of either quantitative or qualitative methods alone (Cameron 2011; Johnson and Onwugbuzie 2007).

Using a questionnaire as the data collection instrument in this research, quantitative data was collected from respondents (financiers and project developers) actively engaged in the financing and development of renewable energy projects (REPs). On the one hand, the response of these individuals represented the actual 'reality' regarding the prevalence of RE

financing mechanisms in the business world which the research seeks evidence to explain. On the other hand, qualitative data was collected through semi-structured interviews with respondents. These respondents included other stakeholders such as policymakers, workers in civil society, energy utilities, governments and RE development institutions. These groups were selected mainly for their knowledge on RE financing. Analysis of the qualitative data was used to explain the broader perspective of the actual reality obtained from analysing the quantitative data collected from financiers of REPs.

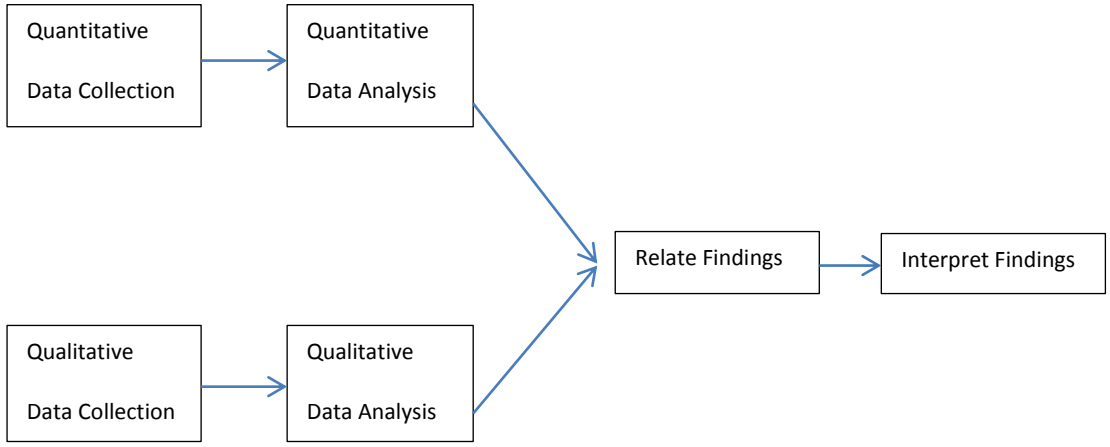


Fig 3.1: Convergent parallel design of mixed methodology (Adapted from Creswell 2006).

Following Figure 3.1, the first step in the research process involved the use of skills associated with qualitative methods – precisely interviewing, such as observation and listening. A preliminary round of semi-structured interviews was conducted with selected experts in RE financing. This was done to help get to the crux of the issues financiers are faced with in making choices relating to the adoption of mechanisms for financing REPs.

This process helped to contextualise the field research and inform the development of the questionnaire. Special attention was paid to important themes in the literature surrounding energy, poverty alleviation, and sustainable development. The preliminary interviews helped to inform refinement of the conceptual framework. This also helped in validating the definition of constructs within the framework.

Secondly, a preliminary version of the questionnaire was developed and distributed online to a few respondents within the sample population. This helped to identify questions that were unclear and could be better comprehended with appropriate rephrasing. This process helped to improve the tendency for questions to be answered more correctly. In parallel with this occurring, a database of viable respondents was built up through extensive collection of data

on possible respondents. Following this, the new version of the questionnaire was distributed online to the entire sample which consisted of REP financiers. The data was then analysed quantitatively using Chi-square tests (explained in details below).

Simultaneously, semi-structured interviews were conducted with selected respondents comprising of policymakers, project developers, financiers, workers in civil society etc. Some respondents were contacted and interviewed via the telephone, while others were contacted and interviewed face-to-face. The collected data was then analysed qualitatively using Atlas.ti (explained in details below).

Upon analysing the data, a brief summary of the results was sent out to all respondents in the research. This document contained a section for feedback which was incorporated into the summary discussion of results in the research. This exercise was conducted in an attempt to explain the findings in more logical and factual ways. Furthermore, qualitative analysis was carried out to compare results from the research to the findings of similar empirical studies in the same field. This process comprised the data validation phase of the research. Figure 3.2 presents a graphical representation of the research design process.

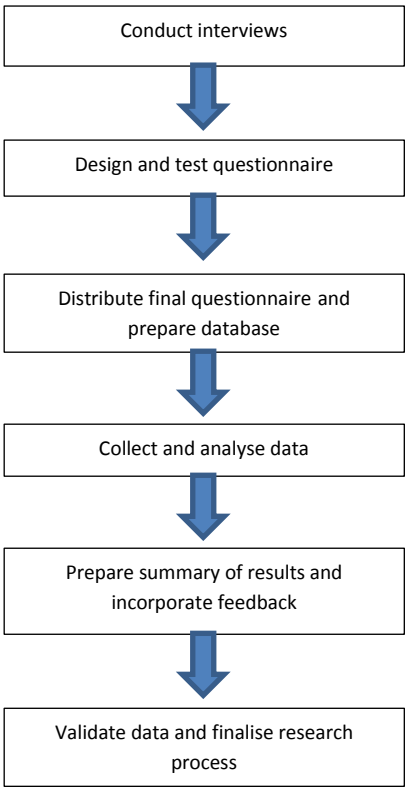


Figure 3.2: An illustration of the main steps in the research design process

3.3 Quantitative Research

This research uses quantitative methods to analyse and elaborate results obtained from the survey. Statistical analysis such as Chi-square tests was selected as the particular quantitative technique based on its clear suitability to fulfil the objectives of the research as stated in the first chapter. The use of Chi-square serves the needs of the research in analysing statistical associations and relationships between the variables.

More specifically in terms of financing RE, the aim of using the technique included analysing the relationship between the use of traditional methods and RET dissemination, and the use of innovative methods and RET dissemination. The technique was also used to assess the association between traditional and innovative financing methods on economic development and as vehicles to promote climate change mitigation through the adoption of RETs.

3.3.1 Survey Instrument

This research employed a questionnaire as the survey instrument for collecting data. The questionnaire was designed using survey monkey – a web-based program which allows users to develop questionnaires for computer-administrated interviews and surveys. The questionnaire was sent to a list of recipients identified as potential respondents for the purpose of the study. The following paragraphs describe the structure and contents of the questionnaire in detail as well as the process through which the survey was administered.

The questionnaire was developed to address five main areas which the research focused on. It comprised of 39 questions which were allocated to the five main areas using a selection process. The main areas were prioritised according to their relevance to the research question and consequent capacity to provide data to explore the questions in-depth. Hence, more questions were allocated to areas that covered issues concerning the mechanisms adopted by firms in the financing of REPs. The main purpose of the questionnaire was to develop valid psychometric measurements based on categorical scales. This was done in order to elicit, ascertain and measure the preferences of financiers regarding the financing of REPs and the extent to which policy influences their financing decisions.

The first section of the questionnaire was aimed at determining the mechanisms employed by financiers in financing REPs. This section posed questions that addressed issues regarding the choice of one mechanism over another and the methods by which projects are financed. The section also posed questions on the type of business model used in establishing the financing

channel, the frequency of repayments made by end-users, the level of market readiness and technological development. These questions were posed to financiers to provide information on the philosophy upon which the choice of a financing mechanism is made.

The questions also served to provide an indication of the prevalence of particular financing mechanisms among financiers and their overall perception of the role of finance in the deployment of renewable energy technologies (RETs). It is important to note that this study targeted firms actively involved in financing REPs in Africa. However, with specific reference to investment firms, the share of REPs in a firm's investment portfolio was not used as a criterion for selection. This is because the initial survey showed that many financiers had only dedicated a small portion of their investment portfolios to REPs.

The second section focused on assessing financiers' knowledge of the impact of investment in RE on economic development – especially the REPs that they had financed. Respondents were asked to highlight any changes observed in terms of societal status, standard of living, employment, disposable income, linked to the use of RETs by community dwellers.

Basically, the questions asked were initiated to provide an understanding of financiers' motivation in financing REPs. These motivations were then analysed in terms of satisfaction levels regarding policies established to promote the development of RE. Questions in this section also asked respondents to prioritise their choice of policy on the financing of REPs. The focus was mainly on established policies to deliver the benefits of economic development while maximising the potential for making profits from investments.

The third section focused on ascertaining the position of financiers regarding the role of finance in removing barriers inhibiting the penetration of RETs. Questions asked sought to elicit information on the possibility of African communities 'leapfrogging' into sustainable development pathways. Questions were asked precisely focusing on using RETs as channels through which the integrity of the environment can be maintained.

Questions asked in this section focused on REP financiers' understanding of climate change, the perceived role of increased RET adoption as an option for mitigating the production of GHGs and the perceived impact of climate change on their immediate communities. These questions were asked to provide an indication of the motivation behind financing REPs and were evaluated in terms of the financiers' receptiveness to the prospects of developing climate policies in Africa.

The fourth section of the questionnaire focused on assessing the performance of financiers' investments in REPs. Respondents were asked questions on the past, present and expected future performance of their investments, using the current financing mechanism their firms had adopted. Questions focused on the perception of value in financing REPs from financiers' perspectives, the returns on investment, incentives for financing REPs and the financiers' time frame or estimated financing cycle for REPs.

Finally, questions directed at understanding the demographics of financing firms were asked in the questionnaire. The questions asked covered areas around the company profile, the number of years the firm has been involved in financing REPs, the age, educational background, experience and positions of respondents.

3.3.2 Survey Administration

The process of administering the survey began with developing a database of target respondents identified through research. The database included the contact details of senior executives at shortlisted firms as potential participants to partake in the survey. In developing the database, particular attention was given to financial institutions that focused entirely on financing REPs. Also institutions that have a broad portfolio of investment projects but are also currently engaging in financing REPs through a specialised unit or department at the institution were considered as important respondents. A particularly important selection criterion was that the firms had to have operations in Africa and should be involved in financing REPs on the continent. The origins of the financial institutions were not taken into account as a prerequisite for selection.

Furthermore, details of the firms were gathered from the websites of important sources of information on RE financing. These included the United Nations Environment Program Financial Initiative (UNEPFI), United Nations Environment Program Sustainable Energy Finance Initiative (UNEP-SEFI), Renewable Energy for the 21st Century (REN21), African Policy Research Network (AFEPREN) and many other specialised directories focusing on the financing of REPs.

Additional sources of information from which respondents were drawn included reputable conferences and workshops on financing RE development in Africa. These conferences include the Renewable Energy Finance Forum (REEF), International Off-Grid Renewable Energy Conference (IOREC), Renewable Energy Africa Conference (RE Africa) and Rural

Electrification Forum Africa (REFA). Overall, the aim was to collect the contacts of over 500 firms engaging in financing REPs in Africa.

The database mainly targeted respondents with RE financing operations in three countries, namely Kenya, Nigeria and South Africa. These countries are considered to be leaders in their various regions, especially with specific reference to financial innovation and the financing of sustainable energy projects. In view of the aims of this research, these countries present particularly interesting cases within which small to medium scale RE financing occurs.

However, respondents from other countries were included in the database but to a lesser extent and the criterion for inclusion was based on the firm's reputation for financing REPs. Profiles of RE financing firms that were contacted include energy service companies (ESCOs), commercial banks, microfinance institutions (MFIs), development banks, venture capitalists and private equity funds.

The administration occurred over three months, precisely from October to December, after the research proposal was approved by the university. It commenced with a pre-test conducted with a few firms from the sample in order to refine the research instrument and validate responses offered. The actual survey which included all of the firms selected from the database commenced after responses from the pre-test had been received and changes to the questionnaire based observing the responses of respondents had been incorporated. Individual emails were sent out to contacts at firms asking for their participation in the survey.

At regular intervals, reminders requesting participation were also sent out to contacts that were yet to complete the survey. A link to the survey was also posted on the UNEP SEFI website and a few other websites that are regularly visited by individuals that engage in financing REPs.

Contacts were assured that their responses would remain totally confidential. Also, respondents were provided with an avenue through which unforeseen challenges with the questionnaire could be addressed. Respondents were encouraged to give feedback on the questions posed – if necessary. Finally, the respondents were guaranteed to receive a summary of the results of the survey.

The promise of confidentiality was given to provide a situation within which the tendency for respondents to answer questions as truthfully as possible can could be greatly increased. The overall aim of this was to maximise the accuracy of results obtained from the survey. This entire process was repeated for REP developers and the database for these respondents comprised of 200 potential participants for the survey.

3.3.3 Chi-square Test

The Chi-square statistic is a nonparametric statistical technique used to determine if a distribution of observed frequencies differs from the theoretical expected frequencies. Instead of testing for means and variances, the Chi-square statistic uses nominal or ordinal level data which test for frequencies and percentages. Chi-square test is a widely used statistical technique in research and this is due to the versatility of the technique particularly in highlighting associations between variables. In business circles where social research is conducted, Chi-square is used very often to conduct analysis and arrive at conclusions that impact decision making processes.

In fields of research, different types of Chi-square tests may be used, namely the goodness of fit and independence tests. In this research, the specific type of Chi-square test selected for analysis is the test for independence. The Chi-square statistic summarises the discrepancies between the expected number of time each outcome occurs, assuming that the model being tested is true, and the observed number of times each outcome actually occurs. This is done by summing the squares of the discrepancies, normalised by the expected numbers (Andrews 1988; Dorak 2006).

Chi-square is a flexible statistical technique used to analyse or explain relationships between two selected variables. In theory, the objective of Chi-square is to statistically explain the associations and relationships or the lack thereof between two selected variables based on the significance of the Chi-square statistic in relation to the p-value selected. An important principle of the Chi-square test is the construction of the null and alternate hypotheses. Accepting or rejecting the null hypothesis is subject to the outcome of the Chi-square test in relation to the specific Chi-square statistic.

The type I and type II errors are two main types of errors associated with Chi-square tests. A type I error is made when a true null hypothesis is incorrectly rejected and a type II error comprises the incorrect failure to reject a false null hypothesis. In this research, Chi-square

test is used to analyse associations between variables developed from categorical and continuous data.

3.3.4 Profile Classification

This research uses profile classification as a technique to determine the relationships between variables in order to enhance the understanding of the characteristics of RE financiers. The models used were derived from the research problem and aim to provide insights into the population for the purpose of investigating the research questions. The main goal of these models was to test the elements of the conceptual framework as described in the literature review section. This research uses decision trees as the classification technique to appropriately explain the relationships between the three core variables selected for the study and the other variables developed for the purpose of the research.

A decision trees is a form of multiple variable analysis that can substitute, complement or supplement traditional forms of statistical analysis, having the capability to reflect both categorical and continuous objects of analysis. A decision tree forms branches or segments beneath the root node based on a method that highlights the relationship between the object of analysis known as the target variable, and other fields that serve as input fields to create branches. The values in the input field are used to estimate the likely value in the target field.

When a decision rule is made forming a decision tree, one or more decision rules can be extracted to highlight the relationship between input variables and the target variable (Zhou and Chen 2002; Jenhani et al 2008; Chen and Hung 2009). In this research, the target variables are number of projects, total investment in RE and number of years in RE while input variables comprise the rest of the variables developed for the research.

3.3.5 Operationalisation of Variables

This study uses Chi-square to examine the methods by which financiers finance their REPs and decision trees to highlight relationships between target and input variables. These techniques were used to analyse the associations and independence among three core areas that highlight the characteristics of REP financiers: the number of projects financed, the total investment in RE and the number of years financiers have engaged in financing REPs. These areas were chosen based on the fact that they explain the relationship between the choice of financing methods and the dissemination of RETs.

Also, the technique was used to examine the association between financing methods on RET adoption. Finally, the technique is used to determine the financing method or combination of methods that deliver the highest adoption levels of RETs. This is done to establish which models of financing RETs can provide greater opportunities for sustainable development in terms of economic development and climate change mitigation.

As elaborated in the conceptual framework in chapter two, methods of financing RE are classified as traditional and innovative. Furthermore, the factors which influenced financiers' choices of methods the most were identified from literature as policy, income and risk. These variables were operationalised in the data collection process, specifically in the questionnaire using selected indicators. In many cases, respondents were asked specific questions relating to their methods of financing REPs and the impact of policy on their financing decisions.

Respondents were also asked questions on the importance of estimated income in choosing financing methods and on the role of risk (specifically investment risks) on their choices of financing methods. In some cases, averages calculated from the responses of individual respondents on these questions were used to operationalise variables which are retained in the models. A list of all variables and the manner in which they were operationalised is attached in the appendix.

3.3.6 Hypotheses and Propositions

The hypotheses and propositions detailed in this section were derived from the body of knowledge upon which RE finance and sustainable development are established. These hypotheses and propositions are linked to the research questions and form an integral part of the conceptual framework in this research. The hypotheses and propositions of this research are as follows:

Hypothesis 1.1: Traditional financing methods are used more often to finance REPs than innovative financing methods.

Hypothesis 1.2: The total investment made by a financier indicates which method of financing is used at a firm.

Hypothesis 1.3: The number of years a firm spends in RE finance is related to the financing period the firm proposes in financing REPs.

Hypothesis 1.4: The dominant RE policy impacts financiers' decision on whether or not to finance REPs.

Proposition 1: Traditional financing methods for renewable energy are driven by the motivation for profits, policy support and localised RE market trends while innovative financing methods are driven by the local culture on repayments of loans issued, motivation to promote economic development and donor funding.

Proposition 2: Traditional methods take into account the performance of investments in making financing decisions and value is translated as profits while innovative methods consider the impact on society in terms of economic development and social wellness over profits as value is in the form of the overarching benefits of sustainable development.

Proposition 3: Traditional financiers do not see value in financing small and medium sized REPs in semi-urban and rural areas considering the barriers to REP development.

Proposition 4: Increasing the impact of innovative financing methods may lead to greater sustainable development outcomes and accelerated adoption of RETs.

Proposition 5: Combining the impact of traditional and innovative financing methods may lead to greater sustainable development outcomes in terms of RE development than either method.

3.3.7 Validity and Reliability

In quantitative research it is assumed that the 'truth' which is a form of reality as it concerns the research, is attainable and can be quantified. However, if this objective approach is to be considered, it is critical that the research instrument is designed to measure constructs upon which the research is built accurately. It is also pertinent that the sample reflects the main characteristics of the population being studied. When these issues are taken into account and built into the in research work, the potential to produce accurate results which can be highly generalised is greatly increased. Consequently, this increases the extent to which results of a research may be considered reliable if repeated under the same research conditions.

Validity of research work refers to the level of accuracy of inferences made in conducting research (Allen and Yen 2001). Validity is further divided into two related concepts – internal and external validity. Internal validity focuses on the appropriateness of the research instrument in terms of its content, definitions of constructs and how these are elaborated in

the research instrument. This ensures that research instruments gather data from the appropriate research population. External validity is concerned with the generalisability of the research in terms of applying research findings to a larger population similar to the sample population studied in the research (Nunnally and Bernstein 1994).

Internal and external validity are integral parts of the research design process. They are necessary to ensure consistency between the research instrument and the target population while maximising the capacity to generalise results of the research. Although originating from quantitative research methods, the concept of validity may also be applied to qualitative research (Onwuegbuzie and Johnson 2006; Morse et al 2002; Kirk and Miller 1986; Golfshani 2003).

In this research, validity has been ensured in terms of the constructs derived from the body of literature surrounding the research questions. Firstly, on a conceptual level, the constructs represent theories on RE finance from which the hypotheses established in this research have been developed. These hypotheses form the basis of scientific inquiry regarding the research questions which consequently inform the research design process. Further, variables that underpin constructs in the research have been clearly defined to elicit the correct information.

Secondly, with respect to the research question, questionnaires have been selected as the appropriate research instrument. In the questionnaire, clearly defined variables as the focus of interest are operationalised through specific simple questions which are easy to understand and do not require complex responses. This has been done as a precaution against respondents leaving questions unanswered or providing untruthful responses which may contribute to decreasing the reliability of the research findings. Also, conducting a pre-test of the questionnaire helped to reduce the potential of questionnaires coming back incomplete. Difficult questions were rephrased to highlight what was being asked in much simpler ways which made the questions clearer.

Finally, effort was made to develop profiles of potential respondents who would be contacted and invited to participate in the research. Although responses were expected to be random, pre-defined characteristics which help to establish the target population were established, ensuring that responses are only solicited from respondents that fit the pre-defined population characteristics. This was done as a measure to increase the reliability of the research findings.

The concept of reliability is based on the level of consistency regarding a research instrument to produce the same results over time upon repeated trials (Kuder and Richardson 1937). Reliability is ensured in this study by designing the research instrument (questionnaire) to accurately measure variables of interest in the research. Questions posed in the questionnaire are derived from variables and constructed to be straightforward as a means to investigate the research question.

This was designed into the research instrument in a bid to elicit standard responses from respondents. The pre-test of the questionnaire also served the purpose of clarifying respondents' comprehension of questions and their rephrasing in instances where questions may have been considered unclear. The questionnaire was designed to measure variables relating to the factors that influence financiers' choices of methods through which they finance REPs and the overall impact of their financing activities on sustainable development.

3.4 Qualitative Research

The second part of this research uses the qualitative approach to gather and analyse data. Qualitative research is a systematic research approach which is subjective in nature and used to describe and give meaning to documented experiences of respondents (Williams 2007). The purpose of adopting the qualitative approach is to obtain data on the positions of stakeholders in the RE sector on financing of RETs. The specific focus was on the barriers to the provision of adequate finance for REPs from the private sector.

Stakeholders who were mostly policymakers were asked questions focused on the perceived impact of the various methods of financing REPs. Stakeholders were asked questions about policy on the integration of the private sector in financing the small and medium scale REPs, especially in semi-urban and rural areas. Also, questions around policy design and the objectives of policies that support contributions of the private sector in RE development were asked. Attention was paid to stakeholders' accounts of consideration for the factors that drive private sector financing of REPs in designing and developing RE finance support policies.

3.4.1 Research Instrument

The qualitative part of this research uses semi-structured interviews as the main instrument for data collection. An interview guide within which information on the scheduling, list of questions and concepts to be discussed, focus and expected outcomes for each interview was employed. Rather than engaging respondents in structured or unstructured interviews, semi-

structured interviews were selected as the main research instrument based on its capacity to satisfy the objectives of this research.

While it is important to obtain individual views of respondents, it is also critical that the interviews are focused on selected concepts in RE financing which the research aims to investigate. Also the perspectives of respondents on policy design and establishment is critical to providing necessary information to explore stated research questions. Policies help to promote further participation of the private sector in financing REPs in especially semi-urban and rural areas. This information may be difficult to elicit using structured interviews which are too rigid and provide little insight on the personal views of respondents. Also, unstructured interviews which may be 'free flowing' could increase the possibility of veering off track into issues that may not be relevant to concepts on RE financing embedded in the research questions.

Interviewing is a systematic qualitative research technique used to collect data from participants by asking questions and consistently documenting responses on issues relating to the subject being investigated. The process of interviewing for the purpose of data collection in research requires an appreciable level of a combination of communication and listening skills to derive reliable data (Gillham 2000). Kvale (1996) regarded interviews as an interchange of views between two or more people on a mutual topic of interest, suggesting that human interaction is central to the production of knowledge which may be elicited from research data.

Commenting on the role of questions in interviewing, Hoyle et al (2002) explain that questions serve the dual purpose of motivating respondents to give precise replies on their perspectives of tabled issues while avoiding biases relating to conformity. In using the semi-structured interviewing method as the instrument for data collection in this part of the research, interview questions consisted of a list of open-ended questions focused on RE financing.

The open-ended nature of the questions allow for discussions to be centred on concepts, themes and beliefs in RE financing, especially from the perspectives of financiers and policymakers. This presents an opportunity for discussions to be focused and directed yet allowing for particular questions and topics to be probed in deeper detail. It is important to also note that interviews with participants were conducted one participant at a time.

The medium by which interviews were conducted varied from one participant to another, depending on participants' preferences. Interviews were conducted face-to-face or telephonically. Interviews were also recorded for transcription and further analysis in later stages of the research using an electronic recording device. Research data took the form of written texts from transcribed interviews.

This section presents an overview of the different techniques and strategies employed in interviewing respondents and collecting data for the research. While the main tool for collecting data used was semi-structured interviews, other techniques such as developing diagrammatic representation of processes narrated by respondents was used. The sketching of storyboards to detail flows and processes in RE financing and policymaking and the overall estimated impact on the economy was also used. Although engaged periodically, note taking was also employed during interviews as a way of documenting important observations noted during the interviews with respondents.

The main instrument used to collect data during interviews was the interview schedule. The interview schedule consisted of a list of open-ended questions focused on particular themes in RE finance and policy development. Two separate interview schedules were prepared for financiers and policymakers. Although, during the interviews, policymakers provided information on financing mechanisms, investment risks, and some other concepts financiers were familiar with. Also, during interviews, financiers provided information on the broad policy landscape and regulatory frameworks on energy and RE development.

The interview schedule for financiers comprised of 14 questions which broadly covered areas on financing models and mechanisms for RE development and internal and external incentives for investing in RE. Furthermore, the schedule highlighted questions focused on the risk and reward trade off in investing in REPs, the impact of financing REPs on local economic development. Also questions on the firm's preferred policy to promote increased investment in RE development, the accessibility of RETs to local communities and the impact of financing REPs as a part of the larger effort to address the energy access challenge in many African countries were listed.

The interview schedule for policymakers contained questions which focused on the policy options available to governments to implement in efforts to promote small and large scale RE development specifically in respondents' countries. Also, questions about the distinct features of specific RE policies and the possibility of incorporating these features into existing policy

frameworks for RE were highlighted in the schedule. Concepts on the perceived impact of broad policy frameworks such as targets for RE generation on financiers were also highlighted as questions in the schedule.

The interview schedule also contained questions on policy certainty as a tool to alleviate investors' concerns and promote investment in RE. Finally, in the interview schedule, respondents were asked to give an account of the performance of policy in promoting investment in RE and the consequent development of RE within their respective countries.

During the interviews, apart from recording conversations electronically, data in the form of notes, story boards, process charts was collected to provide a visual diagrammatic representation of particular phenomena elaborated upon by respondents. Although these techniques were also used in face-to-face interviews, they were used more often in telephonic interviews as a way of documenting concepts explained by respondents.

Notes were taken specifically to track and highlight important issues respondents' detailed, in order to provide points of reference through the analysis of the data. Notes taken in the early interviews provided some insight into developing important themes generated from the data collected. This informed the subsequent use of inductive content analysis technique employed in analysing data for the study. During interviews, process charts were used to collect and document data provided by respondents particularly on the linkages and interrelatedness of sub-concepts discussed. These included finance and policy in RE development and their consequent impacts economic development.

Storyboards were used occasionally to develop and establish sequential processes connecting concepts in RE finance and policy formulation impacting economic development in interviews with respondents. The storyboards were mainly sketched roughly and were also used to map relationships between concepts explained by respondents during interviews.

3.4.2 Data Analysis

The purpose of analysing data qualitatively was to search for and highlight patterns and themes in participants' responses. These themes in turn provided the much needed guidance in interpreting, discussing and concluding interviewee responses as they relate to the research problem. In this process, the first step was to transcribe recorded interviews, converting verbal communications into written texts shortly after these interviews take place. Analysis of

data followed an iterative process. After the first few interviews, preliminary analysis was conducted to highlight themes which may be explored in subsequent interviews.

Content analysis is the selected technique by which data was analysed. Content analysis is a widely used methodology in the social sciences, and its application may either be qualitative or quantitative (Hsieh and Shannon 2005). Here, the research adopts qualitative approaches to content analysis. Primary data in the form of transcripts obtained from interviews with respondents were analysed. Attention was given to the frequency and meaning of key words used in by respondents.

It is important to note that these key words are linked to the theory from which the research question is derived. This form of content analysis which deals with theories and concepts is known as the deductive approach. Content analysis in this research contributed towards the identification and quantification of specific ideas and concepts. These focused on the pattern and trends through which policy establishment for increased private sector financing of small and medium scale REPs occurs.

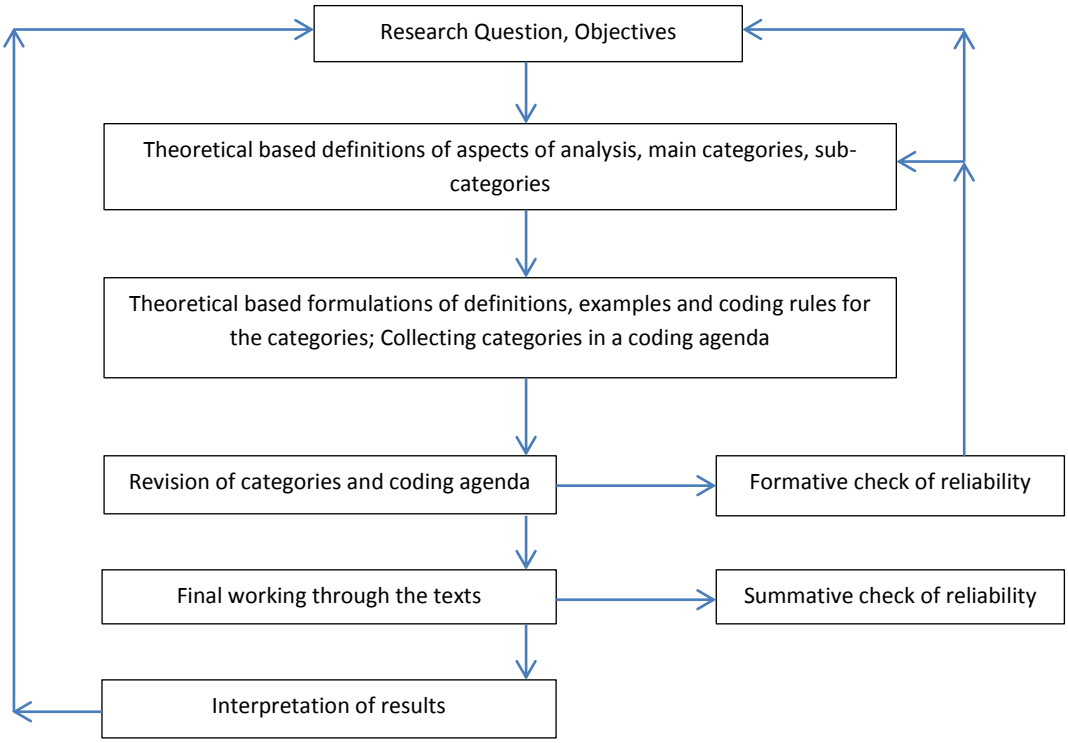


Fig 3.3: Step model of deductive category application (Adapted from Mayring 2000).

In carrying out content analysis, data from interviews was analysed using Atlas.ti, a computer-based program and qualitative research software which supports content analysis. Atlas.ti helps to ease the process of uncovering relationships and themes for systemic analysis of complex issues in written texts, which in this research are transcripts of interviews with respondents. In Atlas.ti, tools which allow for the location, coding and annotating of findings in data are provided to researchers. This allows for the evaluation of the degree of importance of themes, concepts and theories embedded in the data. Complex relationships between themes can also be visualised in Atlas.ti. This helps to provide greater insight into analysed themes as they relate to overarching concepts, which in turn strengthens the findings of the research.

Atlas.ti supports a multi-stage data analysis process from initial coding of data to assessment, rating and organisation of data into conceptual structures to enable comparative analysis of themes occurring in the data. Atlas.ti was used to develop themes from concepts on the role of policy in increasing private sector financing of REPs in semi-urban and rural areas found in the data. The program was also used to evaluate the relationship between themes and to assess the level of importance of these occurring relationships. Through inference on these relationships, suggestions with the possibility of answering the research questions were made.

This section outlines the processes through which recorded interviews were processed into transcripts as data prepared for analysis using Atlas ti. A specific routine was followed after each interview to ensure that data was not mixed up if left to accumulate at the end of the data collection process. The routine entailed transferring recorded interviews as electronic files onto the researcher's personal computer and external hard drive where the files were labelled and dated accordingly. Electronic files were labelled using the first and last names of the respondent interviewed and the date of the interview.

Thus, after each interview, conversations with the respondent were transcribed and filed on the researcher's computer and hard drive as interview transcripts labelled using the name of the respondent and the date of the interview. Transcripts from interviews with respondents were grouped according to the country and filed together. In transcribing interviews, attention was given to the details of responses from respondents in order to improve accuracy in the final transcript and consequently responses in the overall study. On average, each transcripts from interviews with respondents amounted to four pages of written text.

In compiling and storing documented notes and charts from interviews, a separate notebook used as a journal for interviews was kept by the researcher. All the notes, process charts and storyboards derived from interviews with respondents were stored in this notebook. The notebook was kept on hand with the researcher throughout the data collection process for the research. At the end of each interview, the researcher labelled the notes collected using the respondent's name and the date of the interview as information needed to identify the respondent specific data was collected from.

Notes taken during interviews with respondents were normally a mix of scribbled sentences, process charts, diagrams and storyboards. These were documented in no particular sequence as the decision to take notes or sketch diagrams was mainly prompted by responses from the respondents. Thus, at the end of each interview, the data collected in the notebook was a mix of written sentences and sketched diagrams. On average, notes from an interview including sketched diagrams were collected on two pages in the researcher's notebook.

3.5 Population and Sample

The target population in this part of the research is comprised of policymakers and financiers that are familiar with RE development in Africa. The focus however was on Sub-Saharan Africa and interviewees were selected mainly from three countries namely Kenya, Nigeria and South Africa. These countries were selected based on their statuses as leaders in financial services within their regions. Countries were also selected on the basis of development activities occurring within localised RE industries.

At country level, the sample of interviewees was mostly made up of policymakers. Their perspectives on policy issues relating to the financing of REPs are critical in providing data to investigate the research problem. The perspectives of financiers are also important. However, the literature on RE finance suggests that the commitment of financiers to financing REPs greatly depends on the level of support provided by policymakers through policy implementation. Moreover, the nature of the research question requires an inquiry into the perspectives and opinions of policymakers on the role of policy in supporting RE financing for widespread RET adoption.

3.5.1 Sampling Method

According to Blaxter et al (2001) a sample represents a subset of the target population within which a researcher wishes to investigate a phenomenon. The objectives of a research study as

well as characteristics of the target population such as size and diversity determine the number of interviewees and consequent composition of the sample (Barreiro and Albandoz 2001). This part of the research used the purposive sampling technique to derive the sample. Purposive sampling is one of the most common sampling techniques used in qualitative research. Participants were grouped according to preselected criteria relevant to the research question (Barreiro and Albandoz 2001).

In this research, the preselected criteria are participation in policymaking by developing RE policies focused on RE finance and the financing of REPs. Furthermore, quota sampling technique was used to establish the ratio of policymakers to financiers within the sample. Quota sampling is considered a type of purposive sampling but is widely accepted to be a more rigorous technique with respect to developing sizes and proportions of subsets of populations to fit prescribed characteristics. Based on the nature of the research question, for the purpose of this research, it was established that for every five financiers interviewed, five policymakers should be interviewed.

3.5.2 Access to Respondents

In most qualitative studies, access to research sites is critical for getting the research work done as field work and data collection is mostly carried out at the research site. However, in this research access to research sites was not be necessary based on the selected technique for data collection and the principles upon which the technique is founded, in relation to the needs of the research. This said, rather than access to research sites, access to respondents is considered the more critical issue for data collection in this research.

This is due to the fact that the research questions requires individual responses from interviewees and importantly, the subject of investigation is neither linked to group activities nor the observation of evolving social issues in their natural states. Rather, the subject of investigation is based on the perceptions of respondents to concepts in RE financing. It is also based on the role of policy in driving increased participation of the private sector in the financing of REPs in semi-urban and rural communities. Through formal and informal processes, access to a number of interviewees was organised for this research and a list of other possible interviewees was developed. A formal request for participation in the research was sent out to the final list of potential interviewees upon approval of the research proposal by the University.

3.6 Timeframes for Data Collection

Interviews took place over a period of three months precisely from October to December, beginning immediately the study was approved by the university. Depending on the method most convenient for interviewees, interviews were conducted either face-to-face or over the telephone. However, a priority for face-to-face interviews was maintained throughout the period interviews are scheduled to take place. Alternative methods were used when it was absolutely necessary, based on interviewees' schedules. Interviewees were senior managers preferably in executive management positions at institutions partly or entirely focused on RE development. For the purpose of this research, 26 interviews were conducted.

Table 3.1: Details of time allocated for the interview process

Activity	**Duration**	**Quantity**	**Time**
Develop guide	1 hour	26	26 hours
Conduct interview	1 hour	26	26 hours
Code data	30 minutes	26	13 hours
Reflect on data	30 minutes	26	13 hours
Transcribe data	5 hours	26	130 hours
Review transcribed data	1 hour	26	26 hours
Develop themes	2 hours	26	52 hours

3.7 Ethical Considerations

Consideration for ethical issues is of great importance in conducting qualitative research. Researchers have numerous responsibilities towards research participants and beneficiaries of the research done. Respect for the rights of individuals is critical, therefore it is of utmost importance that research is conducted in manners that do not cause harm to participants and does not mislead future researchers building on established research work.

The context within which this research took place was taken into consideration with respect to the aim of the research and also the level of sensitivity of the research problem. It was concluded that questions asked to respondents during interviews would not cause any form of harm, trauma or suffering. This was based on the low sensitivity of the research problem which also has very little to do with the intricate personal issues concerning respondents.

Written or verbal consent from respondents was obtained before interviews took place. In obtaining consent, respondents were well informed about the aims of the research and what their participation entails. Even though it is difficult to measure the dangers (if any) of the research context to the target population, the identity of individual respondents were kept confidential.

Disclosure of interviewees' identity could pose risks to their reputations based on their responses to questions asked during the interview. Finally, prior to commencing with the research, the research proposal was subjected to a formal ethical review process by the ethics committee at the University. This served to highlight any additional issues for concern in the research process.

3.8 Limitations of the Study

It is understandable that every research study has its limitations, and consequently opportunities for further research may arise from such limitations. It is also important to disclose the limitations of a research to show scholarship and demonstrate that issues surrounding limitations have been addressed to the best of the researcher's capacity as to improve the validity of results.

The current stage of RE financing for development and climate change mitigation in Africa can be seen as a limitation for this research. This is due to the fact that RE financing on the continent is currently concentrated in urban areas in selected countries. Financiers from the private sector may not be well versed with concepts of financing RE for semi-urban and rural development. At this juncture, probing and elaboration via interviews played an important role in clarifying concepts as to elicit valid responses from interviewees.

3.9 Issues for Further Consideration

The choice of methodology and selection of research techniques for this research is based on the nature of the research questions the study is designed to investigate. The first research problem focuses on investigating the methods and mechanisms of financing RE development. It also focuses on evaluating the impact of financing methods so as to establish methods which may be more effective in encouraging widespread adoption of RETs in semi-urban and rural areas.

Particularly, the focus of the problem is to establish the impact of financing methods currently employed in order to create channels by which private sector financing of REPs can be increased. These areas are investigated in order to contribute to studies and/or efforts at lowering RET financing challenges to ultimately increase RET penetration.

In turn, the second research question focused on policy elements that support the financing of RETs. Although it is possible to collect quantitative data to investigate this research question, based on the needs of the research qualitative research approach is selected as the more appropriate strategy of inquiry. This is because an understanding of policymakers' positions on the role of private sector financing of RE development, especially in semi-urban and rural areas, has to be established.

Concepts surrounding RE finance and its impact on sustainable development characterised by RET adoption yielded more reliable data through interviews. Also, the implementation of policy to leverage private sector financing of RE which forms the crux of the research question had to be discussed. This was to allow for further probing of responses to questions in order to understand the perspectives and priorities of policymakers on RE financing.

3.10 Summary of the Chapter

This research uses the convergent parallel design of mixed methodology which allows for research questions to be investigated in a mixed methods research design. Quantitative and qualitative research methods were engaged to derive findings that are converged to serve the purpose of providing better answers to research questions. The choice of this design stemmed from the need to quantify the RE financing activities of financiers as well as the impact on sustainable development. This was done while seeking to understand the perspectives of policymakers regarding efforts at increasing private sector financing of mostly small and medium sized REPs in semi-urban and rural areas.

For the quantitative part of the research, questionnaires were selected as the appropriate research instrument, with Chi-square and decision trees selected as the data analysis methods. Semi-structured interviews and content analysis were chosen as the preferred research instrument and data analysis method, respectively, for the qualitative part of the research. The mixed methodology design fulfilled the research aim of the quantifying RE financing activities in selected African countries. This was done using theory developed from researching a subset of the sample from which respondents were selected to understand

possible ways in which policy can play a more useful role in increasing private sector financing of REPs in semi-urban and rural communities.

The mixed methods approach was selected based on the need to obtain statistical information from the population of RE financiers. This results obtained can be applied to the general population of REP financiers in African countries. Additionally, results of the qualitative research helps to provide an understanding of the unique perspectives of stakeholders involved in RE development within African countries. The selected mixed methodology approach used quantitative and qualitative data to analyse important concepts such as risk, value, investment objectives, policy design and structure from the perspectives of RE financiers, developers and policymakers.

4.0 PRESENTATION OF RESULTS FROM QUANTITATIVE RESEARCH

4.1 Introduction

This chapter presents the results obtained from the quantitative research conducted in this study. In the following sections, the population and sample is discussed, descriptive statistics for the population are highlighted and elaborated upon in a bid to provide a holistic view of the data as well as an understanding of the associations between selected variables used in the quantitative research. In addition to this, results of appropriate tests carried out on the data are presented as a means of providing an understanding of the population. In subsequent chapters of this research, this understanding provides a foundation upon which results from the quantitative and qualitative research are interrogated holistically in relation to popular themes highlighted in the body of literature surrounding this study.

The main statistical test carried out in this section of the research is the Chi-square test of association or independence. Additionally, results of an exploratory analysis in the form of decision trees are presented in this chapter. While highlighted results from decision trees may not provide a robust statistical analysis of the relationships between variables, they serve as useful tools in classifying profiles of firms within the study. This provides additional information on the relationships between variables as the process highlights the influence of variables on each other, essentially contributing to inform the findings in this research.

4.2 Population and Sample for RE Financiers

The population targeted for this section of the research comprised of senior executives at financial institutions which had financed renewable energy projects (REPs) in Africa. The population of this sample is derived by adding up the total number of financiers involved in financing REPs. Financiers qualify as respondents if their firms have financed at least one REP in an African country. At best, RE development can be described as an infant industry with the potential to impact mainly the energy sectors in African countries positively by contributing to reduce the challenges for economic development linked to energy provision.

This, coupled with undefined directions for RE development as is the case with many African countries made it highly challenging to find local financial institutions investing in REPs within African countries. Hence, the bulk of the population as defined earlier, and consequently, the sample is mainly comprised of foreign financial institutions financing REPs within African countries.

The sample is made up of 155 respondents mainly from five geographical areas and each respondent's institution had financed at least one REP in an African country. In the figures below, details such as the characteristics and properties of the sample are highlighted. Some of these details include the regions where the financial institutions are located, the regions within Africa where financed projects are located and the type of financial institutions respondents are attached to. Further details regarding the level of experience respondents have in the RE finance sector measured in years, the backgrounds of respondents and the age brackets of respondents is presented in the appendix.

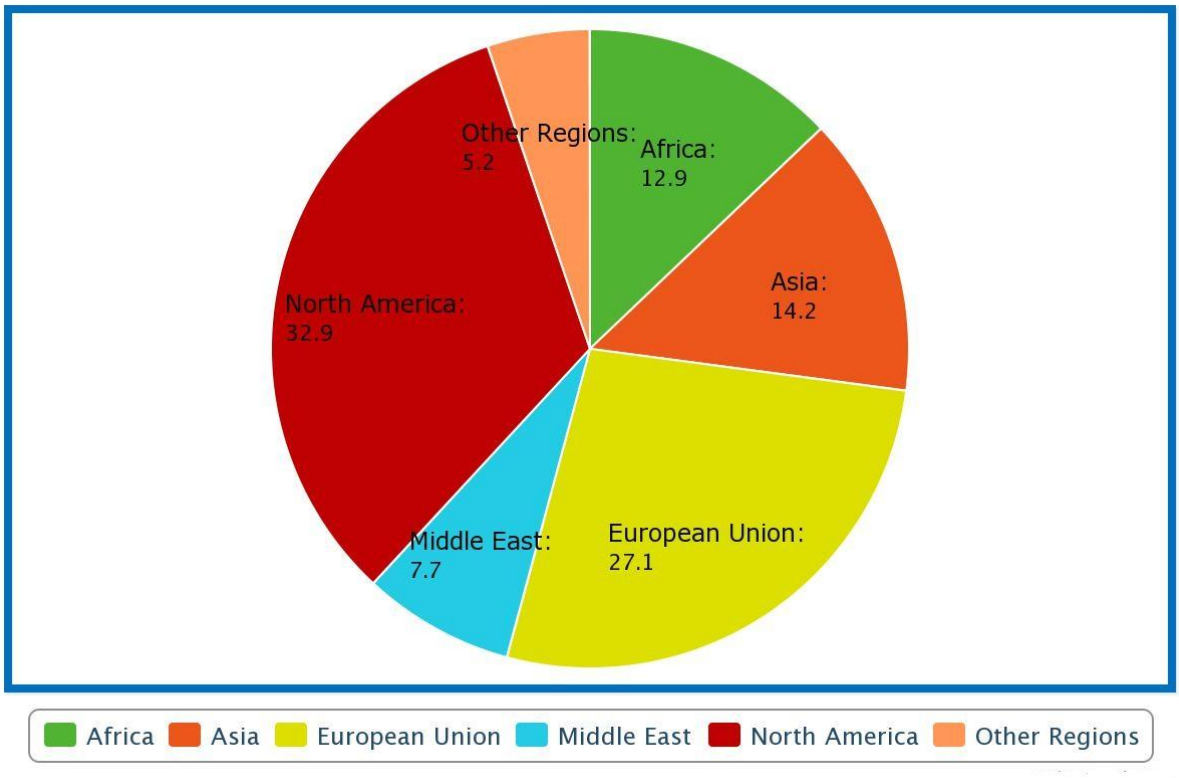


Fig 4.1 Distribution of RE financiers by geographical region

The population for this section of the research comprised of the total number of financial institutions globally that had financed at least one REP in an African country. While it is difficult to ascribe a specific number to this population, much academic and policy research on the subject suggests that this population could change rapidly with the establishment of RE policy in African countries (Foster-Pedley and Hertzog 2006; Hamilton 2010; Varadarajan 2011; IRENA 2012; UNEPFI 2012).

For the purpose of this research, 500 potential respondents were identified and contacted. Respondents were identified mainly through the databases of the Deutsche Gesellschaft fur

Internationale Zusammenarbeit (GIZ), United Nations Environmental Program Finance Initiative (UNEPFI), Organisation for Economic Cooperation and Development (OECD), European Investment Bank (EIB), the World Bank and the International Renewable Energy Agency (IRENA). However, only 155 complete and useable responses were received, corresponding to an effective response rate of 31% which is in line with studies of this nature.

In Fig 4.1, above the distribution of respondents according to the regions within which the financial institutions' respondents are associated with is highlighted. The bulk of respondents for this section of the study come from North America and countries in the European Union (EU), while respondents from Asia and Africa have similar representations regarding the actual number of respondents. Similar to this, the Middle East and other regions excluding those highlighted here are almost equally represented in terms of the actual number of respondents that comprise the sample.

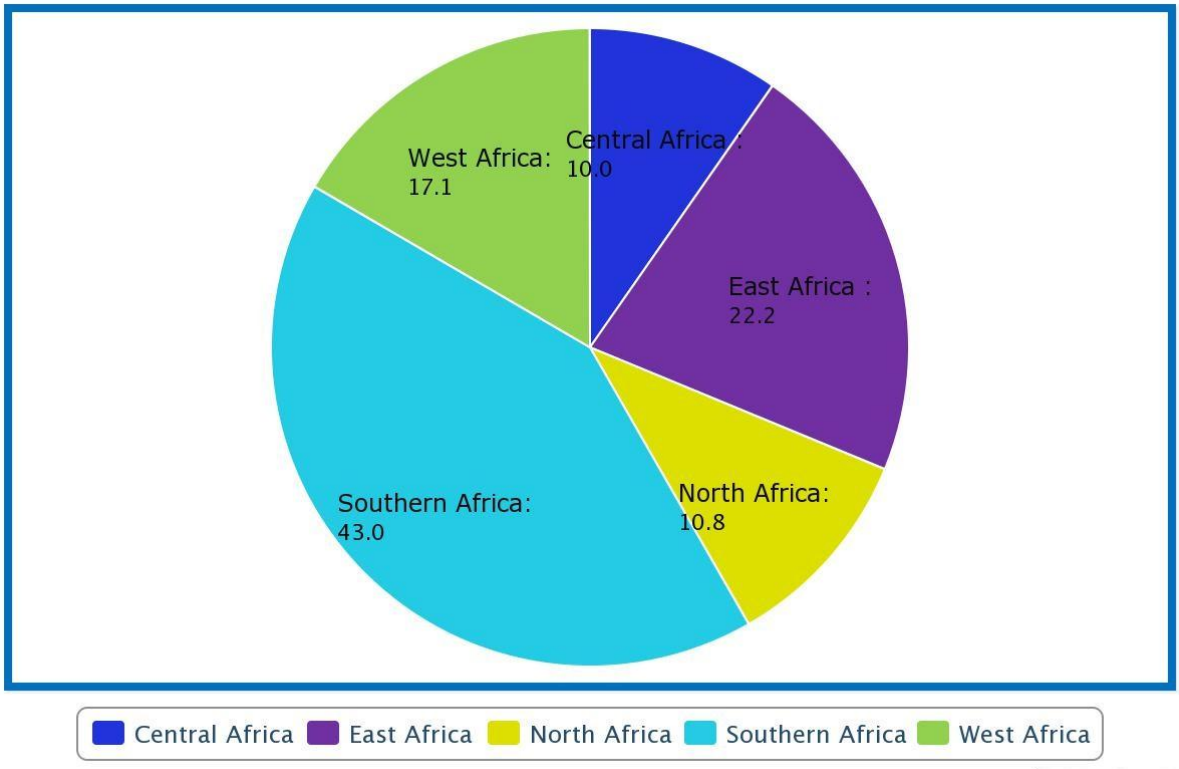


Fig 4.2: Distribution of REPs financed by respondents' institutions

In Fig 4.2 the distribution of REPs financed by institutions that the respondents are associated with is highlighted. According to the data obtained, the bulk of REPs in African countries financed by respondents' institutions is located in Southern Africa which accounts for almost half of these REPs. East Africa is the next region where respondents' institutions have

financed a high number of REPs. This is followed closely by West Africa which in the rank of regions in Africa has the third largest number of REPs financed, according to respondents. Finally, the regions of North Africa and Central Africa have a similar number of REPs financed by respondents' institutions.

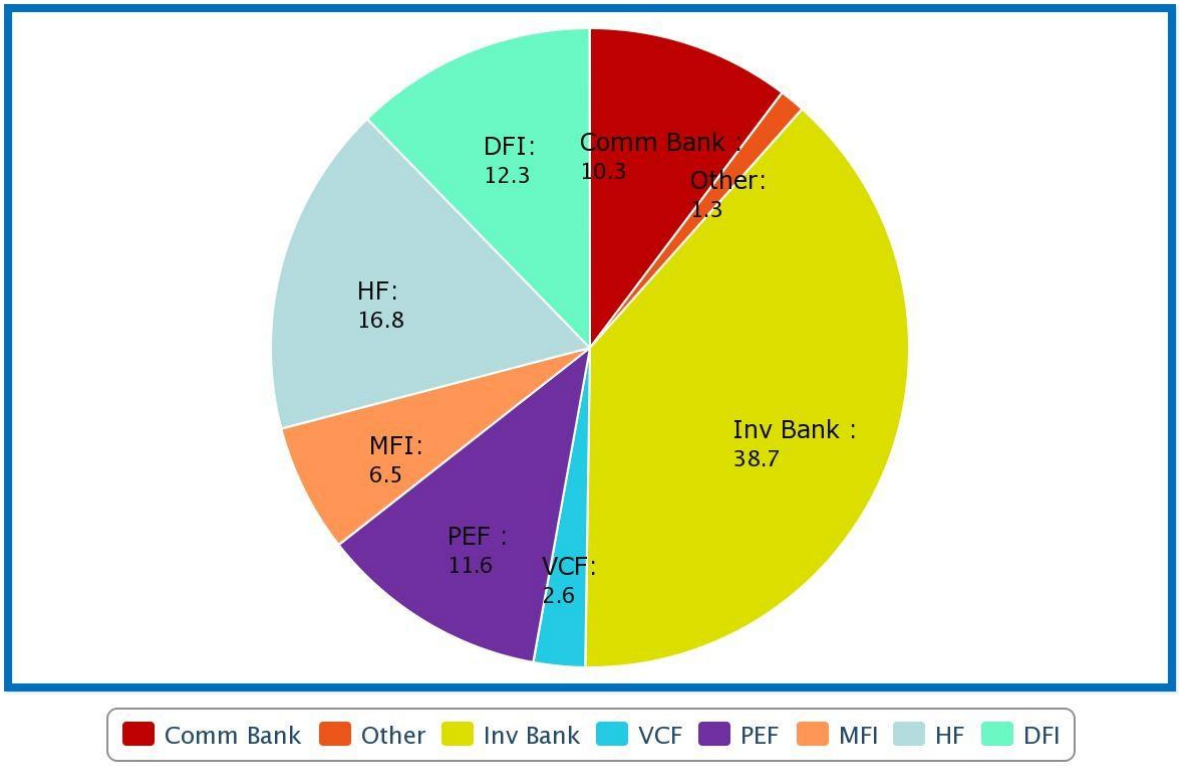


Fig 4.3: Distribution of RE financiers according to type of financial institution represented[8]

In Fig 4.3 the distribution of respondents according to the type of financial institution that respondents are associated with is highlighted. The bulk of respondents for this section of the research come from investment banks accounting for almost half of the population of respondents. After investment banks, in an order of higher representation, hedge funds, development banks, private equity funds and commercial banks are represented as the financial institutions that respondents are associated with. Again, ranking by the level of representation, the number of respondents associated with microfinance banks, venture capital funds and other institutions engaging in financing REPs can be said to be low in comparison to other financial institutions previously discussed.

[8] Comm Bank, Inv Bank, VCF, PEF, MFI, HF and DFI are Commercial Bank, Investment Bank, Venture Capital Fund, Private Equity Fund, Microfinance Institution, Hedge Fund and Development Finance Institution respectively. Other includes entities that could be involved in financing REPs but are not financial institutions. This includes institutions such as energy utilities and energy service companies.

4.3 Statistical Tests and Analyses for RE Financiers

This section provides a broad overview of the data collected, highlighting descriptive statistics such as the percentages and frequencies of selected variables relating to the financing of REPs. The selected variables represent the financiers' perspectives on financing REPs. In the following sections, descriptive statistics which highlight responses from REP financiers are presented and correlations between variables are presented.

In addition to this, the results from Chi-square tests carried out on the three core variables that best describe the characteristics of the population are presented and the associations between variables are highlighted. Possible relationships between variables are identified and expanded on. Finally, the outcome of profile classification using decision trees carried out on the three core variables is highlighted. Summaries of selected decision rules describing relationships between target and input variables are presented to provide further insight into the characteristics of the sample of financiers.

Table 4.1: Frequencies and percentages for REP financiers (n = 155)

Variable	Frequency	Percentage
Number of projects		
0 to 10 projects	113	72.9
11 projects and above	42	27.1
Method of financing[9]		
Traditional financing	121	78.1
Innovative financing	34	21.9
Financing method motivation		
Risk reduction	112	72.3
Energy access	43	27.7
Barriers to financing		
Financial	31	20.0
Economic	37	23.9
Financial and economic[10]	87	56.1
Value measurement		
Financial	33	21.3
Economic	35	22.3
Financial and economic	87	56.1

[9] For this study, only information on the dominant financing method was required from financiers.
[10] In this study, high capital costs, high interest rates and low credit repayments collectively make up the financial barriers while low access to capital, lack of awareness of RETs, economic instability and exchange rates comprise economic barriers.

Variable	Frequency	Percentage
Average investment per project		
Less than $10000[11]	27	17.4
Above $10000	128	82.6
Financing period		
Less than 10 years	61	39.4
More than 10 years	94	60.6
Location of projects		
Rural	58	37.4
Semi-rural	77	49.7
Urban	20	12.9
Company type		
Large financial institution	93	60.0
Small financial institution	62	40.0
Number of years in RE		
1 to 5 years	66	42.6
6 to 20 years[12]	89	57.4
Total investment		
Small investment	61	39.4
Medium investment	89	57.4
Large investment	5	3.2
Company age		
Below 10 years	105	67.7
Above 10 years	50	32.3
RE sources		
Solar	92	59.4
Wind	43	27.7
Other[13]	20	12.9
Policy influence		
Some influence	145	93.5
No influence	10	6.5
Preferred policy		
Feed-in tariffs	79	51
RE certificates	1	0.6
PPAs	37	23.9
Other incentives	38	24.5

[11] This figure is used to broaden the sample size so as to include indigenous smaller financiers and developers.
[12] Initial analysis of the data collected showed that most firms that originated from Africa had operated in the renewable energy industry for a period of one to five years. Also, firms originating from other continents had been operating in the renewable energy industry for at least six years but not over a period of twenty years.
[13] In this study, other renewable energy sources include wave energy, ocean energy, geothermal, biofuel, and biomass. It is important to note that in this study, financiers of solar and wind renewable energy projects were mainly targeted. However, some of these financiers also financed renewable energy projects other than solar and wind although these comprised a small portion of their renewable energy investment portfolio.

4.3.1 Correlation Analysis (REP Financiers)

Correlation refers to the strength of a relationship between two variables and is useful in determining the direction of strength between the two variables selected. In Table 4.2, a correlation matrix highlighting the strength of relationships between all variables is presented. Results for the correlation analysis are produced using Spearman's r coefficient which is a nonparametric measure of statistical dependence between two variables. It is important to note that the variables total investment and number of years in RE were converted to categories to allow for appropriate analyses between all selected variables.[14] The equation for the Spearman's r coefficient is provided below:

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}.$$

Where ρ (rho) is Spearman's rank order correlation coefficient, n is the number of data pairs or total number of subjects, d is the difference between ranks for the two observations within a pair.

[14] For further analysis, the total investment and number of years in RE variables were converted to categories in order to standardise measurement values with other variables.

Table 4.2: Correlation of variables for REP financiers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Number of projects	1.00														
(2) Method of financing	-0.64	1.00													
(3) Financing mtd. motivation	0.93	0.84*	1.00												
(4) Barriers to financing	0.14	0.09	0.14	1.00											
(5) Value measurement	-0.57	0.73*	0.15	-0.15	1.00										
(6) Avg. investment per project	0.07	-0.43	-0.06	-0.68	-0.13	1.00									
(7) Financing period	0.06	-0.14	0.03	0.20	-0.01	0.13	1.00								
(8) Location of projects	-0.11	0.11	0.16	0.06	0.11	-0.19	0.71*	1.00							
(9) Company type	-0.37	0.010	0.01	-0.13	0.11	0.86*	-0.08	0.13	1.00						
(10) Number of years in RE	0.05	0.07	-0.04	-0.13	-0.02	-0.08	0.73*	0.13	-0.06	1.00					
(11) Total investment	0.04	0.87*	-0.05	-0.05	-0.04	-0.03	-0.01	0.10	0.08	0.69	1.00				
(12) Company age	0.08	-0.26	-0.08	-0.08	-0.05	0.28	-0.03	-0.04	0.06	-0.01	-0.02	1.00			
(13) RE sources	0.50	0.12	-0.02	-0.08	-0.08	0.07	0.72*	0.05	0.05	0.03	0.03	0.02	1.00		
(14) Policy influence	0.05	-0.13	0.04	-0.03	0.05	0.14	-0.03	-0.06	-0.12	0.06	-0.23	-0.02	0.04	1.00	
(15) Preferred policy	-0.10	0.02	0.04	0.14	0.04	0.02	0.78*	0.11	-0.12	0.03	0.08	-0.06	0.13	0.13	1.00

Table 4.2 presents a summary of correlations between selected variables. The correlation coefficients are highlighted to show the variables that are correlated. Using a p-value of 0.05 to test for correlations, six values were found to be significant. The motivation for financing and method of financing showed strong positive correlation (0.84) suggesting that the method of financing is related to the motivation for choosing a specific financing method.

Also, method of financing showed strong positive correlation with value measurement (0.73) and this suggests that the way financiers perceive value from financing REPs is related to their choice of financing methods. Location of projects and financing period also showed a strong positive correlation (0.71) and this suggests that the period over which financiers finance REPs is related to the area in which REPs are specifically located.

Additionally, average investment per project and company type showed strong positive correlation (0.86) suggesting that the type of institution is related to the average amount of capital invested per REP. Also, total investment and method of financing showed strong positive correlation (0.87) suggesting that the amount of investment in a REP is related to the method of financing selected by financing institutions. Finally, preferred policy and financing period showed a strong positive correlation (0.78) and this suggests that financiers' preferred policy is related to the length of the financing period financiers choose to fund REPs.

4.3.2 Results for Chi-square Analysis (REP Financiers)

In analysing the associations between variables to test for statistical significance, the Pearson's Chi-square test for independence was employed. Informed by the literature surrounding the financing of REPs, three variables were selected to test for associations with all other variables as these three variables represent important factors in RE finance.

The selected variables are number of projects, total investment and number of years in RE. The literature on RE finance presents theories on associations between the number of REPs a firm finances in relation to the number of years a firm has actively operated as a financier of REPs. Also, relationships between the number of REPs financed and total capital invested in financing REPs have been highlighted. In summary, these three variables selected best describe the characteristics of the population of financiers involved in financing REPs.

The Chi-square test is used to test for statistical differences between categories of responses in the proportion of responses in each of the variables highlighted. The null hypothesis of the Chi-square test is that there is no association between various categories of selected variables

and any difference observed is due to random variation. Conversely, the alternate hypothesis of the Chi-square test is that there are associations between various categories of selected variables and any difference observed is not due to random variation. Using a p-value of 0.05, the null hypothesis is rejected if the p-value indicating an association between two variables is lower than 0.05. In Table 4.3 below, the statistics highlighting associations or independence between the three selected variables are presented.

Table 4.3: Chi-square statistics for number of projects variable (n = 155)

Variables	**Value**	**Significance**	**Cramer's V**
Total investment	0.681	0.712	0.069
Number of years in RE	0.013	0.914	0.011
Finance method	6.632	0.028*	0.616
Financing method motivation	1.335	0.255	0.019
Barriers to financing	0.038	0.863	0.025
Value measurement	0.115	0.579	0.109
Average investment per project	8.096	0.041*	0.716
Financing period	0.698	0.403	0.068
Location of projects	5.062	0.081	0.178
Company type	9.204	0.038*	0.624
Company age	1.197	0.304	0.018
RE sources	0.385	0.535	0.050
Policy influence	5.356	0.048*	0.531
Preferred policy	9.234	0.035*	0.683

In Table 4.3 the variables finance method (0.028), average investment per project (0.041), company type (0.038), policy influence (0.048) and preferred policy (0.035) are significant. Hence, these variables show positive association with the number of RE projects funded by financial institutions. The result of the Chi-square test shows that for the finance method, 78.6% of financiers finance REPs using traditional financing methods while 21.4% finance REPs using innovative methods. Analysing average investment per project, 17.5% of financiers spend less than $10000 per project and 82.5% spend more than this amount per project.

For company type, 90.4% of large financial institutions have financed ten or more REPs while 9.6% of smaller institutions have financed ten or more REPs. For policy influence, 93.5% of financiers suggested that the dominant policy influenced their financing decisions while 6.5% suggested the dominant policy had no influence on their financing decisions. Also, for preferred policy, 51%, of financiers prefer RE feed-in tariffs while 24.5%, 23.9% and 0.6% of financiers prefer power purchase agreements (PPAs), other government incentives and Renewable Energy Certificates (RECs) respectively.

The Cramer V statistics show that average investment per project (0.716) has a strong association with the number of projects financed while company type (0.624) and preferred policy (0.683) have moderately strong associations with the number of projects financed.

Table 4.4: Chi-square statistics for total investment variable (n = 155)

Variables	**Value**	**Significance**	**Cramer's V**
Number of projects	0.681	0.712	0.069
Number of years in RE	31.067	0.000*	0.448
Finance method	6.185	0.046*	0.766
Financing method motivation	1.269	0.525	0.085
Barriers to financing	2.177	0.338	0.108
Value measurement	0.169	0.109	0.027
Average investment per project	5.088	0.049*	0.575
Financing period	3.323	0.194	0.149
Location of projects	7.486	0.112	0.215
Company type	1.834	0.401	0.106
Company age	2.276	0.321	0.119
RE sources	1.261	0.523	0.090
Policy influence	1.950	0.377	0.113
Preferred policy	6.640	0.355	0.147

In Table 4.4 number of years in RE (0.000), finance method (0.046) and average investment per project (0.049) are significant hence these variables show positive association with the total investment in RE made by financial institutions. The result of the Chi-square test shows

that for number of years in RE, 65.4% of financial institutions are over six years old while 44.6% investing in REPs are less than five years old.

Analysing finance method, 82.3% of financiers use traditional financing methods while 18.7% of financiers use innovative financing methods. For average investment per project, 82.5% of financiers invest over $10000 on average per project and 17.5% invest less than this amount per project. The Cramer V statistic shows that finance method (0.766) and total investment have a strong association.

Table 4.5: Chi-square statistics for number of years in RE variable (n = 155)

Variables	**Value**	**Significance**	**Cramer's V**
Number of projects	0.013	0.914	0.011
Total investment	31.067	0.000*	0.448
Finance method	0.675	0.413	0.066
Financing method motivation	0.105	0.041*	0.475
Barriers to financing	2.619	0.111	0.134
Value measurement	0.747	0.685	0.065
Average investment per project	2.388	0.122	0.133
Financing period	0.344	0.044*	0.447
Location of projects	1.823	0.401	0.113
Company type	0.059	0.803	0.021
Company age	0.013	0.969	0.014
RE sources	0.063	0.802	0.020
Policy influence	0.101	0.751	0.026
Preferred policy	0.872	0.832	0.075

In Table 4.5 total investment (0.000), financing method motivation (0.041) and financing period (0.044) are significant. The results of the Chi-square test shows that in total investment, 14.7% of financial institutions made small sized investments in REPs, 60.6% made medium sized investments in REPs and 24.7% made large investments in REPs.

Analysing financing method motivation, 72.7% of financiers suggested that their motivation for choosing a particular financing method was to lower risks associated with financing REPs

and 27.3% suggested that their financing choices are motivated by the need to increase energy access. For financing period, 70.4% of financiers have been financing REPs for over ten years while 29.1% of financiers have been financing REPs for less than ten years. The Cramer V statistics show that total investment (0.448), financing method motivation (0.475) and financing period (0.447) show associations with the number of years in RE. However, these associations are considered moderately weak.

4.3.3 Results for Profile Classification (REP Financiers)

Based on the nature of the data collected which was mostly ordinal, profiling was selected as the appropriate classification tool for exploratory analysis using decision trees. This section highlights results from the analysis of the three main variables selected as core variables for analysis in this chapter. These variables are number of projects, total investment and number of years in RE. Decision trees highlight the relationships between target variables which in this case are the aforementioned variables, and input variables comprised of all other variables used in this section. The models developed from the profile classification process are highlighted below and selected decision rules established as profiles are also explained.

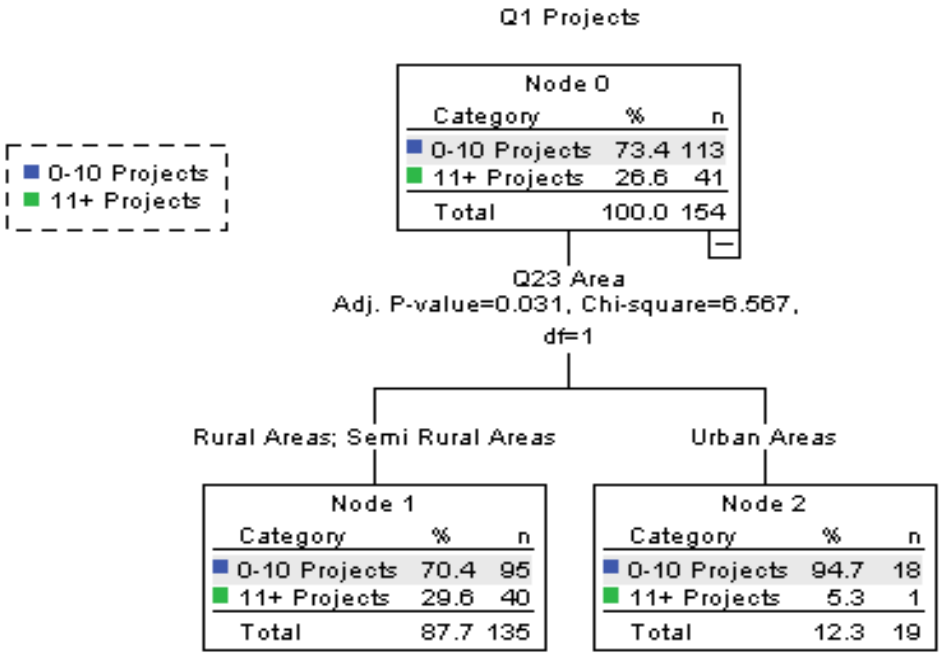


Fig 4.4: Decision tree for number of projects variable (n = 155)

In Fig 4.4 the decision rule within the decision tree that provides a profile of the relationship between number of projects as the target variable and all other input variables is number of projects–area.[15] In the decision tree,[16] the variable area is split further into two nodes. Rural and semi-rural areas have a value of 87.7% while urban areas have 12.3% as the established value.

Hence, the model suggests that profile of firms financing smaller numbers of REPs is mainly those with projects located in the rural areas. Essentially, this suggests that firms mainly financed REPs located in rural and semi-rural areas. However, in most cases as observed in this study, these REPs are mostly located far away from neighbouring rural communities which may not benefit as much from the development of these REPs as if these projects were located closer.

On the other side of the decision tree, deriving from the variable area, details of REPs located in urban areas is shown. The decision rule that provides an indication of the relationship between the variables is number of projects–area. The value for urban areas is 12.3% and this shows that fewer financiers finance REPs located in urban areas. Conversely, the model suggests that firms with small numbers of projects have the REPs they finance located in urban areas. Hence, the motivation for financing is mainly to supplement existing electricity networks available in urban areas. The decision tree for the total investment variable is presented below.

[15] For the purpose of the analysis and presentation, the names of variables were shortened while developing the decision tree. Location of projects is denoted as "area".

[16] In the development of decision trees, decision analyses are made through the use of different algorithms to measure the best relationships between the target variable and other input variables. The algorithms measure the homogeneity of the target variable within the subsets analysed.

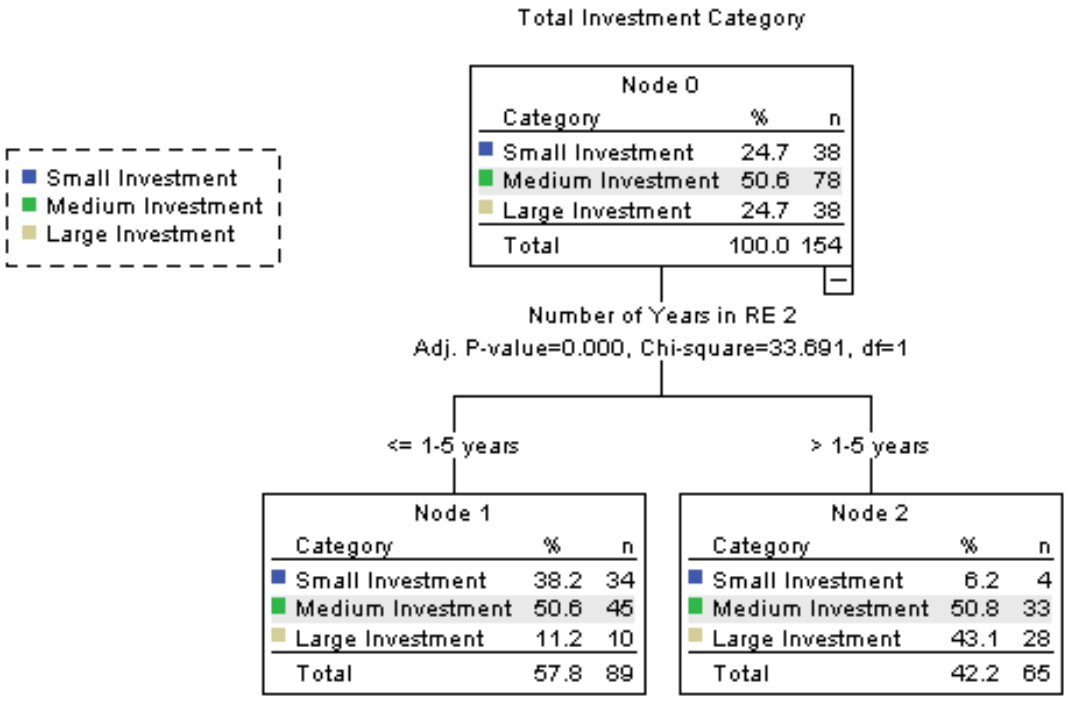


Fig 4.5: Decision tree for total investment variable (n = 155)

In Fig 4.5 the decision rule within the decision tree that provides a profile of the relationship between total investment as the target variable and all other input variables on one side of the decision tree is total investment–number of years in RE. The number of years in RE variable is split further into two subsidiary nodes which are <1–5 years (node 1) and >1–5 years (node 2). In node 1, small, medium and large investments have values of 38.2%, 50.6% and 11.2% respectively.

Also, firms investing in RE but with less than five years in the sector amounted to 58.9%. In node 2, small, medium and large investments have values of 6.2%, 40.8% and 43.1% respectively. Additionally, firms investing in RE but with more than five years in the sector amounted to 42.2%. Hence, the model suggests that financiers that invest more finances in REP development have fewer years of experience in financing REPs than firms with more years of experience in RE finance.

Essentially, this profiling shows that firms operating in the RE sector for less than five years have invested more capital in REP development than firms with over five years of operating in the RE sector. From observations and analyses conducted during this study, this can be

attributed to the growth and development of RE in Africa, hence the mobilisation and deployment of capital by into RE by newer firms to exploit economic opportunities in growing RE sectors. The decision tree for the number of years in RE variable is presented below.

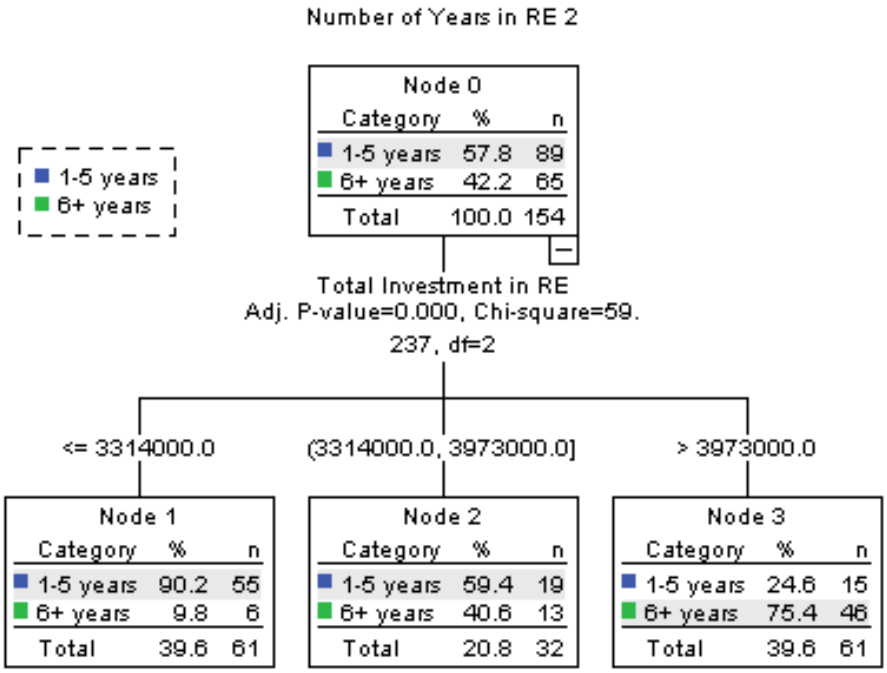


Fig 4.6: Decision tree for number of years in RE variable (n = 155)

In Fig 4.6 the decision rule within the decision tree that provides a profile of the relationship between number of projects as the target variable and all other input variables on one side of the decision tree is number of years in RE-total investment in RE. The total investment node is split into three different nodes to provide details of the relationship between the two variables (number of years in RE and total investment in RE.

The model shows that 39.6% of financiers have invested an average of $3.314 million in REPs – 90.2% of financiers in this category have been operating in the RE sector for 5 years or less while 9.8% of the firms have been operating in the RE sector for over 5 years. Also, 20.8% of financiers invested between $3.314 million to $3.973 million in REPs – 59.4% of financiers in this category have been operating in the RE sector for less than 5 years and 40.6% have operated in the sector for over 5 years.

Finally, 39.6% of financiers invested over $3.973 million in REPs – 24.6% of financiers in this category have been operating in the RE sector for less than 5 years and 75.4% have operated in the sector for more than 5 years. Analyses conducted during this study support this profiling as vast numbers of financiers with less experience in financing REPs have entered into the sector for economic gains and profit making fostered by government policy to promote RE development.

This is especially true as in the case of South Africa where financiers with little or no experience invested large amounts of capital to finance large scale REP development in various RE programs conducted by the government of South Africa.

4.4 Population and Sample for REP Developers

This section provides a summary of the population and sample of REP developers actively developing REPs within various African countries. The target population for this section is comprised of senior executives at firms developing REPs within Africa. For a firm to qualify as a part of this population it must at least be currently involved in developing a REP in an African country.

Based on the nature of the RE industry which is still in the infant growth stage in many African countries, the population and consequent sample of REP developers was expected to be small. While the bulk of respondents attached to firms financing REPs in African countries are located outside of Africa, the majority of the respondents attached to firms developing REPs are local institutions driving REP development on the continent.

The sample is comprised of 63 REP developers that have developed at least one REP in an African country. In the following figures, important details such as the overall characteristics of the sample are presented. This includes the regions where respondents and their REPs are located as well as the types of REP developers represented in the sample. Further detail regarding the level of experience respondents have in REP development measured in years, the backgrounds and age brackets of respondents is presented in the appendix.

Based on the nature of the study as it is related to a new and emerging field in Africa, the number of potential respondents was limited. It is difficult to ascertain the total number of REP developers that have at least developed one REP in an African country and consequently comprise the target population. Nonetheless, the survey was sent out to 200 potential respondents and 63 responses were used for the analysis in this section resulting in a return

rate of 31.5% which is consistent with studies of this nature. The largest portions of respondents have their projects located in Southern Africa, while North and East Africa have similar representation. The representation from West Africa though not as large as the aforementioned regions is double the size of respondents from Central Africa.

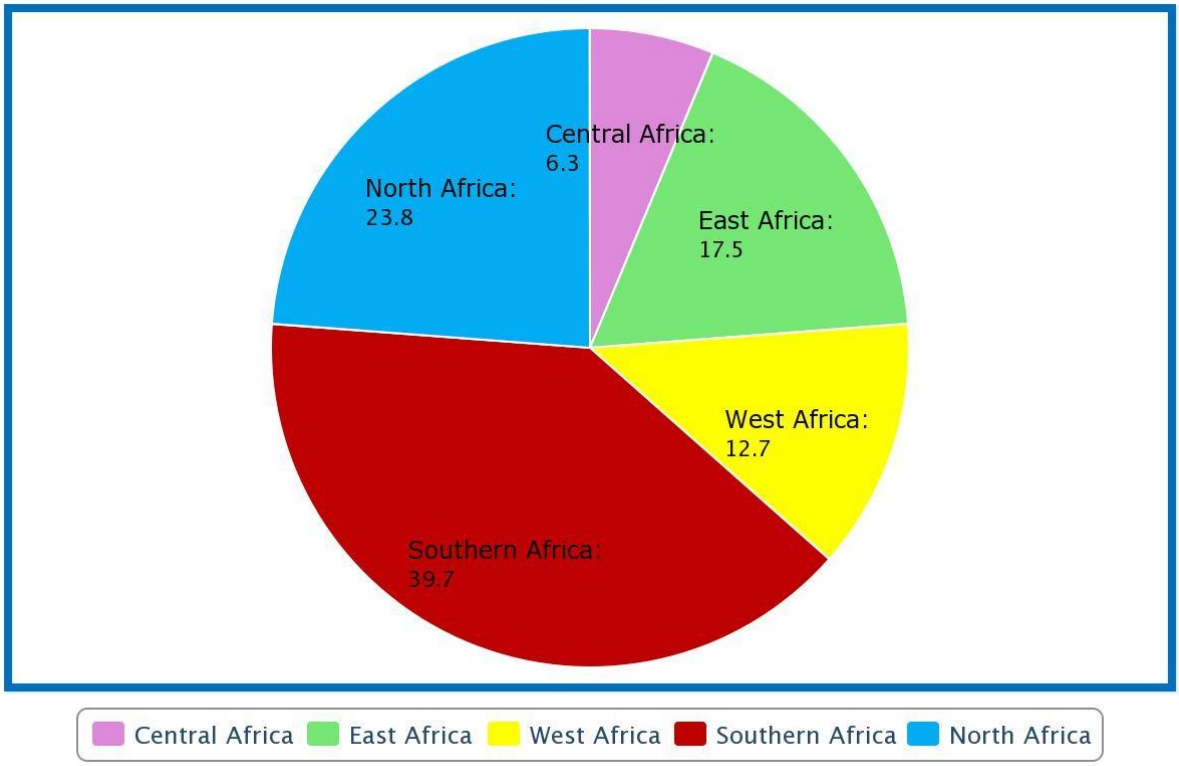


Fig. 4.7 Distribution of REP developers by region

In Fig 4.7 the distribution of REP developers is presented to show the percentages of projects located in the different regions on the continent. In this, Southern Africa is shown to have the highest number of REPs located in the region, according to the respondents, and North Africa is the next region with the highest number of REPs located within the region. East Africa surpasses West Africa regarding the number of REPs located in the regions and Central Africa is shown to have the lowest number of REPs among all the regions.

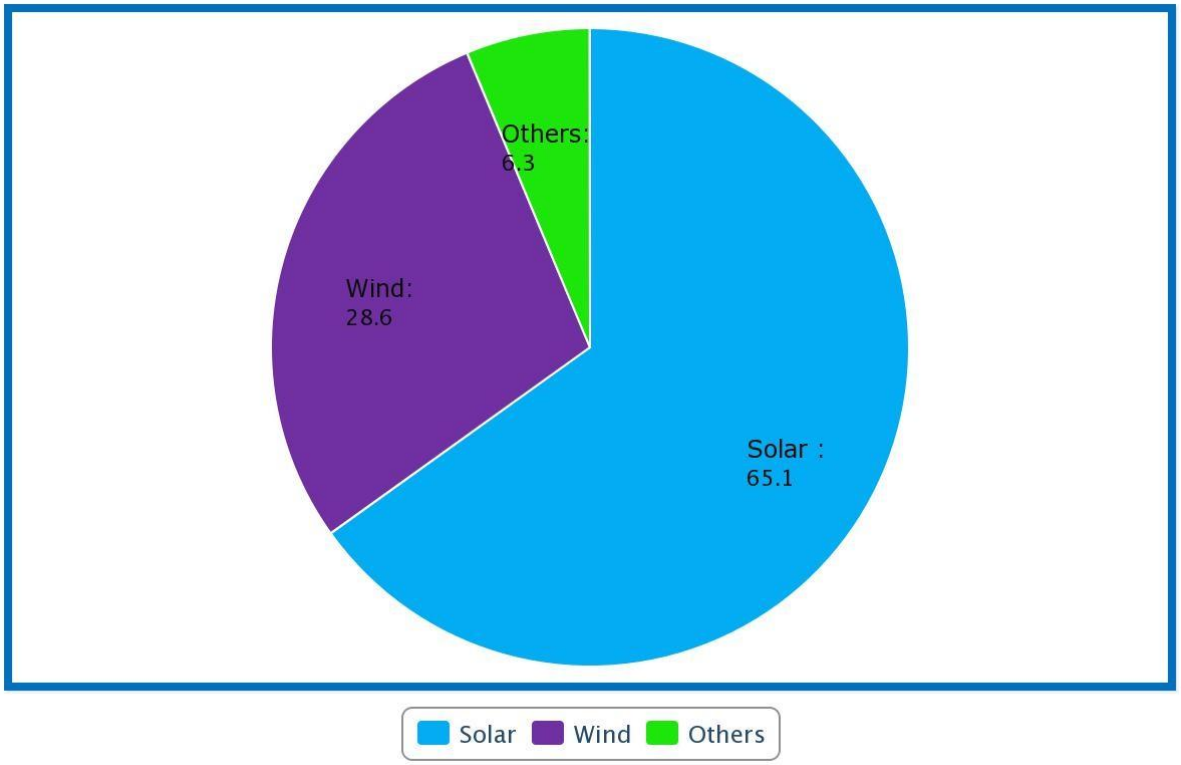


Fig 4.8: Distribution of REP developers by REPs developed

In Fig 4.8 the distribution of REP developers is presented to highlight the particular REP type that REP developers in the survey developed as well as the source from which the RE technology used is obtained. Solar is the most common RE source REP developers in the survey use in developing projects which accounts for 65.1% of the projects developed. This is followed by wind which has its deployment at approximately half of solar, accounting for 28.6% of the REPs developed. Other RE sources[17] used total 6.3% and account for a small fraction of the REP deployment according to the respondents.

[17] "Other" accounts for all other RE sources outside of solar and wind such as small and medium-sized hydro, ocean energy, wave energy, geothermal, biofuels and biomass.

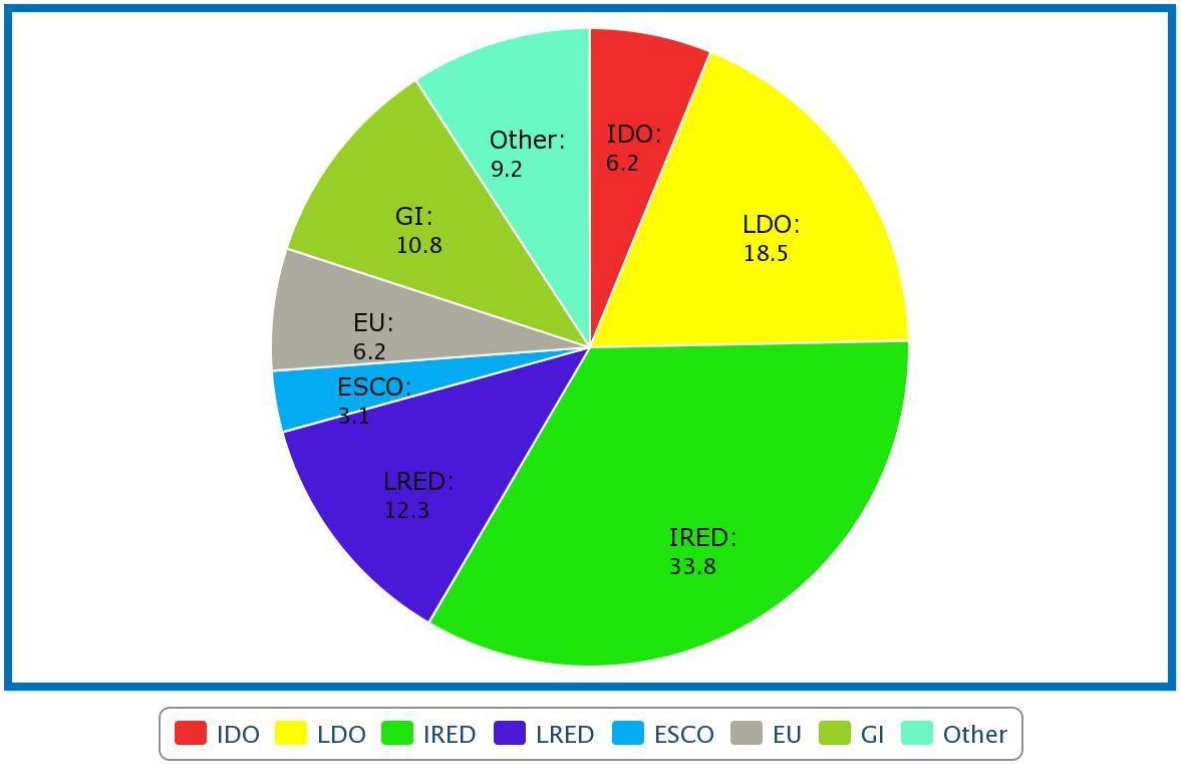


Fig 4.9: Distribution of REP developers according to organisation type represented[18]

In Fig 4.9 the distribution of REP developers according to the organisations respondents from the survey are engaged with is presented. Of the eight groups highlighted, international RE developers have the highest representation. Local development organisations and local RE developers respectively have a higher representation than other types of organisations.[19] The representation of government institutions is higher than international energy utilities and international development organisations which have equal representation in the sample. Energy Service Companies (ESCOs) are the least represented group.

4.5 Statistical Tests and Analyses for REP Developers

This section provides an overview of the statistical tests carried out on the data for REP developers. Basic statistics such as frequencies and percentages, of selected variables are presented. In order to maintain consistency with the section on REP financiers, correlation

[18] IDO, LDO, IRED. LRED, ESCO, EU and GI are international development organisations, local development organisations, international RE developers, local RE developers, energy service companies, energy utilities and government institutions respectively. Other is made up of REP developers that do not fit any of these classifications.

[19] Other types of organisations include renewable energy development agencies and institutes such as the South African National Energy Development Institute (SANEDI), New Partnership for Africa's Development (NEPAD) and the Economic Community of West African States' Centre for Renewable Energy and Energy Efficiency (ECREEE).

analysis was carried out on the same set of variables used in the section on REP financiers. A correlation matrix highlighting the correlation coefficients between all selected variables is presented and variables with high correlations are detailed. In addition to this, Chi-square tests were carried out on the three main variables that also describe the characteristics of the REP developers appropriately.

These three variables are number of projects, total investment and number of years in RE and associations between these three variables and all other variables are presented and expanded. Finally, the results of the profile classification for the three main variables are presented. The results highlight the relationships between the three main target variables and the input variables as characteristics of the sample reflected in the data.

Table 4.6: Frequencies and Percentages for REP developers (n = 63)

Variable	Frequency	Percentage
Number of projects		
0 to 10 projects	53	84.1
11 projects and above[20]	10	15.9
Method of financing		
Traditional financing	40	63.5
Innovative financing	23	36.5
Financing method motivation		
Risk reduction	48	76.2
Energy access	15	23.8
Barriers to financing		
Financial	52	82.5
Economic	4	6.4
Financial and economic	7	11.1
Value measurement		
Financial	41	65.1
Economic	8	12.7
Financial and economic	14	22.2
Average investment per project		
Less than $10000	18	28.6
Above $10000	45	71.4

[20] The number of projects developed by renewable energy project developers varied with the number of years these firms developed renewable energy projects. However, firms with more years in renewable energy project development had mostly developed more renewable energy projects than the firms with fewer years. In this study, the highest number of projects developed by a firm is eighteen.

Variable	Frequency	Percentage
Financing period		
Less than 10 years	44	69.8
More than 10 years	19	30.2
Location of projects		
Rural	15	23.8
Semi-rural	42	66.7
Urban	6	9.5
Company type		
Large REP developer	41	65.0
Small REP developer	22	35.0
Number of years in RE		
1 to 5 years	46	73.0
6 to 20 years[21]	17	27.0
Total investment		
Small investment	12	19.0
Medium investment	43	68.3
Large investment	8	12.7
Company age		
Below 10 years	52	82.5
Above 10 years	11	17.5
RE sources		
Solar	46	73.0
Wind	15	23.8
Other[22]	2	3.2
Policy influence		
Some influence	51	81.0
No influence	12	19.0
Preferred policy		
Feed-in tariffs	21	33.3
RE certificates	2	3.2
PPAs	33	52.4
Other incentives	7	11.1

[21] Initial analysis of the data collected showed that most firms that originated from Africa had operated in the renewable energy industry for a period of one to five years. Also, firms originating from other continents had been operating in the renewable energy industry for at least six years but not over a period of twenty years.

[22] In this study, other renewable energy sources include wave energy, ocean energy, geothermal, biofuel, and biomass. It is important to note that in this study, developers of solar and wind renewable energy projects were mainly targeted. However, some of these developers also developed renewable energy projects other than solar and wind although these comprised a small portion of their renewable energy project development portfolio.

4.5.1 Correlation Analysis (REP Developers)

In Table 4.7 a correlation matrix highlighting the strength of relationships between all variables is presented. Results for the correlation analysis are produced using Spearman r coefficient which is a nonparametric measure of statistical dependence between two variables. It is important to note that the variables total investment and number of years in RE were converted to categories to allow for appropriate analyses between all selected variables.[23]

[23] These variables were converted to categories to enable combined analyses of all variables developed.

Table 4.7: Correlation of variables for REP developers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Number of projects	1.00														
(2) Method of financing	-0.10	1.00													
(3) Financing mtd. motivation	-0.10	0.20	1.00												
(4) Barriers to financing	0.08	0.13	0.27	1.00											
(5) Value measurement	0.04	0.88*	0.06	0.16	1.00										
(6) Avg. investment per project	-0.19	0.79*	-0.47	-0.04	0.57	1.00									
(7) Financing period	0.72*	0.16	0.14	0.29	0.10	0.40	1.00								
(8) Location of projects	0.17	0.74*	0.77*	0.03	-0.04	0.29	0.04	1.00							
(9) Company type	-0.11	0.72	0.31	0.18	0.24	0.60	-0.39	0.67	1.00						
(10) Number of years in RE	0.33	0.31	0.25	0.31	0.44	0.38	0.20	0.33	0.07	1.00					
(11) Total investment	-0.19	0.16	0.33	0.09	0.12	0.15	0.08	0.30	0.33	0.13	1.00				
(12) Company age	0.24	0.09	0.02	-0.11	0.07	-0.22	0.13	0.21	0.02	0.07	0.19	1.00			
(13) RE sources	0.10	0.49	0.64	-0.17	0.10	-0.33	0.09	0.87*	0.42	0.36	-0.37	0.03	1.00		
(14) Policy influence	0.81*	0.48	0.19	0.02	0.34	0.01	0.40	0.54	0.31	0.47	-0.06	0.21	-0.47	1.00	
(15) Preferred policy	0.21	0.31	0.23	0.22	0.58	0.72*	0.54	-0.24	-0.39	0.08	-0.09	0.17	0.08	-0.10	1.00

In Table 4.7, a summary of the correlations for all variables is presented. The correlation matrix is used to highlight the correlation coefficients between variables as shown above. At a significance level of 0.05, eight values were seen to be significant. The method of financing and value measurement (0.88) showed strong positive correlation suggesting that the method of financing is related to the ways in which REP developers measure value. Also, the method of financing and average investment per project (0.79) showed strong positive correlation signifying a relationship between these two variables.

The correlation matrix also highlights a strong positive correlation between number of projects and financing period (0.72) suggesting that these variables are also related. Furthermore, location of projects and method of financing (0.74) showed a strong positive correlation, also location of projects and financing method motivation showed strong positive correlation (0.77), suggesting that the location of a REP is related to the method of financing and the motivation for using specific financing methods.

In addition, location of projects showed strong positive correlation with RE sources (0.87) suggesting a relationship between the two variables. Also, policy influence and number of projects showed a strong positive relationship (0.81) highlighting a relationship between the variables. Finally, preferred policy and average investment per project showed a strong positive correlation (0.72) suggesting a relationship also exists between these two variables.

4.5.2 Results for Chi-square Analysis (REP Developers)

In this section, the result for Chi-square analysis for REP developers is presented. As detailed in previous sections, the purpose of the Chi-square analysis is to test for associations between variables. Based on the nature of the data which is mainly categorical, the Pearson's Chi-square test is used to analyse the data on REP developers. Results for the three main variables which represent the characteristics of the sample are presented in tables below. The three main variables are number of projects, total investment and number of years in RE.

The Chi-square test is used to test for statistical differences between categories of responses in each of the variables highlighted. The null hypothesis of the Chi-square test is that there is no association between various categories of selected variables and any difference observed is due to random variation. Conversely, the alternate hypothesis of the Chi-square test is that there are associations between various categories of selected variables and any difference

observed is not due to random variation. Using a p-value of 0.05, the null hypothesis is rejected if the p-value indicating an association between two variables is lower than 0.05.

Table 4.8: Chi-square statistics for number of projects variable (n = 63)

Variables	**Value**	**Significance**	**Cramer's V**
Total investment	26.010	0.003*	0.622
Number of years in RE	6.053	0.048*	0.531
Finance method	11.230	0.004*	0.422
Financing method motivation	1.150	0.553	0.135
Barriers to financing	2.197	0.615	0.086
Value measurement	6.596	0.159	0.324
Average investment per project	2.795	0.247	0.211
Financing period	19.204	0.000*	0.552
Location of projects	11.472	0.022*	0.427
Company type	2.864	0.239	0.213
Company age	1.371	0.729	0.161
RE sources	7.174	0.127	0.337
Policy influence	30.072	0.000*	0.691
Preferred policy	46.199	0.000*	0.856

In Table 4.8 the variables total investment (0.003), number of years in RE (0.048), finance method (0.004), financing period (0.000) location of projects (0.022), policy influence (0.000) and preferred policy (0.000) are significant. Hence, these variables show positive associations with the number of projects variable. The result of the Chi-square test shows that for total investment, small, medium and large investments were 19%, 68.3% and 12.7% respectively. For finance method, 63.5% of the sample had their REPs financed using traditional methods while 36.5% of developers' REPs were financed using innovative methods.

In analysing financing period, 69.8% of developers had their REPs financed for less than 10 years while 30.2% of developers' REPs were financed for more than 10 years. Also, for location of projects, 23.8%, 66.7% and 9.5% of REP developers' projects were located in

rural, semi-rural and urban areas respectively. For policy influence, 81% of developers suggested that the main RE policy influenced their decisions to develop REPs while 19% suggested the main policy did not influence their decisions to develop REPs. For preferred policy, 33.3%, 3.2%, 52.4% and 11.1% of REP developers preferred feed-in tariffs, RECs, PPAs and other incentives respectively. The Cramer V statistics show that preferred policy (0.856) has a very strong association with the number of projects while total investment (0.622) and policy influence (0.691) show moderately strong associations with the number of projects.

Table 4.9: Chi-square statistics for total investment variable (n = 63)

Variables	**Value**	**Significance**	**Cramer's V**
Number of projects	26.010	0.003*	0.622
Number of years in RE	0.287	0.872	0.121
Finance method	7.231	0.046*	0.528
Financing method motivation	2.484	0.632	0.215
Barriers to financing	5.957	0.032*	0.427
Value measurement	0.641	0.893	0.045
Average investment per project	3.438	0.087	0.212
Financing period	6.771	0.044*	0.564
Location of projects	1.093	0.784	0.082
Company type	0.539	0.431	0.103
Company age	1.859	0.772	0.098
RE sources	2.854	0.561	0.103
Policy influence	7.912	0.028*	0.609
Preferred policy	3.119	0.061	0.299

In Table 4.9 the significant variables are number of projects (0.003), finance method (0.046), financing period (0.044) and policy influence (0.028). Hence, these variables show positive associations with total investment. The result of the Chi-square test shows that for number of projects, 84.1%, of developers had developed less than ten REPs while 15.9% of developers had developed more than ten REPs. For finance method, 63.5% of the sample had their REPs financed using traditional methods while 36.5% of developers' REPs were financed using

innovative methods. For financing period, 69.8% of developers had their REPs financed for less than ten years while 30.2% of developers' REPs were financed for more than ten years. Finally, for policy influence 81% of developers suggested that the main RE policy influenced their decisions to develop REPs while 19% suggested the main policy did not influence their decisions to develop REPs. The Cramer V statistic shows that number of projects (0.622) has a moderately strong association with total investment.

Table 4.10: Chi-square statistics for number of years in RE variable (n = 63)

Variables	**Value**	**Significance**	**Cramer's V**
Number of projects	6.053	0.048*	0.337
Total investment	2.854	0.561	0.103
Finance method	1.692	0.193	0.164
Financing method motivation	3.871	0.049*	0.448
Barriers to financing	0.128	0.629	0.112
Value measurement	12.493	0.002*	0.445
Average investment per project	9.313	0.002*	0.584
Financing period	2.589	0.108	0.203
Location of projects	25.375	0.000*	0.635
Company type	0.003	0.957	0.007
Company age	0.192	0.483	0.176
RE sources	21.320	0.000*	0.582
Policy influence	0.008	0.928	0.011
Preferred policy	21.166	0.000*	0.580

In Table 4.10 the variables number of projects (0.048), financing method motivation (0.049), value measurement (0.002), average investment per project (0.002), location of projects (0.000), RE sources (0.000) and preferred policy (0.000) are significant. Hence, these variables show positive associations with the number of years in RE. The results of the Chi-square test shows that for number of projects, 84.1%, of developers had developed less than ten REPs while 15.9% of developers had developed more than 10 REPs.

For financing method motivation 76.4% of developers suggested the motivation for financiers using specific financing methods to fund REPs was based on the capacity of the method to reduce risk, while 23.8% suggested energy access was the motivation for using specific financing methods. In analysing value measurement, 65.2%, of developers suggested value is measured in financial terms while 12.7% suggested value is measured in economic terms, also 22.2% of developers suggested value is measured in both financial and economic terms.

For location of projects, 23.8%, 66.7% and 9.5% of REP developers' projects were located in rural, semi-rural and urban areas respectively. Also, for RE sources 73.0% of developers used solar as the main resource while 23.8% used wind as the main resource, also 3.2% of developers used other RE resources that were neither solar nor wind. For preferred policy, 33.3%, 3.2%, 52.4% and 11.1% of REP developers preferred feed-in tariffs, RECs, PPAs and other incentives such as grants and subsidies respectively. The Cramer V statistic shows that location of projects (0.635) shows a moderately strong association with number of years in RE.

4.5.3 Results for Profile Classification (REP Developers)

The nature of the data collected which in this research is mainly ordinal, helped to inform the use of profiling as the relevant classification tool for exploratory analysis using decision trees. This section highlights results from the analysis of the three main variables selected as core variables for analysis in this chapter. These variables are number of projects, total investment and number of years in RE. Decision trees highlight the relationships between target variables which in this case are the aforementioned variables, and input variables comprised of all other variables used in this section. The models developed from the profile classification process are highlighted below and selected decision rules established as profiles are also explained.

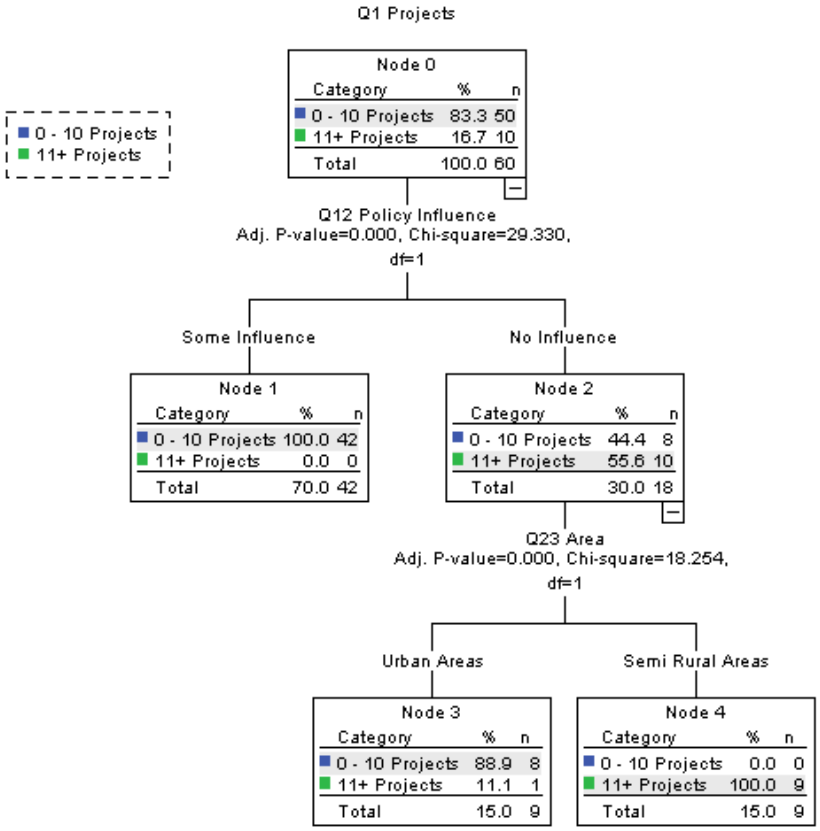


Fig 4.10: Decision tree for number of projects variable (n = 63)

In Fig 4.10 the decision rule within the decision tree that provides a profile of the relationship between number of projects as the target variable and all other input variables is number of projects–policy influence–area. On one side of the decision tree, the sub-variables some influence and no influence have values of 70% and 30% respectively. Hence the model suggests that the profile of firms developing REPs are those influenced by the main RE policy within a country. The sub-variable no influence has values of 15% and 15% which suggests that population of developers developing REPs in urban and semi-rural areas with no influence of the main RE policy on the decision to develop REPs is equal. The decision tree for the total investment variable is presented below.

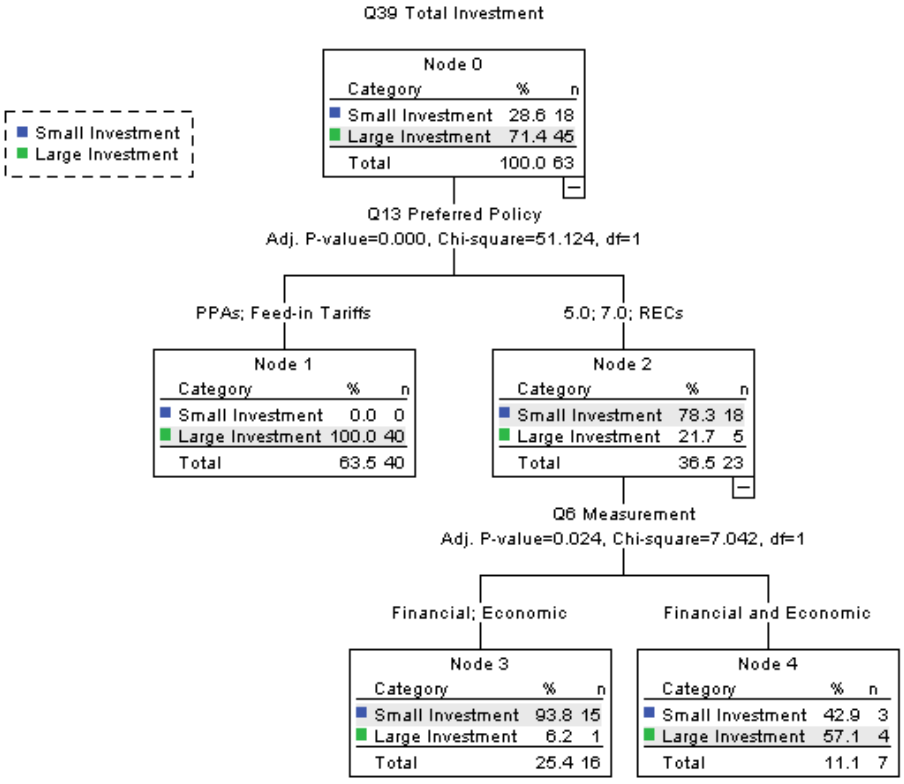


Fig 4.11: Decision tree for total investment variable (n = 63)

In Fig 4.11 the decision rule within the decision tree that provides a profile of the relationship between total investment as the target variable and all other input variables is total investment-preferred policy-measurement.[24] The sub-variables of preferred policy PPAs and feed-in tariffs have 63.5% as the value represented while government incentives and RECs have 36.5% as the value. Under the sub-variables government incentives and RECs, 25.4% measure value in either economic or financial terms while 11.1% measure value in both economic and financial terms. The profile highlighted shows that developers with larger investments in REPs prefer feed-in tariffs and PPAs to other RE policies. The decision tree for the number of years in RE variable is presented below.

[24] For the purpose of the analysis and presentation, the names of variables were shortened while developing the decision tree. Value measurement is denoted as "measurement".

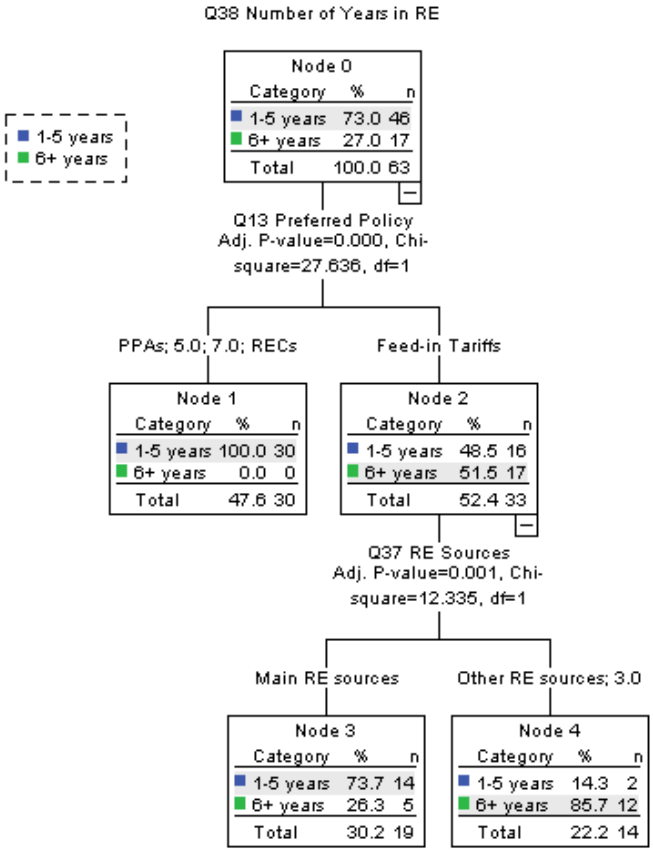


Fig 4.12: Decision tree for number of years in RE variable (n = 63)

In Fig 4.12 the decision rule within the decision tree that provides a profile of the relationship between number of years in RE as the target variable and all other input variables is total investment-preferred policy-RE sources. The sub-variables of preferred policy PPAs and RECs have 47.6% as the value while feed-in tariffs have 52.4% as the value. Under the sub-variable feed-in tariffs 30.2% use the main RE sources i.e. solar or wind in developing their REPs while 22.1% use other RE sources. The profile highlighted shows that developers with more years in REP prefer feed-in tariffs over other RE policies and use the main RE sources in developing their REPs.

4.6 Summary of the Chapter

This chapter provided a presentation of the results from the quantitative research conducted for this study. In previous sections of this chapter, the population and sample for RE financiers and REP developers used for the quantitative study is described and elaborated on, and results from correlation tests were highlighted in effort describe the data more

appropriately. Also, results from Chi-square tests conducted to highlight associations between variables were explained and results from profile classification using decision trees were highlighted and explained to provide further understanding of the relationships between selected variables.

The results of analyses conducted in this chapter shows that RE financiers mainly finance REPs using traditional financing methods and the main motivation for using this method is to reduce risks associated with the development of REPs. The results also show that the financing method selected by financiers is linked to the way in which financiers perceive value from the investments in developing REPs. In this regard, majority of the financiers perceive value from their investments in REPs in both financial and economic terms. Additionally, the results showed that the period through which financiers commit to finance REPs is influenced by the financiers' preferred policy for promoting RE development.

Furthermore, for REP developers, the preferred method of financing is related to the way in which REP developers measure value. The results of the analyses show that the majority of REP developers measure value derived from developing REPs in financial terms. Similar to financiers of REPs, the results show that developers of REPs prefer traditional financing methods over innovative financing methods. The motivation behind this preference is the capacity to maximise the risk reduction potential traditional financing offers through structured financing of REPs.

Also, the results showed that REP developers prefer shorter financing period with large amounts of capital invested as this structure tends to result in shorter waiting periods for profit realisation. The next chapter presents a detailed presentation of the results from the qualitative research conducted in this study. The chapter attempts to highlight critical theoretical concepts and themes in RE finance providing an in-depth presentation of how these impact REP financers and developers in selected African countries.

5.0 PRESENTATION OF RESULTS FROM QUALITATIVE RESEARCH

5.1 Introduction

This chapter highlights the results of the qualitative research undertaken for the purpose of this study. In this chapter, the data derived from the population studied for this research is expanded on to specifically provide information on the groups of respondents in the research. Also, the frequency of responses categorised under themes established using the inductive approach to content analysis is highlighted and the relationships between differing responses from interviewees regarding specific themes is presented.

The main response categories amalgamated to form themes in the research are also presented and briefly elaborated upon. The chapter also presents an appraisal of the techniques used to analyse data. Additionally, the process by which data was analysed and appropriate measures taken to improve validity and reliability during the actual data collection process and is explained.

Data for the study was collected using semi-structured interviews as the method of inquiry. The aim of using this method was to provide some structure during the interview process, while enabling respondents provide responses to open-ended questions from which new and unanticipated themes can emanate, enriching the data collected. The general and specific issues prioritised for discussions during the interviews were derived from the literature on renewable energy (RE) finance and the role of policy in promoting investment in renewable energy projects (REPs) in African countries. Interviews were conducted face to face and telephonically. After the interview process, data from the interviews were transcribed electronically in preparation for the analysis.

Considering the location of the different African countries selected for the study, no preference was given to any particular country in terms of the decision to either conduct interviews face to face or telephonically. Data for each country was collected using a mix of face to face and telephonic interviews, depending on the availability of the respondent and the resources of the researcher. The chapter concludes with a summary presentation of the findings and themes from the data obtained from the three countries studied – Kenya, Nigeria and South Africa.

As a means to present a better understanding of the drivers of RE finance and the impact of policy on investment in RE, the findings are presented thematically for individual countries to

draw comparisons as well as contrasts among these countries. The findings are presented to provide the context and meanings of themes elaborated on by the different respondents.

5.2 Characteristics of Respondents

The population of respondents comprised of the total number of financiers and policymakers in Kenya, Nigeria and South Africa. Broadly, the population of financiers included bankers that worked for investment, commercial and development banks. Also, financiers that worked for private equity firms, hedge funds and microfinance institutions in the countries selected for the study. The population of policymakers was made up of individuals that worked at selected government ministries such as the ministries of economic development, energy, finance and treasury. Senior workers at electricity utilities also comprised a part of the population selected for the study.

Although Nigeria is currently transforming its electricity sector in efforts to reform the industry by privatising generation, transmission and distribution of electricity, the country's state utility Power Holding Company of Nigeria (PHCN) currently oversees the electricity industry. The electricity sectors in Kenya and South Africa are also managed by state companies Kenya Electricity Generating Company (KenGen) and Electricity Supply Commission (Eskom) respectively.

Hence, individuals from these institutions at top management levels were included in the population of policymakers for the study. Kenya, Nigeria and South Africa all have regulatory boards that oversee electricity regulation and energy policy development within the respective countries. Senior employees of the Energy Regulatory Commission (ERC) in Kenya, the Nigerian Electricity Regulatory Commission (NERC) and the Energy Commission of Nigeria (ECN) and the National Energy Regulator of South Africa (NERSA), for the purpose of the study formed a part of the population of policymakers.

As part of the effort to obtain a list of respondents that was representative of the population, a database of senior executives in finance and senior government officials involved in policy development was drafted. For Kenya, the database comprised of ten individuals, five of which were senior executives in the financial industry and the remaining five individuals were selected from government ministries and parastatals. The database for Nigeria comprised of twelve individuals, six of which were senior executives in the financial industry and the other six were from government ministries and parastatals. The database for South

Africa comprised of eighteen individuals, of which a set of six were from the financial industry, another set of six were REP developers and the final set of six comprised of government employees in ministries and parastatals. Essentially, the actual population for the study comprised of financiers, REP developers and policymakers.

The main factor that distinguished selected respondents from the population was the proof of knowledge and experience with renewable energy technologies (RETs), finance, project development and policy formulation. Evidence of this as a characteristic that qualified potential respondents to be included in the database of interviewees was obtained by conducting preliminary background research to estimate the level of experience each respondent had with RE financing and policy development. However, due to constraints with time and resources mainly related to the busy schedules of some senior executives in the finance industry and government, it was not possible to interview all of the individuals listed in the Kenya, Nigeria and South Africa databases.

Interviews could not be conducted with all of the individuals listed in the database for reasons mainly surrounding availability of respondents. However, it was important to ensure that an almost equal number of respondents as financiers from the financial industry, REP developers from the private sector and policymakers in government participated in the research. This was done by comparing the experience of potential respondents in the database so that for instance, the final database did not contain more experienced RE financiers than either REP developers or policymakers.

The essence of undertaking this process was to ensure a balance between the views of the financiers, REP developers and policymakers in order to avoid the dominance of one view over the other. Essentially, the objective of this process was to ensure that the views of financiers, REP developers and policymakers were equally represented in the data. According to Moula et al (2013), during the research process, experience plays an important role in respondents providing valid responses to questions posed in interviews.

Hence, a respondent with more experience on particular RE subjects is likely to possess greater knowledge on the subject matter being investigated. With the use of semi-structured interviews as the tool for data collection, experienced respondents can provide rich data to provide researchers with insights into social phenomena being studied. Tables 5.1, 5.2 and 5.3 show details of the total number of respondents interviewed for the purpose of this study.

Table 5.1: Summary profile participating respondents in the research (financiers)

Position	**Average Years of Experience**	**Number of Respondents**
Partner	Over 30 years	1
CEO	Over 17 years	2
Director	Over 14 years	2
Senior Executive	Over 15 years	6
Principal	Over 19 years	1

Table 5.2: Summary profile participating respondents in the research (policymakers)

Position	**Average Years of Experience**	**Number of Respondents**
Partner		-
CEO		-
Director	Over 30 years	8
Senior Executive	Over 22 years	4
Principal		-

Table 5.3: Summary profile participating respondents in the research (REP developers)

Position	**Average Years of Experience**	**Number of Respondents**
Partner	Over 8 years	1
CEO		-
Director	Over 8 years	1
Senior Executive		-
Principal		-

In Table 5.4 below a summary of the characteristics of all respondents is provided. The main characteristics highlighted in the table provide an overview of the types of institutions from which respondents were selected for the study.

The aim of providing an overview of the types of respondents in the research is to present insights into the data obtained from the interviews. Also, highlighting the characteristics of respondents provides information on the categories of respondents that were interviewed. In

turn, this provides better understanding of the how data was collected and the processes through which the data was analysed. This step as aforementioned was undertaken to provide an insight into the views of groups of respondents from the different countries studied for the purpose of this research.

Table 5.4 Summary characteristics of all respondents in the research

Organisation Type	**Number Represented**	**Category**
Commercial Bank	-	Financier
Investment Bank	5	Financier
Private Equity	1	Financier
Hedge Fund	-	Financier
Development Bank	3	Financier
Development Financial Institution	1	Financier
Microfinance Institution	1	Financier
Project Developer	2	Financier
Economic Development Ministry	3	Policymaker
Energy Ministry	3	Policymaker
Energy Utility	3	Policymaker
Energy Regulator	3	Policymaker
Non-Government Organisation	1	Policymaker

5.2.1 Kenya Respondents

The aim of this section is to highlight the characteristics of respondents from Kenya in order to provide an overview of the respondents from the country. The main characteristics highlighted provide information on the background and experience of respondents in financing REPs and policy formulation for the development of RE. The database of potential respondents comprised of a list of ten individuals, five from financial institutions and the other five from government departments and ministries as well as non-governmental organisations (NGOs).

While the initial approach to selecting respondents was to obtain an equal number of financiers and policymakers, in order to provide balanced views, the researcher noted that following the premise of qualitative research this was not entirely necessary. Since the aim of

qualitative research is not to generalise findings, but to provide depth of information on selected social phenomena, a different approach to selecting respondents was taken. Due to unforeseen challenges with time, resources and also considering the busy schedules of the individuals listed as respondents, the database of respondents was redrafted in an order where potential respondents that had confirmed interview dates and times were listed above those that had not provided a time and date for interviews.

The outcome of redrafting the database however presented a list of potential respondents that did support a consistent and equal representation between financiers and policymakers. The final list of respondents contained the details of three financiers and three policymakers. The financiers were from development banks and development financial institutions (DFIs) investment banks while the policymakers were from government ministries and quasi-government institutions. Table 5.5 shows details of the respondents from Kenya interviewed for the study. Interviews mostly lasted for one hour and occasionally for a few minutes over one hour, not exceeding twenty minutes. All the respondents from Kenya were located in Nairobi.

Table 5.5 Description of Kenya respondents

Respondents	**Organisation Type**	**Position**	**Location**
Respondent 1	Development Bank	Director	Nairobi
Respondent 2	Development Finance Institution	Senior Executive	Nairobi
Respondent 3	Investment Bank	Senior Executive	Nairobi
Respondent 4	Economic Development Ministry	Director	Nairobi
Respondent 5	Energy Ministry	Director	Nairobi
Respondent 6	Energy Regulator	Director	Nairobi

5.2.2 Nigeria Respondents

This section highlights the characteristics of respondents in Nigeria and the aim is to provide an overview of the profiles of respondents interviewed for the study. In this section the characteristics that qualify respondents as experts in the areas of financing and policymaking are detailed. Also respondents' level of experience with financing and contribution to policy establishment for the development of RE is highlighted. Using the database for potential

respondents in Nigeria which comprised of six financiers and six policymakers, potential respondents were contacted to arrange interview dates and times.

There had been consistent communication with the offices of potential respondents who mostly were senior executives at financial institutions and government officials with knowledge on energy finance and policy development. However, due to constraints with time and resources, not all of the respondents confirmed interview times and dates. This resulted in the researcher adding more names to the list in order to obtain a high number of respondents and consequently enrich the data to be collected from Nigeria.

Twenty potential respondents were contacted, but only eight were interviewed due to cancellations by some potential respondents. The final list of respondents comprised of four financiers and four policymakers in government. The average length of the interviews was one hour and no respondent exceeded the time allocated for the interview. Table 5.6 shows the type of institutions the respondents worked for, their position in the organisation, and the years of experience with either financing projects or developing policy. Respondents were located mainly in Lagos and Abuja.

Table 5.6 Description of Nigeria respondents

Respondents	**Organisation Type**	**Position**	**Location**
Respondent 1	Microfinance Bank	CEO	Lagos
Respondent 2	Development Bank	Director	Lagos
Respondent 3	Investment Bank	Division Head	Lagos
Respondent 4	Investment Bank	Division Head	Lagos
Respondent 5	Energy Ministry	Director	Abuja
Respondent 6	Economic Development Ministry	Director	Abuja
Respondent 7	Energy Regulator	Senior Executive	Abuja
Respondent 8	Energy Utility	Senior Executive	Abuja

5.2.3 South Africa Respondents

The aim of this section is to present information on respondents to the study in South Africa. The main characteristics of respondents highlighted in this section include the level of experience of respondents as either financiers or policymakers knowledgeable on the

financing of REPs and development of RE policy. The initial database of potential respondents comprised of twenty four individuals, eight from the financial sector, eight from private sector REP developers and the final eight from government and government-owned enterprises. Potential respondents were selected according to their knowledge of financing REPs and policy formulation to support RE development.

At the time the database of potential respondents was being compiled and refined to allocate times for interviews to potential respondents, the South African government announced the results of the second round of its Renewable Energy Independent Power Producers Programme (REIPPP). This provided the researcher with details of more REP developers and financiers and consequently more potential respondents were added onto the list for possible interviews.

The final list comprised of thirty two potential respondents, but only twelve respondents were interviewed. The reduction in the number of potential respondents was due to the unavailability of financiers, REP developers and policymakers shortlisted. The group of twelve respondents was made up of individuals from investment banks, development banks, development financial institutions, private equity firms, REP development firms, government departments and non-governmental organisations. In total, the list of respondents interviewed comprised of six financiers, two REP developers and four policymakers. The average interview period for respondents was one hour. Respondents were mainly located in Gauteng.

Table 5.7 Respondents from South Africa

Respondents	Organisation Type	Position	Location
Respondent 1	Development Finance Institution	Unit Head	Johannesburg
Respondent 2	Development Bank	Senior Executive	Johannesburg
Respondent 3	Investment Bank	Principal	Johannesburg
Respondent 4	Investment Bank	Division Head	Johannesburg
Respondent 5	Private Equity	Partner	Johannesburg
Respondent 6	Project Developer	Partner	Johannesburg
Respondent 7	Project Developer	Director	Johannesburg
Respondent 8	Economic Development Ministry	Unit Head	Pretoria
Respondent 9	Energy Ministry	Director	Pretoria
Respondent 10	Energy Regulator	Director	Pretoria
Respondent 11	Energy Utility	Director	Johannesburg
Respondent 12	NGO	CEO	Cape Town

5.3 Data Collection Process

This section provides information on the process through which qualitative data for the research was collected. Qualitative data was collected using semi-structured interviews as the tool for data collection. Thus, this section also provides information on the preparatory processes for interviews and the interview schedule used. Also, information on the various techniques applied in collecting data and a description of measures taken to ensure that the interview sessions were used efficiently to optimise data collection is presented. Mainly, data on concepts in RE finance and the policy frameworks surrounding the development of RE or the lack thereof was collected for further analysis in efforts to investigate the research questions posed.

In order to maximise the time allocated for interviews, the database with details of the level of experience respondents possessed was consulted at least one week before the interviews were conducted. This was to ensure that the researcher became familiar with the specific areas in finance or policymaking that potential respondents were comfortable with and had a vast amount of experience in. Although a generic interview schedule with a list of open-ended and closed questions was developed, from which respondents were asked questions, understanding the respondents' background helped to highlight specific questions to focus on.

Also, the decision to probe further on particular questions asked in the interview process was informed by the initial research on the respondent, bearing the experience of respondents' in mind. Prior to the interviews, an outline highlighting the aims and objectives of the research was sent to all respondents. The interview outline explained the importance of interviews and the significant role data collected played in the research process. Through the offices of selected respondents, letters of permission to interview employees of selected organisations were also sent to the departments responsible for coordinating external interactions. In prior communication preceding interviews, respondents were informed of the letter of informed consent.

In summary, the letter of informed consent authorised the researcher to use information obtained from the interview for the purpose of the research and clarified that respondents were aware of that their responses would be used in the study. Before the interviews took place, each respondent was asked to sign a letter of informed consent.

5.4. Presentation of Findings from the Study

This section details the findings from the research in Kenya, Nigeria and South Africa. The findings for each country were obtained after transcripts from interviews with respondents were analysed using Atlas ti. After interviews with respondents, transcripts obtained from interviews were carefully read repeatedly to develop a systematic approach to establish themes from the data. This resulted in the researcher obtaining a sense of the concepts highlighted by respondents during the interviews.

Using the inductive approach to content analysis, a list of themes was developed from each transcript and when all the transcripts were analysed, concepts derived from transcripts were classified, grouped and categorised to form themes from the data. In the following sections, findings from the data from Kenya, Nigeria and South Africa are presented. Direct quotes from data obtained from respondents as sources of evidence supporting the development of themes and categories in line with which the findings are also presented. Additionally, the frequency of concepts mentioned and explained by respondents is presented to provide an overview of respondents' responses from which themes and categories were developed.

The findings obtained from data collected in Kenya are presented in this section using quotes to highlight and categories of responses obtained from respondents participating in the study. In the transcription process, interviews were transcribed verbatim and summarising texts was

avoided in order to provide an actual reflection of the respondents' responses in the data. Thus, quotations from the data are presented as the responses of the respondents in the study.

After each interview was completed and developed into a transcript, the researcher made a list of concepts and issues highlighted and explained by respondents in the interview. This was to provide the researcher with an understanding of the respondents' perception of the impact of these concepts in promoting RE development through finance and establishing supportive policies. This list obtained after transcribing interviews, was compared with the previous list of categories of responses developed prior to transcription, informed only by immediate perceptions of the data provided during interviews as is typical of the inductive approach to content analysis. After all six interviews from the Kenyan respondents were completely transcribed categories developed from each interview were amalgamated into one list. This list was compared with the list of categories developed before transcription.

The final list of categories was much longer and more detailed than the list developed before transcription. Concepts from the list developed prior to transcription were incorporated into the final list of categories of respondents' responses. In developing the final list that categorised the responses of respondents, a number of related sub-categories were merged to form single categories with multiple related concepts. These categories were then merged to form overarching groups of categories that had multiple related categories.

The process of reducing data into groups of categories entailed developing eighteen categories of responses from thirty one sub-categories. The eighteen categories were then reduced to seven grouped categories of responses which are rural development, access to energy, small scale financing, financial innovation, energy and development policy, technological learning, capacity building and high electricity costs. In the following paragraphs, quotes are provided as evidence to support categories and interpretations of quotes are given.

The following section also provides data obtained from respondents as findings from interviews conducted for the research in Nigeria. The findings are presented using quotes directly obtained from data as evidence to support results of the research. Following the completion of interviews conducted and subsequent transcription of conversations after each interview, the data was analysed using Atlas ti. The purpose of this analysis was to highlight categories and sub-categories of respondents' responses in the data. Using the inductive

approach to content analysis, the researcher began to develop a list of categories after interviewing the first respondent from Nigeria.

Over the course of the interview period with respondents in Nigeria, this list was populated with categories and sub-categories extracted from the data. It is important to note that the preliminary process of developing categories was informed only by the initial discussion with respondents during interviews. After all eight interviews with respondents in Nigeria were completed and interviews were transcribed, the data was analysed thoroughly and holistically to ascertain the linkages between sub-categories and categories.

The aim of this process was to develop groups of categories as the main findings that represented the responses of respondents in Nigeria. The lists of categories developed before and after the transcription process were merged to form one list containing twenty two sub-categories. These sub-categories were linked together to form five main groups of categories that represented respondents' responses which were policy uncertainty, rural development, low exposure, high risk and timing. In line with these groups of categories, the findings from Nigeria are presented below.

This section also presents findings from the research conducted in South Africa. Following the completion of each interview, recorded conversations were transcribed. The final transcripts were analysed to provide an understanding of the data and in order to highlight sub-categories and categories consistent in the data. After each interview, during the transcription process sub- categories were listed and subsequently put together to form categories.

The research for South Africa consisted of twelve interviews and on average, after transcription each interview provided a four-paged long transcript. Sub-categories and categories were developed during and after the transcription process upon further analysis of the data. After transcription, further analysis using Atlas ti resulted in twenty eight sub-categories formed by merging the categories and sub-categories highlighted during the transcription process and after a holistic analysis of the data.

These sub-categories were grouped into five major categories namely industry deregulation, policy stability, environmental considerations, socioeconomic development and market development. Rather than present the findings according to countries, for the purpose of

comparison, the researcher chose to present the findings according to themes established from the analysis of data.

Themes were developed after concluding the analysis of data by comparing listed categories for each country in efforts to group related categories together to form themes. Five main themes were developed from the research namely economic development, RE policy, RE finance, market development and energy access. The section concludes with a summary comparison of concepts highlighted by respondents which was extracted from the data.

5.4.1 Economic Development

In Kenya, most respondents addressed the concept of economic development in terms of rural electrification and development, highlighting related concepts such as energy poverty and energy access as key issues during the interviews. All respondents explained that the use of RETs as systems that are decentralised and capable of providing stable electricity for rural populations was part of a broader plan for semi-urban and rural development. According to some respondents the Kenyan government seeks to promote RE as a component of its entire integrated plan for providing electricity to communities without access to modern electricity.

Some respondents also suggested that developing rural communities through establishing REPs to provide electricity could impact the living standards of Kenyan citizens adversely affected by poverty. A number of respondents maintained that the use of RETs alone cannot solve the challenge of energy poverty which they suggested impeded local economic development for the vast rural Kenyan population. Respondents were of the opinion that the private sector had an important role to play in financing small scale REPs.

However, they explained that the extent to which firms in the private sector would become involved would depend largely on the Kenyan government's policy to increase energy access across the country. This, respondents suggested could occur through the development of an incentives program to reward investment in REPs in semi-urban and rural areas. The following quote extracted from an interview with an official from the energy ministry in Kenya buttresses the issues relating to energy poverty alleviation as a means to increase economic development.

"More than 75% of the Kenyan population live in rural areas and just over 25% of the entire population has access to electricity. Our government is focused on using renewable energy as a means to energise and empower rural populations to bring about development in these local communities."

In Nigeria, some financiers and REP developers suggested that the government's plan for developing RE was still not clear. Notwithstanding this, they explained that the benefits of developing a RE sector can have positive impacts on the local economy in terms of development. Many financiers from Nigeria approached the concept of RE and economic development by highlighting the need for DFIs to enter into the industry to finance large, medium and small scale REPs to impact development across communities in Nigeria.

Some financiers and REP developers were of the opinion that in order to reduce barriers to financing REPs in Nigeria, DFIs could play an important role in smoothing out the learning curve for other financial institutions, especially those in the private sector. Respondents suggested that the rationale for highlighting DFIs as possible early stage financing is based on DFIs' capacity to provide risk capital for experimental projects that contribute overall to the development of specific economic sectors.

Also, the mandate for DFIs in Nigeria is to spur development by financing viable projects with the capacity to transform local communities positively. In addition, respondents suggested that DFIs are able to invest in projects that financial institutions in the private sector may not be able to venture into due to the high level of associated risks. Respondents further explained that the development of a RE framework which outlines the action plans and objectives of the government can help promote RE in the country.

Additionally, respondents suggested that the role of local DFIs as the early stage financing partners of the government could in time open up channels for other financial institutions to invest in developing REPs. According to some respondents, increased participation of financiers would result in Nigeria reaping the economic benefits of developing RE. The following quote extracted from an interview with a division head at an investment bank illuminates the responses from respondents in Nigeria regarding DFIs, RE and economic development.

"Development financial institutions ought to lead the way in financing renewable energy projects. They are partners with the government and can be used as anchors for other firms coming into the industry. This way, the government would have built its case for other financial institutions to invest and then we can all enjoy the economic rewards that renewable energy provides."

In South Africa, most respondents related to the concept of economic development in relation to RE in terms of financing REPs to promote economic development. However, respondents from DFIs and private sector financiers held differing views on the objectives and motivation to finance REPs for economic development. Respondents from DFIs suggested that the decision to finance REPs was ultimately linked to the mandate of the organisations which was to promote socioeconomic development and growth within the various regions of the country.

Respondents explained that collaborating with the various government departments to provide electricity by financing REPs which in turn improves the living conditions of South Africans was a necessary step that had to be taken. In this, respondents highlighted the New Growth Path (NGP), a document developed by the South African government which outlines important steps the country has to take in order to achieve higher economic inclusivity and social development.

In addition to this, some respondents explained that in the early stages of developing the South African renewable energy bidding program (REBID), it was important for DFIs to step in and show leadership by financing REPs. Other respondents from private financial institution confirmed that the decision of DFIs to commit financially to early stage financing of REPs helped to alleviate the worries many financiers had regarding the program and suitability of the policy to the South African market.

Essentially, for the DFIs in South Africa, financing REPs was a part of their obligation to fulfil their broad mandate to promote development. This, according to some respondents occurs through financing projects that contributes to achieving the government's overarching policy of attaining development by bettering the living conditions of its citizens. The quote below highlights the objectives for economic development in financing REPs as explained by a unit head at a South African DFI.

"Our organisation works hand in hand with the government. The department of energy set a goal for all South Africans to have modern electricity in a few years and the department of economic development's goal is to provide all South Africans with a better quality of life. By financing renewable energy projects we help to actualise these objectives."

Although financiers from the private sector in South Africa shared the same views as financiers from DFIs as in the aforementioned countries, the two groups of financiers differed on the motivation and objectives for financing REPs. In financing REPs, private sector financiers mostly explained that their objective in financing REPs was to make profits. These respondents suggested that the profit-making objective preceded objectives for socioeconomic development, although this was also an important objective.

Rather than having socioeconomic development as the dominant motivator for financing REPs, respondents suggested that as is typical of a capitalist system, the objective for financing REPs was to make profit. According to these respondents, in the process of financing REPs, socioeconomic development would occur within the communities. Respondents suggested that contributing to the development of communities was an important criterion in entering into agreements to finance REPs. However, they maintained that for their institutions to consider financing a particular REP, it had to make financial sense and bring in profits to the firm, first and foremost.

Respondents explained that in establishing a RE program, it was up to the government to ensure that private sector financiers incorporate a compulsory socioeconomic development aspect into the overall program for REP developers to observe. The position of private sector financiers on RE finance and economic development is highlighted in the quote below from a principal at an investment bank in South Africa.

"The objective of a capitalist is to always make some more capital and the objective of policy is to ensure sustainability and the best possible solution for the country and its future which means being able to supply specifically for this industry, reliable, affordable electricity."

REP developers and policymakers in South Africa also explained that the government played an important role in ensuring that the independent power producers (IPPs) given licenses to develop REPs linked electricity generation to development. This occurred through the creation of jobs and transfer of skills to unskilled workers. According to some respondents, this was an obligation requested from each IPP by the South African government.

Some respondents agreed that if the government had made the socioeconomic development aspect of project proposals in the bidding rounds optional, many developers would not have considered adding in this component. Some respondents also explained that in the greater interest of the South African economy some REP developers integrated aspects of socioeconomic development into their IPP programs.

Most locally-based REP developers explained that they had elements of socioeconomic development as a core part of their business functions in their organisations. According these respondents, the motivation for including socioeconomic development as a core business function in their organisation is based on the large skills gap currently existing in South Africa, especially outside of the main cities in the country. The socioeconomic dimension, according to some respondents is necessary to develop important skills needed to grow the RE industry over a period of time.

Thus, rather than looking at the component of socioeconomic development as an unnecessary obligation to the government, some respondents suggested that for their organisations, following through with socioeconomic development was mainly about investing in the future of the RE industry in South Africa. The role of the South African government in linking its REIPPP program to socioeconomic development is highlighted below in the quote from a director at a local firm involved in developing REPs in the country.

"Government recognised the need to link the generation of electricity to social development. All the projects that we are involved in have a heavy social development element to it which is a state requirement but it is really part of our core business. We have an entity that monitors all the social development work within our organisation."

5.4.2 RE Finance

In Kenya, respondents confirmed that almost every REP developed in Kenya after the establishment of the renewable energy feed-in-tariff (REFIT) policy was financed using project finance. Some respondents, particularly REP financiers, explained that it was simply too risky to invest capital in REPs even with the REFIT policy in place. Respondents cited the lack of understanding in funding REPs, a lack of expertise with managing RETs, the time consuming process of filing expressions of interest (EOIs) until power purchase agreements (PPAs) are signed as barriers to REP development.

These respondents also expressed concerns about the low number of successfully signed PPAs and the very few numbers of completed REPs as some of the factors deterring financial institutions from investing in REPs. Some respondents also suggested that the process of revising the REFIT policy should be more inclusive and take the perspectives of financiers and REP developers into consideration.

Respondents explained that this can be possible by appointing representatives from all groups involved in the financing and developing of REPs onto the REFIT policy board. This would not be for stakeholders to lobby for the group they represent, but to provide a clearer understanding of the challenges each group faces to consequently obtain outcomes that are inclusive. Respondents suggested that by doing this, results that benefit each group and subsequently, the entire country could be obtained. Some respondents also suggested that even while using project finance to finance REPs, financiers still faced heavy risks due to a high level of unfamiliarity with REPs.

A significant risk to financiers as highlighted by respondents was the risk of construction delays which are costly and sometimes inevitable. RE financiers suggested that for RE development to increase, other models of financing REPs must be implemented. This in turn depends largely on the extent to which the government is willing to incentivise financiers and REP developers to explore other possible models. The following quote from a senior executive at an investment bank in Kenya shows as an example, the reaction of many Kenyan financiers in the choice of REP financing models.

"Right now, for all the right reasons compared to other financing models project finance is the safest method of financing renewable energy projects. It would make no sense to finance such high risk projects entirely through equity."

Financiers confirmed that financial innovation using differing financial instruments and models was an important link entirely missing in the RE development agenda in Kenya. Some respondents analysed the government's objective for developing its REFIT policy and contended that since the aim of establishing the policy was to add capacity to the grid, it effectively shut out the possibility of rural populations benefitting from the policy through the development of small scale REPs to provide electricity for communities.

These respondents suggested that the development of the REFIT policy was not consistent with the government's objective to increase energy access as the greater part of the

population of Kenyans that lived without electricity were located in rural areas. In the following quote, a director at a development bank in Kenya expressed concerns about the low level of financial innovation occurring in the RE sector within the country.

"We have to innovate financially, some way or the other. As a first step, government can support start-up energy companies and initiatives with sensible business models. It would be a continuous learning process."

Furthermore, Kenyan financiers suggested that the REFIT policy was at best elitist and that the government should take a different approach if it really wanted to increase access to electricity within the country. In this, respondents suggested that there was no "one size fits all" approach to developing RE and increasing access to electricity. Rather, a mix of viable policy approaches was what the government needed to implement. Respondents from the ministries of energy and economic development and the energy regulator in Kenya confirmed that financiers from the private sector had limited resources. Considering this, it would be very difficult to persuade financiers to invest in REPs in semi-rural and rural areas.

These respondents suggested that the government empowers microfinance institutions (MFIs), credit societies and other quasi-financial institutions to focus on financing small and medium scale REPs for their localised communities as a way to increase RE development and access to electricity. The quote below from a director at the economic development ministry highlights some respondents' trust in MFIs to finance REPs.

"Microfinance institutions can act as agents of change to bring energy to areas lacking modern electricity by financing strategic small scale renewable energy projects. They can finance these projects and provide electricity at lower costs but the operating model and approach has to be appropriate. It would be naïve to think private firms would risk their capital in these communities."

Most respondents in Kenya also suggested that it would be difficult to use project finance as the model of financing small and medium scale REPs. These respondents reckon that this is because project finance is usually used to finance large scale projects and the revenue from the project is mostly used as collateral in borrowing capital to finance these projects. Financiers suggested that although the revenue from electricity generated by small and medium scale REPs can be used as collateral in borrowing funds if project finance was used. However, lack of support from the government acts as a barrier to private sector financiers.

These respondents suggested that the government can attract financial institutions in the private sector to fund small and medium scale REPs by developing an IPP program focused on generating electricity for communities through small and medium scale REPs. Additionally, these respondents suggested that the key to the success of such a program rests on the capacity of the government to prioritise communities within which small and medium scale REPs would be developed. Also, inviting financiers and developers from the private sector to submit EOIs for specific projects in selected communities is essential.

This way, the government would be realising its objective of developing RE to increase electricity supply and addressing the energy access challenge. Some respondents suggested that upon implementing such an initiative, financiers from the private sector would benefit from investing in small and medium scale REPs for semi-rural and rural communities through the sale of electricity.

In Nigeria, financiers suggested that the financing of REPs differs from financing development projects and other forms of energy, particularly crude oil production in the country. This in the view of some financiers is due to the inherent risks associated with REPs. Also, some financiers suggested that financing large scale REPs is particularly risky due to the high level of unfamiliarity with RETs, unprecedented construction risks and legal issues surrounding challenges associated with obtaining permits and licenses to develop REPs.

Some respondents also suggested that financial institutions in Nigeria have the capability to learn about RE development to begin financing REPs. However; this learning process would only be undertaken when the government successfully outlines its objectives for the development of REPs and the consequent role of the private sector. Some financiers were of the opinion that financing REPs was not a novel idea for financial institutions in Nigeria. Hence, prioritising REP finance for development to a point where it impacts growth and local economic development would only be possible when government institutes policy to provide a roadmap for RE generation. The concerns of some respondents regarding financing REPs are elaborated below in the quote from a division head at an investment bank in Nigeria.

"The learning curve for financing renewable energy projects is very steep. Generally, our financial institutions learn very fast but this is still not a reason to invest huge capital in high risk projects without any assurance from the government backing investors."

Financiers also concluded that the government had not made consistent efforts to promote RE in Nigeria and that this in turn had impacted the private sector's ability to contribute to developing RE. Most financiers suggested that the fact that the Nigerian government had not expressed a coherent strategy for the development of REPs acted as a deterrent to financial institutions within the country. These respondents explained that it was not enough for the government to highlight the development of RE as an instrument for economic development. They suggested that only a cohesive plan of action would sufficiently attract financiers.

In addition, financiers suggested that in developing policy frameworks to promote investment in RE, rather than establish market-driven frameworks, government-designed frameworks could be more appropriate for the market. This, according to financiers is due to the nature of financial institutions which require a high level of clarity especially in financing high risk projects. The quote below from a director at a development bank in Nigeria highlights some of the frustrations of financiers regarding the development of RE in Nigeria.

"The government has been talking about promoting renewable energy in the country but very little has actually been done to tickle the interest of the financial institutions to invest in developing renewable energy. What would be the primary rationale behind this development and how would it be organised?"

Financiers and policymakers in Nigeria also suggested that financing large scale REPs would mean financial institutions would be entering into new terrains as many of the local institutions are not versed in REP financing. These respondents explained that the financing of REPs comes with technical attributes and challenges that local financiers are yet to master in order to make sound judgements to protect investments in providing capital for REPs.

Since Nigeria is an oil-rich country, some respondents suggested that the local financial institutions had developed competencies in financing crude oil production across the entire value chain. This, according to these respondents is based on the fact that financiers had engaged oil companies over the years and had developed an understanding of the crude oil business within the country.

Also, these respondents suggested that in developing the Nigerian crude oil industry, the national government developed clear policies and strategies to foster development of the industry. This in turn according to these respondents provided a high level of certainty for willing investors and financiers. On this, some respondents concluded that the focus of

private institutions is to make profits. They suggested that until there is a clear policy that highlights the government's strategy for RE development which financiers can analyse to locate areas where they can add and extract value, many financiers would not embark on financing REPs.

Below, the quote from a director at an investment bank in Nigeria is used in an attempt to highlight the competencies of financial institution in Nigeria with financing fossil-based energy. The quote focuses on the lack of experience with financing REPs in the country.

"Financial institutions lack the technical knowhow to finance renewable energy projects. We know everything about financing crude oil production because we have learnt over the years. Renewable energy projects come with new challenges and complexities, private institutions want to make profits and the government has to provide guidance in this regard."

In South Africa, many respondents confirmed that the main model their organisations used in financing REPs is project finance. According to the financiers, project finance is the most preferred model because it functions to protect investors from the high risks associated with financing REPs. These respondents explained that financiers prefer project finance because of the features of the model which in many ways works to insulate organisations from the high-risk projects they commit to financially.

In some financiers' view, in using project finance, financiers can fund high-risk projects that would not appear on the firm's balance sheet and so these projects have no impact on the firm's overall operations. Also, in the event that the project is unsuccessful, other parties involved in the development of REPs such as the government would not have any claim on the assets of the financiers if financiers fund REPs using project finance. Some financiers explained that this thinking is in line with the objectives of capitalism which aims to make profits. So, by reducing the risks associated with financing REPs by using project finance, financiers can maximise their chances of making profits from their overall operations.

Also, financiers suggested that they prefer project finance due to its capacity to attract multiple financiers for REPs. The risk of financing is spread across different organisations, which make it easier to absorb losses due to construction delays and cost overruns. Many financiers confirmed that for a new sector such as RE, the safest model to adopt is project finance. This they explained is due to the high risks associated with the sector, especially in Africa where the capital markets are highly underdeveloped.

In addition, financiers suggested that even with South Africa which has the most developed financial market in Africa, it would be too risky to finance REPs using equity and other financing models and instruments. Financiers suggested that project finance is used mainly in the early stages of market development and that as the market matures and financiers begin to understand the cycles of REP development, more models could be introduced to finance REPs.

The quote below explains the perception of financiers regarding the RE industry in South Africa, specifically in terms of the models of financing REPs firms have adopted. This quote from a principal at an investment bank in South Africa highlights financiers' preference for project finance.

"Primarily our organisation finances its renewable energy projects using project finance as its main model. We aim to adopt different funding models in future but that would depend greatly on the rate at which the market matures. So, it really depends on the stage of renewable energy development in the country but generally financiers prefer project finance even though it is expensive."

Financiers and REP developers in South Africa also suggested that private sector financiers showed no interest in financing rural REPs. This was mainly due to the perceived inability to recoup capital investment based on the lack of appreciable purchasing power among the rural poor in South Africa. Some financiers and REP developers concluded that private sector financiers see no prospect to make profits from financing semi-rural and rural REPs. These respondents explained that financiers from the private sector do not see the financing of rural REPs as a viable investment.

The respondents further explained that since the objective and philosophy of private sector financiers was to make profits, it would be difficult to extend financing to communities that may not be able to pay back, consequently costing the firms. Following this conclusion, some financiers and REP developers suggested that different funding models and mechanisms may have to be implemented to enable the private sector to come in and finance REPs. These respondents explained that these models would have to be developed taking into account the non-sequential income cycle of rural dwellers.

Furthermore, financiers and REP developers suggested that the government would also have to take the lead in ensuring that private financiers get some of the invested capital back

through developing programs such as rebates for specific RETs and issuing policy to support the development of a market for renewable energy certificates (RECs). In the quote from a senior executive at a development bank in South Africa below, the position of financiers in financing rural and semi-rural REPs is detailed.

"We need to understand the cultural differences between people and communities in different parts of the world. Graamen Shakti is successful because it built on its lessons from Graamen Bank. If we wanted to invest in rural areas, many of the financial institutions would not know where to start."

REP developers also explained that in the African context, the lack of access to capital for local banks is a critical barrier for private sector financiers willing to finance REPs. Some financiers and REP developers suggested that many financiers are wary of entering into long-term financial commitments to finance REPs. This is based on the high upfront costs that go into financing REPs and compared with the low initial return on investment recouped in the early stages of a the life cycle of a REP. According to these respondents, this risk coupled with the risk of policy uncertainty, would serve as a major deterrent for many financiers.

Some financiers and developers explained that financiers were able to enter into the RE market because the South African government did its best to ensure that the conditions for entry were acceptable for financiers. According to these respondents, although there was a lot of uncertainty about the policy framework in the early stages of developing the RE program, the objectives for RE as a part of the broad energy mix as established by the government provided financiers with some level of assurance.

Financiers, REP developers and policymakers explained that it would be very difficult to get financiers to participate in developing REPs in a market where policy is uncertain. This is mainly due to the high risks associated with financing REPs. Some of these risks according to respondents include the cost of capital, access to capital, licensing requirements and purchasing equipment. In addition to this, respondents suggested that based on the nature of the financial markets where financial institutions are mostly able to provide short-term financing, financing long-term REPs is very challenging.

For banks to finance long term REPs, financiers explained that matching the tenure of short term deposits collected by banks and the long tenure of REPs is one of the most difficult barriers to overcome in financing REPs. The quote below from a partner at a private equity

firm in South Africa provides further evidence of financiers' scepticism to embark on financing REPs. This is primarily based on the nature of the banking system and the highly underdeveloped capital markets in Africa.

"Renewable energy projects are capital intensive, so they require a large amount of money. Unlike in the developed world, access to capital is not as broad in South Africa and on the continent. The hardest part for financiers is matching the tenure of the investment to the time they have to repay back the money."

5.4.3 RE Policy

In Kenya, most respondents suggested that the IPP program has been largely unsuccessful due to bottlenecks in the system and a lack of clarity on the benefits for potential investors. Some financiers and policymakers suggested that the design of the REFIT did not make any provision for off-grid REPs through which localisation of energy production can occur. Consequently, the contribution of REPs to impacting local economic development is low. Some policymakers also explained that the slow implementation of REPs made financiers hesitant about investing in REP development. Also, these respondents mentioned that the timeframe from submitting an EOI, as is the procedure, to signing PPAs was lengthy.

However, policymakers suggested that the Kenyan government and the ERC showed their support for the development of RE by following globally acceptable best practices in reviewing the REFIT framework twice since it was first established in 2008. Additionally, policymakers also explained that the government's main aim in developing the REFIT was to increase investment in RE development to add capacity to the national grid. The quote below from a director at the energy regulatory body in Kenya summarises the view of most Kenyan respondents' on the success of the REFIT policy.

"Kenya was the first Sub-Saharan country to implement a REFIT policy in 2008. At this point only a handful of projects have advanced to the power purchase agreement (PPA) phase. Financing for projects has been stifled because investors are unwilling to commit funds without any form of certainty. This defeats the general purpose of the policy."

In Nigeria, financiers and policymakers suggested that the development of RE in Nigeria is being stifled by the lack of clear policies to highlight the objectives of government in promoting its development. Some policymakers explained that although the national government and a few other ministries had begun conversations around the implementation

of RETs, the dialogue needed to be broadened to include forecasts and expected impacts on economic development.

Furthermore, some policymakers suggested that in broadening this dialogue, the government should endeavour to highlight the particular technologies it sought to apply to generate renewable electricity for the country. Some respondents also suggested that the objective for developing RE differs from one country to the other. Although commonly among African countries, the aim was generally to increase energy access across communities and impact economic development.

In addition, financiers explained that the lack of clarity on the Nigerian government's agenda for the development of RE increased the difficulty of willing parties such as financial institutions and REP developers to contribute to the development of RE in the country. The quote below from a chief executive officer of a microfinance bank in Nigeria summarises the concerns of many respondents regarding the lack of a stable RE policy in Nigeria and the impact of this on the development of RE within the country.

"What is lacking is a national framework for the development of renewable energy and the purposes this would serve. It would be difficult for investors to commit capital to such high risk undertakings without clarity of purpose from government and a statement of the benefits to all willing parties."

Some respondents also suggested that selected policy instruments should be designed to provide guarantees for financiers if sizeable capital is to be committed to developing REPs. These respondents also suggested that in developing policy instruments, consideration for the implications in the short and long-term should be given to REP developers and financiers. One way of ensuring this would be for the government to engage the financiers in order to understand the mechanisms of financing complex REPs in view of the expected impacts of the selected policy.

Some respondents explained that the critical factors must be considered in designing a RE policy instrument. These include, clarifying the objectives of the program, understanding the nature of the domestic market and selecting elements of policy instruments that would be adapted to the local economic conditions in the country. Additionally, some respondents suggested that an inflation-linked REFIT with a cap and floor could provide financiers with a level of certainty that returns on investment would be guaranteed. In the quote below from a

principal at an investment bank in Nigeria, the position of financiers in Nigeria on the financing of REPs is summarised.

"Financing large scale renewable energy projects is truly a high risk venture. You cannot just wake up one day and decide you will be committing XYZ amounts of money to finance projects of this nature. The government has to lead the way by showing dedication to the cause and providing guarantees for firms that may be willing to invest."

Financiers suggested that there was a lack of policy coherence and direction regarding the development of RE in Nigeria and that although the government had indicated it was developing its REFIT policy, financiers were not prepared to commit funds to develop REPs. According to some respondents, financiers had developed a "wait and see" approach. In addition, some financiers suggested that when the policy is established, the level of commitment that would be shown by financiers would be a direct indication of the likelihood of the policy to be successful in developing RE within the country.

Some financiers suggested that advancing to finance REPs without a clear direction from the government on the development of RE could be a futile and expensive exercise. Furthermore, financiers explained that the high risk associated with financing REPs and the lack of policy to guide the development of REPs made financing REPs even more risky.

These respondents expressed concerns about the institutional framework for selling electricity generated from RE plants and echoed the role of government in driving RE development from generation to transmission. The respondents also explained that the process of approaching state and local governments for licences to generate renewable electricity was cumbersome. This is because electricity generation and transmission in Nigeria is mandated to the NERC, a division of the national government.

In South Africa, most respondents mainly spoke about RE policy in terms of the stability needed for the market to develop as a result of policy implementation. Some respondents suggested that in financing REPs, for financiers, the stability and longevity of the government's policy is critical. These respondents explained that this is extremely important because a stable policy environment allows financiers to plan for longer periods of time in order to even out the impacts of the risks associated with financing REPs.

In addition to this, financiers, REP developers and policymakers explained that although the choice of policy lies within the jurisdiction of the government, in developing policies to

promote RE it is important that all parties contribute to policy formulation. Most respondents suggested that this is important because it allows for government and the private sector to agree on specific areas of interest for each party. Hence, both parties can ultimately influence the final outcome to an extent that common ground between the objectives of the government and private sector is found.

Most respondents explained that in developing its policy to promote RE, the South African government's decision to change from the REFIT model to the renewable energy bidding system (REBID) model troubled local and foreign investors greatly. The position of respondents on the importance of having a stable RE policy is highlighted in the quote from a South African REP developer below.

"Having policy that is stable over an extended period certainly helps. Policy must not change a lot of times so stability is critical. The way you shape it is really the choice of government. Stability makes it possible for us to make decisions today projecting for 40 years."

In 2008, the South African government adopted the REFIT model but abandoned this policy for the REBID model in 2010. REP developers suggested that investors preferred the REFIT model because it provided absolute certainty as tariffs for renewable electricity were fixed over the life span of PPAs. The REBID model according to these respondents was particularly problematic for investors. This is because it did not guarantee certainty of fixed renewable electricity prices and financiers had to make projections based on assumptions of the market over the life span of PPAs.

In some respondents' view, the government's plan for developing RE as a part of its effort to diversify the country's energy mix and establish long-term frameworks to support renewable electricity generation provided a sense of security for investors. However, many financiers and REP developers agreed in hindsight that the REBID model was a better choice than the REFIT model. This is mainly because it helped to achieve the objectives of the government and private sector, which were to develop RE capacity at an affordable cost and to make profits from developing REPs respectively.

Financiers and REP developers also spoke about RE policy in terms of the linkage to environmental policy and benefits derived from RE development, specifically the reduction of greenhouse gas (GHG) emissions. Financiers explained that all the REPs their organisation financed or developed went through compulsory approval stages where REP proposals are

matched with the objectives of the firm in contributing to the development of clean energy in South Africa.

According to these respondents, in the approval stages, project proposals are evaluated to ensure that the projects are not hazardous to the environment. If projects do not reflect objectives to maintain the integrity of the environment, they are either reviewed to clearly highlight the benefits to the environment or entirely dropped. Some policymakers explained that in developing its RE program, the South African government made it mandatory for financiers and developers in their proposals to elaborate on the impact of their REPs on the environment.

According to some respondents, this was a joint decision that stemmed from the close collaboration between the departments of energy and environmental affairs. The objective focused on developing energy to broaden the country's energy mix in an environmentally responsible manner. REP developers suggested that many of their partners in foreign countries were signatories to the equator principle, which has the primary objective of protecting the environment, thereby ensuring that the newly developed REPs had high environmental standards. The quote below from a principal at an investment bank in South Africa highlights respondents' view on deriving converging benefits of implementing RE policy alongside an environmental policy.

"Besides what environmental policy the firms have, the South African energy department works very closely with environmental affairs and most of the partners that we have come from countries that are signatories to the equator principle which has very high environmental standards."

Many respondents confirmed that while their organisations had genuine objectives of contributing to the integrity of the environment by developing REPs to facilitate the production of clean energy, carbon reduction to their firms is mainly an accompanying process occurring naturally. These respondents also suggested that the main focus of their firms in developing REPs is to contribute to the government's program to diversify the energy mix while realising profits from their investments in RE.

Many of the respondents suggested that carbon reduction was not an importantly prioritised objective in the broad decisions of their firms on whether to finance or develop REPs. According to these respondents, for their organisations, the objectives of financing and

developing REPs were based more on the capacity of the projects to provide returns for the firm and the impact of the projects on the development of local economies.

Some respondents qualified the process of carbon reduction as an added benefit to developing REPs. They suggested that their firms developed REPs based on the belief that for the economy of a country to be progressive, several sources of energy have to be developed to contribute to driving economic systems. In the quote by a South African REP developer below, these respondents' views on the issue of financing and developing REPs as a means to reduce carbon emission and GHG production is elaborated on.

"Carbon reduction is something that I have no care for. I have no care for it because developed countries spent the last 150 years polluting the world using fossil fuels, now when it is time for Africa to come up we are told we cannot use the very resources that we have in our own ground."

Many respondents also confirmed that alongside REPs, their firms also financed and developed energy plants driven by fossil fuels. From a development perspective, some respondents suggested that RETs are foreign to many African countries and these countries lack the competency needed to develop and manage REPs. Also, considering the cost of RETs, according to some respondents, it would only make sense for RE to form a part of a South Africa's energy mix. This is because South Africa has an abundance of coal which is used to power electricity generating plants in the country.

This according to some respondents makes the cost of energy cheaper and ultimately impacts the government's agenda for countrywide socioeconomic development. In addition, some respondents explained that they believed climate change and global warming was real. However, they suggested that developed countries are using these subjects to curtail the growth of developing African countries by coercing these countries into agreements that makes it difficult for them to use their natural resources to develop their economies.

5.4.4 Market Development

In Kenya, some respondents explained the concept of market development in relation to the objectives of the REFIT policy and the capacity of RE to contribute to stimulating economic activity within the country. These respondents suggested that the government's main objective with developing REPs and designing the REFIT policy was to increase the supply of electricity within the country.

One aim of increasing electricity supply according to some respondents was to afford businesses and institutions an alternative to steady supply of electricity. This would consequently increase the performance of these firms as well as their contribution to the development of the economy. According to some respondents, in promoting the development of RE the Kenyan government also sought to reduce the burden of supplying electricity to the growing population.

Over the past years, KenGen and its subsidiaries had been tasked with the responsibility to provide electricity to the Kenyan population. Hence, these respondents concluded that although mitigating climate change through reducing the emission of GHGs was a part of the agenda for promoting RE, the drive towards developing REPs and generating renewable electricity was more focused on economic development for the Kenyan people. The quote below from a director at the economic development ministry in Kenya highlights some Kenyan respondents' positions on the promotion of RE as a means to develop greater energy capacity in Kenya.

"With renewable energy projects, the government's main aim is to increase electricity generation capacity to support local economic growth. The government believes that the spill over effect of this would be felt throughout the economy."

In Nigeria, several respondents spoke about market development in terms of the government's inability to develop a framework for the promotion of RE. Most of these respondents were of the opinion that developing the framework was a necessary step the government needed to take first to develop a RE sector. Many respondents confirmed that investing in REPs was a high-risk undertaking for financial institutions and REP developers. Thus, the lack of clearly defined support from the government makes investing in REPs even more risky.

Some respondents confirmed that financiers were very well aware of the developments in RE occurring globally but were not compelled to invest locally without an indication of the government's commitment towards developing RE. These respondents suggested that an indication of commitment to develop RE would entail the establishment of a national framework for developing REPs within the country. In addition to this, some respondents explained that this framework should include details on the national government's strategy for RE in terms of forecasts for generation and among other issues, the preferred policy to support growth of RE.

Additionally, these respondents suggested that a framework that details these objectives can help to highlight the role of different groups in developing RE. According to these respondents, this would subsequently increase the interest of willing financiers and developers of REPs. Subsequently; this would result in commitment to develop RE within the country. The quote below from a division head at an investment bank in Nigeria highlights respondents' position on the development of a framework to promote RE in Nigeria.

"While setting targets for the development of renewable energy is good, what is missing is a plan for how these targets would be achieved and how developing renewable energy would impact the economy. The government's strategy for renewable energy is not clear and there is no certainty. Investors need confirmation that the government is in this for the long run."

In South Africa, most respondents referred to market development in terms of providing an enabling environment for the growth of a viable RE industry. Further than the impact of regulation, many respondents suggested that financiers in the private sector are more willing to finance REPs when there is a credible purchaser of renewable electricity. In the case of South Africa, these roles are occupied by the national utility Eskom which is backed by the Department of Energy as the procurer.

These respondents explained that since the focus of the South African government in developing its RE program was to diversify the energy mix and increase electricity supply for its citizens, it was important that the government led the process of procuring electricity from IPPs. Some respondents confirmed that the framework for procurement of electricity gave financiers the confidence to commit their resources to financing REPs based on the operational stability of the procurer and the overall creditworthiness of the South African government.

According to these respondents, the procurement plan detailed the responsibilities of the procurer to the IPP and vice versa. This helped to create a system of transparency between the procurer and the IPP. It also gave financiers an increased level of confidence that their investments were secure and projected return on investment was guaranteed. The quote below from a director at an energy utility in South Africa highlights respondents' views on private sector participation in the development of RE sectors in African countries, providing the South African experience as a case in focus.

"What helps the private sector to come in is how you create stability in the system. In the South African context, the stability of the off-taker[25] and its ability to off-take power was the precursor that attracted the private sector financing. Without a stable off-taker that is honest to its obligations, you would not be able to attract private financing."

Some financiers and REP developers suggested that in order to attract and retain investment in REP development, agreements to secure the purchase of electricity are critical to investors. This in these respondents' view was due to the certainty that PPAs provided financiers with. This in turn impacts financiers' ability to make informed projections based on an underlying understanding of how the entire capital structure for the REP can be put together. Some respondents further suggested that for financiers, PPAs provided the clarity needed to model financial projections according to interest rates which also take economic factors such as inflation into account.

Other respondents explained that rather than adopting a variation of a policy that was successful in another country, the objectives of the government in promoting RE should form the foundation of policy development. These respondents suggested that if this is achieved, financiers from the private sector would support government initiatives for the development of RE as long as financiers can make profits through investing. Some respondents explained that although tariffs for renewable electricity were important, rather than focusing on the tariff structure as the main factor to attract financiers from the private sector, PPAs are more important for financiers.

Hence, according to some respondents, for private sector financiers to increase participation in financing REPs, the government should find innovative ways to increase the number of PPAs that have tariff structures providing financiers with a fair amount of profits. In the quote below from a principal at an investment bank in South Africa, respondents' views on factors that enable the development of a RE sector is highlighted.

[25] In this quote, an off-taker is denoted as the electricity utility that purchases electricity from independent power producers (IPPs). In South Africa, the electricity utility entered into off-take agreements with the renewable energy independent power producers (REIPPs) to purchase electricity generated as a part of the renewable energy independent power producer program (REIPPP).

"For investors to feel more secure and comfortable to finance renewable energy projects wheeling agreements must be in place based on the selected policy framework. Every policy has its pros and cons but what should matter is its suitability to achieve the objectives of the government for the local market. The private sector would support government initiatives as long as there is a window for profit-making over a period of time."

Some respondents explained that in order for the private sector to enter into the RE sector and finance projects, it was important that the government take steps to create a stable market by showing long-term commitment to RE development. According to these respondents, for financiers, a government showing this commitment by integrating RE supply into the energy mix signals a high level of dedication in developing RE.

Additionally, some respondents suggested that when assured of long term stability, financiers can then begin to consider investing in REPs. These respondents suggested that in this case, providing long term stability is more important than the price of renewable electricity and the overarching policy the government plans to use to promote the development of RE. Also, the respondents confirmed that stability is the primary concern of financiers because pricing and policy issues can always be reviewed to suit the different parties involved as the RE program progresses over time.

Many respondents also explained that the impact of regulation as regards electricity generation, transmission and distribution played an important role in contributing to the development of the RE sector. Some respondents suggested that the process of electricity supply suffers several structural imbalances in South Africa and that this is an important concern for foreign investors. These respondents explained that with Eskom being the only utility purchasing and transmitting electricity, South Africa operated the "player-referee" model where the same institution sets the price of and purchases renewable electricity from IPPs.

Some respondents explained that this structure rarely works for the development of RE as the price-setters are also the buyers. These respondents suggested that from the perspectives of financiers and REP developers, a more ideal situation would be for the government to have more than one utility purchasing, transmitting and distributing electricity throughout the country. In the opinion of some respondents, this would allow for an increased level of competition among utilities, giving REP developers and IPPs broader options in negotiating transmission and distribution contracts which could ultimately impact financiers positively.

The quote below from a partner at a REP development firm in South Africa highlights the importance of stability in developing a RE sector, according to respondents.

"The key thing is to create stability in terms of committing to a future of renewable energy or renewable energy being part of the electricity mix on a long-term is critical. It is also important that governments get their regulatory environment correct by separating and making sure that the tendency for the player-referee model is decreased."

Many respondents also explained that issues generally relating electricity generation, transmission and distribution were highly sensitive and political in South Africa. Some respondents outlined important economic reasons that results in the private sector remaining uninvolved in the transmission and distribution of electricity in South Africa. They alluded to the fact that the private sector's contribution to electricity generation was minimal as well. According to some respondents, one important issue is based on the value chain of electricity supply in South Africa where a closed purchasing model is operated between the utility and municipalities.

In this prevalent model, municipalities purchase bulk electricity from Eskom at lower costs and then sell to residents at a higher cost. Thus, the bulk purchase and reselling of electricity is an important source of revenue for municipalities in South Africa. According to some respondents, if the private sector was to come in to begin transmitting and distributing electricity, many of the municipalities would have to purchase electricity at higher costs. Electricity from Eskom is subsidised by the government and private sector firms transmitting and distributing electricity would not benefit from purchase contracts since the private sector is not subsidised by the government.

These respondents explained that among municipalities, this type of thinking applied across all forms of energy including RE. The quote below from a CEO of an NGO involved in developing community REPs in South Africa highlights the views of respondents on the politics of energy generation, transmission and distribution in South Africa. The quote also provides insight into the low level of participation of private sector firms in these processes.

"There are political and economic reasons why the private sector stays away from electricity issues. Municipalities do not like the interference of the private sector or investors in electricity generation and distribution."

5.4.5 Energy Access

On the issue of energy access in Kenya, many respondents explained that if the Kenyan government's local economic development plan which prioritised targets for increasing energy access were to be met, dependency on foreign aid must be reduced. Regarding this, some respondents suggested that foreign aid as a component of development packages does not retard efforts to increase energy access to the Kenyan people. Rather, the dependency on foreign aid as the main source of revenue to finance electrification projects in the rural areas would surely retard efforts to scale up the electrification of local Kenyan communities.

Respondents suggested that the government finds innovative ways to incentivise financiers in the private sector to invest in REPs so as to reduce alleviate challenges associated with financing such high risk projects, especially in rural areas. As mentioned by the respondents, some means by which the Kenyan government could provide incentives for private sector firms to finance REPs included offering production credits, production tax cuts and offering rebates on the financing of solar home systems. The quote below from a director at a development bank in Kenya summarises the perception of Kenyan respondents regarding development aid for financing RE development in the country.

"Poverty alleviation is a noble cause but foreign investment through financial aid can only contribute so much to address the problem of energy access. The private sector has an important role to play here but the truth is that investing in renewable energy for rural development is a really complex issue."

Other respondents suggested developing policy to support the localised establishment of energy service companies (ESCOs) in partnership with Kenya's Rural Electrification Authority (REA) to finance and manage small and medium scale REPs. Some respondents also explained that the incentives for private firms to invest in REPs located in urban areas outweighed incentives, if any at all, to invest in and finance semi-rural and rural REPs. The incentive most frequently highlighted was the purchasing power of urban communities and respondents suggested that although REPs were generally high-risk investments, rural REPs presented even higher risks for financiers.

Thus, some respondents explained that the government had to increase incentives for rural REPs to strengthen the rationale for private firms to invest. These respondents suggested that for an incentives program to be successful in attracting private sector financiers, the program

should be tied to policy frameworks for energy access and other national development objectives.

Several respondents suggested that the government's policy for RE development fit into the broader energy policy framework to increase access to energy to bring about local economic development. However, the main challenge for the government in efforts to provide Kenyans with modern electricity using RETs for rural areas was the cost of RE generating kits. Mainly for semi-urban and urban areas, the challenges included developing and refining its policies to encourage investment in REPs to increase the supply of electricity within the country.

Some respondents explained that as much as the government's policy was to develop all areas of the country, it was impractical to extend the electricity grid to all Kenyans. The main reason that this would be difficult to accomplish according to the respondents was the cost of developing grid lines especially for dispersed rural communities. These respondents explained that setting targets for RE generation and developing policy to promote investment in REPs counted as positive actions on the part of the Kenyan government.

Some respondents, however, concluded that the benefits of the REFIT policy have not resonated with financiers from the private sector and this was partly responsible for the slow development of REPs in Kenya. Furthermore, these respondents suggested that the government aligns its policy for energy access with development objectives by prioritising policy to support investment in REPs. The quote below by a director in the energy ministry in Kenya highlights respondents' views on this.

"The dilemma we face is that we know it is virtually impossible to extend the grid to all citizens but our motto is development for all. This is where the government should look to prioritise policy to enable investment in renewable energy."

In Nigeria, many respondents spoke about energy access in relation to the unbundling of the electricity across the value chain as a strategy to increase access to energy within the country. These respondents also suggested that the slow rate of development regarding dialogues and actual plans for promoting RE in Nigeria was due to the current unbundling and privatisation of the power sector within the country. According to these respondents, the incessant power cuts interrupted economic activity and the use of generating sets increased the cost of doing business in Nigeria.

Some respondents suggested that the national government's priority was to bring stability to the power sector in order for economic production activities to occur uninterruptedly. This, in some respondents' opinion can impact production output and hence the overall economy of the country, which is an important priority for the government. Some respondents concluded that in view of this, RE development forms a part of the government's effort to increase access to electricity for rural dwellers. The prevailing view of respondents' regarding energy access is highlighted in the following quote by a director in the energy ministry in Nigeria.

"For the past few years, the unbundling of the power sector has been the priority of the government in terms of matters related to energy. Our aim with the unbundling process is to stablise the supply of electricity so that the impact is felt in other economic sectors. Plans for the development of renewable energy are underway and the focus is to reduce emissions and electrify rural settlements."

In South Africa, many respondents linked energy access to the government's overall development policy. They concluded that financing REPs as a means to increase energy access was important, but the government had to point investors in the direction it chooses to go. Some respondents explained that in addition to policy formulation, for financiers to contribute to the development of RE, a regulatory framework that highlights the objectives of government in developing RE should be at the core of the government's plans.

These respondents confirmed that financiers are mainly concerned about the security of their investments and that the best way to increase investor confidence is to provide assurance through implementing broad regulations that take into account perspectives of the financiers. Other respondents suggested that the high cost associated with REPs makes it even more difficult for financiers to decide to finance REPs on their own, without any form of assurance through policy and regulation developed by government.

Some respondents highlighted examples of how policy influenced financiers' decisions to invest in high risk projects that ought to deliver basic services to citizens, in this case, renewable electricity. The South African government's policy is to ensure that all citizens have access to modern electricity that is affordable and stable. Due to the fact that RE forms a part of the energy mix, the government is developing other forms of energy to fulfil its obligation to the citizens in this regard.

Currently, the state electricity utility is completing the construction of three coal-fired power stations in the government's quest to increase access to electricity. Some respondents explained that the government has a master plan for the supply of electricity to communities the utility would supply electricity to. Thus, even if there is a clear economic opportunity to finance the development of REPs to power communities without electricity, financiers would be wary of forging ahead to do this because people would likely migrate to the utility's supply of electricity when the grid is extended to their communities.

According to some respondents, this is where regulation can play an important role in providing certainty for investors by securing their investments. The quote below from a unit head at a DFI in South Africa provides some insight into respondents' concerns about financing REPs to address the energy access challenge in South Africa in view of the government's broad development policy.

"For financiers in the private sector to participate, a regulatory framework must be in place. In South Africa the government's priority is to provide electricity for all its citizens therefore financing a solar or wind plant by oneself can be a bad idea. The government may decide to extend the grid to where you have the solar or wind plant and people would migrate away from purchasing electricity from your company. This would be a severe loss for any firm which is the main reason why firms follow the government's lead."

5.5 Summary of the Chapter

This chapter outlined the presentation of findings from the qualitative research for the study. In the chapter, the various processes undertaken by the researcher in collecting, transcribing and analysing data was also explained. In addition to this, the characteristics of respondents from Kenya, Nigeria and South Africa were highlighted and the responses from interviews with these respondents were presented as categories developed from sub-categories and then merged into themes for the research.

Respondents from the different countries mainly agreed on several subjects highlighted in the research but the focus differed across countries as well as among respondents from the same country. Using the theme of energy access as an example, respondents from Kenya spoke about rural development in terms of the practical aspects of rural electrification as a means to address the energy access challenge.

In Nigeria, some respondents addressed the issue of energy access in relation to the government's privatisation program and suggested that a RE component should be included in the design of the new power sector for the country. In South Africa, respondents spoke about energy access from a broader perspective of providing reliable and affordable electricity to the South African population. Some respondents suggested that the South African government's main objective in embarking on its RE program is to increase the country's capacity to generate electricity as well as diversify the energy mix.

Furthermore, as an example, many respondents from Kenya spoke about market development from the perspective of the government's ability to continually review the REFIT policy established in 2008, concluding that the RE has still not taken off because the policy has not been successful in preparing the market to participate in developing REPs. In Nigeria many respondents spoke about market development from the perspectives of the government providing certainty in terms of developing policy instruments, frameworks and structures to encourage investment in RE.

In South Africa, most respondents spoke about market development by describing the various stages the government had been through in developing its RE program. In addition to this, respondents from South Africa spoke about the implementation of the REBID policy and the efforts the government made to prepare the market for the commencement of the program as the stages of market development. Also, respondents from South Africa spoke about market development in terms of the possible steps the government can take to unbundle electricity generation, transmission and distribution in order to reduce the impact of monopolies across the electricity value chain in the country.

Table 5.8 below shows the summary of themes and the level of significance attached to each theme within the different countries. The level significance attached to each theme is a reflection of the importance of a particular theme as a contributor to overall state of development of RE within the selected countries. The indicators also highlight the importance of each theme as overarching objectives of government in promoting RE development within their countries.

Table 5.8: Summary of the significance of themes in RE development in countries

Theme	**Economic Development**	**RE Policy**	**RE Finance**	**Market Development**	**Energy Access**
Country	**Significance**				
Kenya	II	II	I	II	I
Nigeria	I	I	I	III	III
South Africa	III	III	I	II	I

Key: I = minor significance; II = moderate significance; III = high significance

6.0 ANALYSIS OF FINDINGS

6.1 Introduction

This section presents an analysis of the findings obtained from the research as described in the preceding chapters. Following the convergent mixed methodology approach, the results from the quantitative and qualitative research are combined and used to highlight the findings from the research. The analysis focuses on highlighting the main themes as well as sub-themes in the research findings while contrasting with the literature. Thus, the analysis also aims to provide evidence from the research as findings to either accept or reject established hypotheses and propositions detailed in the chapter on methodology.

While there are many methods by which the analysis can be presented, a thematic approach for the analysis of findings is judged to be best suited for this research. The analysis of findings begins with a presentation of the findings for the first research question and sub-themes related to this question. Essentially, issues relating to the financing choices and behaviour of renewable energy (RE) financiers are highlighted in relation to the body of literature supporting these themes and concepts. Additionally, issues and concepts relating to policy to support RE finance as well as related sub-themes in RE are presented in relation to similar studies undertaken in the area. Areas in which the findings from this research are consistent with similar studies in the field are highlighted. Also, points of divergence are explained.

6.2 Hypotheses and Findings

The following sections detail the results of the statistical tests carried out to test the hypotheses outlined in the methodology chapter. In effort to highlight the findings of the research in relation to the hypotheses, the null and alternate hypotheses are presented. The null hypothesis is either accepted or rejected based on evidence from the statistical tests. Additionally, the findings from the research are explained in detail as they relate the hypothesis. Also, in the following sections, the findings are compared and contrasted with the literature on which this study is developed.

6.2.1 Hypothesis 1.1: The higher use of traditional financing methods to fund REPs.

H_0: Traditional financing methods are used more often to finance REPs than innovative financing methods.

H_A: Traditional financing methods are not used more often to finance REPs than innovative financing methods.

The results from this research show that traditional financing methods are used more often to fund renewable energy projects (REPs) than innovative methods are. In this study, the methods of financing were broadly grouped as traditional and innovative. However, data for individual financing methods in these broad groups were collected and used as the basis for analysing the results.

The research showed that 78.1% of financiers use traditional methods to finance REPs in comparison to 21.9% of financiers that finance REPs using innovative methods to finance REPs. At a significance level of 0.05, the Chi-square test for independence also shows that the number of projects financed and the finance method are associated. In view of this, the null hypothesis is accepted. This finding is consistent with Mills and Taylor (1994) who suggested that REPs can be more easily financed when traditional financing methods such as project finance is used.

The authors' arguments for the use of project finance are founded in the subject of risk associated with REP development. They contend that isolating a REP by using project finance insulates a financier from any form of recourse or liability in the event that the project is unsuccessful. Also, since REPs are costly, the authors explain that it is typical for a joint venture structure to be adopted where financiers share the costs of financing REPs and consequently, the risk associated in limited recourse.

The findings from this study also suggest that project finance as a traditional financing method is used more often by RE financiers to finance their REPs, mainly as a means to limit the risks associated with financing REPs. This finding was obtained by comparing the percentage of financiers that used various traditional and innovative methods to finance their REPs. While the survey showed that 70.6% of financiers used project finance to finance their REPs, all respondents from the interviews suggested that they financed their REPs using project finance.

Particularly in Africa, the use of project finance appears to dominate RE financing based on reasons rooted in the underdeveloped nature of capital markets in the continent as well as an aversion to risks associated with REP financing. The level of liquidity in African capital markets is relatively low and banks are mostly unable to singlehandedly fund large REPs.

Consequently, on most occasions, a group of financiers aggregate to finance a single REP, resulting in the formation of a cluster of financiers engaged in a joint venture which operates and allocates shares of risk in financing the REP accordingly.

One important aim of this study was to investigate the linkage between RE finance and economic development. Kleimeier and Versteeg (2010) investigated the role of project finance as a driver of economic prosperity, hypothesising that the economies of least developed countries (LDCs) benefit from using project finance. The authors suggest that project finance is able to compensate for the lack of domestic financial development which is rife in this category of countries. The results of their work showed that project finance fosters economic prosperity and the effect is strongest in low-income countries where financial development and governance is weak.

While the objectives of this research differ from the work of Kleimeier and Versteeg (2010), the findings in this research converge with the results of the work of the aforementioned authors. This study finds that project finance plays an important role in REP development and may be related to an increase in local economic activities within communities. Also, the results of the study showed that majority of RE financiers use project finance as the main financing method to compensate for deficiencies in capital markets and governance systems within African countries. This is as a means to reduce systematic risk in REP development.

The nature of REPs is such that multifaceted risks associated with technology, regulations and finance are inherent in developing a single project. Pollio (1998) suggests that RE financiers choose project finance over other lower-cost debt structures in the capital asset pricing model (CAPM) because project finance enhances firm value through the reduction of systematic risk. Evidence from this research supports the finding of Pollio (1998) as 72.7% of financiers in this study highlighted risk reduction as the main motivation for using traditional financing methods.

In view of the financing landscape for REPs in Africa where corporate structures to mediate between RE financiers and REP developers are few and have limited capabilities, the element of risk associated with financing REPs stands out as an important factor. This study finds that financiers are also concerned by economic and regulatory risks.

6.2.2 Hypothesis 1.2: The method of financing used to finance REPs.

H_0: The total investment made by a financier indicates the method of financing a firm uses to finance its REPs.

H_A: The total investment made by a financier does not indicate the method of financing a firm uses to finance its REPs.

The results from this research show that the total investment made by a financier indicates the method of financing used to fund REP projects. In this research, the investments made by RE financiers were categorised in three groups namely small, medium and large investments. Investments below $5 million, between $5 million and $10 million and above $10 million were categorised as small, medium and large investments respectively. The results showed that 39.4% of RE financiers made small investments, 57.4% made medium-sized investments and 3.2% of RE financiers made large investments in REPs. Additionally, at a significance level of 0.05 the Chi-square test statistic which was 0.046 highlighted a significant positive association between the total investment variable and the finance method variable. In view of the evidence presented, the null hypothesis is accepted.

The association between total investment and finance method supports the theory on financiers' choice of financing models based on the risk profile of projects, as highlighted by Farrell (2003) and Borgonovo et al (2010). In relation to the financing behaviours of RE financiers, evidence from this study suggests that larger financial institutions are geared towards using traditional financing methods while smaller firms would be more likely to use innovative financing methods to finance REPs. Some scholars such as Sterling (1994), Pollio (1998) and Nikolic et al (2011) suggest that rather than capital constraint, risk management is main reason financiers choose project finance. Linking this theory to the results of this study, the motivation for selecting financing methods in view of the expected benefits that can be derived from financing REPs from the financiers' perspective becomes even more evident.

Casson et al (2008) examined the linkages between forms of financing and expenditure on research and development in innovative firms. Through their analysis, they confirm the "control rights theory" which suggests that firms mostly prefer to maintain control of their operations in seeking finance for projects. Hence, they follow an established hierarchy of preferred modes for financing projects and mostly settle for debt, suggesting that debt is preferred to equity as it involves less loss of control rights. They conclude their work by

suggesting a linkage between the modes of financing and business systems. The results from this research show that RE financiers also follow a carefully refined line of thinking with reference to how they intend to finance REPs mainly offering debt finance to possible REP developers as equity finance is considered to be more risky.

Research in RE development links the level of investment made by investors to the type of policy framework a country establishes. Engaging 380 RE investment managers, Loock (2010) conducted research on the type of business models that RE investors preferred to invest in. The author found that beyond models established to support the best technology and lowest price, RE investment managers preferred to invest capital in service-driven models. Considering the position of Loock (2010), the results from this research differ with the finding of the aforementioned author.

The results from this research show that while service-driven models are important, RE financiers preferred production-focused business models. In many African countries, the RE sector is still at the infant stage of development. As observed in countries with developed RE markets, growth of the RE sector follows a path towards evolution. In the early stages of development, RE policies are mostly focused on the type of technology and providing support for specific renewable energy technologies (RETs). However, as the markets advance, the focus of policy shifts to production-based models where the emphasis is on power generation and the cost of generating and transmitting power using RETs. Finally, as is seen in more advanced RE markets, the focus switches to service-based models and the development of policy to support these.

Focusing on the type of RET financiers prefer to invest in Ludeke-Freund and Loock (2011) conducted research on the brands of solar photovoltaic (PV) projects that debt financiers preferred to finance in Germany. Their findings suggest that debt investors preferred to finance REPs with premium brand RETs produced by highly regarded manufacturers over low-cost technologies produced by less popular manufacturing firms. Additionally, the authors suggest that RE financiers would finance REPs with higher risk if the RETs used were premium brands.

In contrast to these findings, the results of this research show that the brands of RETs available for a project do not influence the financing decisions of RE financiers. While RE financiers agree that the quality of the RET provides some confidence regarding the success of a REP, the decision to finance a project does not lie in the quality of the RET available.

Furthermore, most RE financiers with REPs in African countries are not averse to financing low-cost technologies. Also, evidence from this research shows that most financing decisions are made based on the actual viability of the REP and the stability of the support mechanisms used to promote RE development within a country.

Some scholars suggest that developed countries have more options through which they can finance REPs. Enzensberger et al (2003) investigated the use of the closed-end funding model in which immediate communities are invited by REP project sponsors to participate in the financing of REPs for various wind-based REPs in Germany. The authors suggest that the use of closed-end funds is a logical consequence of increasing professionalism and specialisation in wind-based REP development.

They find that the closed-end funding model is popularly preferred within communities and transferring the model to other technologies and regions in the world can result in lowering risks associated with REP development. The authors suggest that the funding model is derived from the traditional model of citizen-financed REPs in Germany. However, in the African context, the closed-end funding model can be described as an innovative approach to financing REPs. This research finds that community-based finance for REPs is not popular in African countries and an appreciation for the benefits of RE has to be developed in order to finance REPs successfully using such a model.

The results of this research also show that at a significance level of 0.05, the Chi-square test for association showed that financing method motivation and number of years in RE (0.041) are associated. Also, the results show that 72.3% of RE financiers are motivated to use specific financing methods based on the capacity of the selected method to reduce risks associated with investing in REPs. Conversely, 23.7% of financiers select a specific financing method to finance their REPs based on the capacity to increase access to energy.

The findings from this research also highlight differing motivations for financing REPs between the governments of countries studied for this research and the financiers located within these countries. Lagniss (1996) categorises decisions to invest in REP development as economic, strategic, political and environmental. Using the classification of Lagniss (1996), the results of this study shows that in Africa, the motivation of governments in financing REPs through establishing support policies to encourage investment is mainly economic, strategic and political.

6.2.3 Hypothesis 1.3: The number of years in RE finance

H_0: The number of years a firm spends in RE finance is related to the financing period the firm proposes in financing REPs.

H_A: The number of years a firm spends in RE finance is not related to the financing period the firm proposes in financing REPs.

The results from this research show that the number of years a firm spends in RE finance is indeed associated with the financing period the firm proposes to finance REPs. The research categorised firms by the number of years spent in financing REPs, hence the sample of RE financiers was divided into two main groups. The first group comprised of financiers that had been involved in RE finance for less than five years and the second group of financiers was made up of financers involved in RE for six years or more.

The results from the study showed that 42.6% of RE financiers had been involved with RE financing activities for less than five years while 57.4% of RE financiers had been financing REPs for more than six years. In addition to this, the average period over which financiers financed REPs was longer for firms that operated RE financing activities for six years or more. Firms engaged in RE finance for less than five years had shorter financing periods. Also, at a significance level of 0.05 the Chi-square test statistic which was 0.044 showed there was a strong positive association between the number of years in RE and the financing period. In view of this evidence, the null hypothesis is accepted.

In their work, Richards et al (2012) conducted a multi-dimensional analysis of the barriers to RE development and investigated the impact on investment in RE. The authors' work focused on wind generation in Saskatchewan, Canada. They found that the barriers to investment in RE development cannot be explained solely by highlighting the technological, social, political and economic barriers. The authors propose a multi-dimensional analysis of the underlying factors responsible for the existence of these barriers.

The results of this research show that over other classes of barriers, RE financiers considered a combination of financial and economic barriers as greater impediments to financing RE development in African countries. While 20% of financiers in the study highlighted financial barriers as the most critical obstruction and 23.9% of financiers pointed out economic barriers as the major obstacles, 56.4% of financiers mentioned that a combination of these barriers imposed limitations on their financing activities.

Energy is a major driving force behind the social and economic development of a population. Hence, some scholars argue that all forms of energy are important as its main aim is to drive economic activity. Environmental economists in developed countries argue for the promotion of RETs based on benefits linked to reduced emission of greenhouse gases (GHGs) and overall environmental protection. The situation is however different with many developing countries with little experience in RE development. This is primarily because numerous barriers pose severe impediments to a developing country harnessing its RE potential.

Also, some conflicting energy-related growth agendas in developing countries tend to weaken the argument for developing RE. Kinab and Elkhoury (2012) investigated the barriers to the development of RE in Lebanon and highlighted the lack of reliable data on the performance of RETs and the absence of a proper institutional agenda to promote RE as the main barriers to RE development within the country. The authors also listed the high cost of RE, the absence of an independent bureau to set standards for RETs and the lack of awareness of the benefits of RETs as other important barriers to RE development in Lebanon. While most of the barriers listed by the authors are commonplace in many developing countries, the results of this research show that these barriers impact different African countries to varying degrees.

While many large infrastructure projects carry multiple risks which financiers are not entirely aware of, the lack of understanding and the high level of ambiguity surrounding RE development in Nigeria prevents financiers from funding RE. Financiers in Nigeria suggest that in order to trigger investment into RE, the government should provide a framework highlighting the objectives for RE development. This, they suggest would provide a level of comfort needed to manoeuvre risks associated with RE development.

While financing energy generated from fossil fuels, particularly crude oil, may be a more expensive process, financiers in Nigeria suggest that the experience gained while engaging in the process over the years provides a high degree of comfort. This is due to the fact that the entire process is fully understood and this helps financiers forecast profits. In the case of RE development, the market is non-existent and in addition to that, the institutional framework that should guide developers and provide some understanding on the potential structure of the RE market is lacking. A combination of these factors results in impeding investment into Nigeria for the purpose of financing RE development.

Mirza et al (2007) investigated the barriers associated with RE development in Pakistan in order to highlight solutions to remove these barriers. They classify barriers to RE

development in relation to regulation/policy, institutional structures, market-related mechanisms, technological systems and fiscal/financial shortcomings. Specifically on the financial barriers, the authors highlight the difficulty in raising competitive forms of finance, the absence of proper lending facilities for smaller REPs and the restriction of finance to the RETs as challenges. Variations of these financial barriers exist in many African countries.

This research finds that in many African countries, financiers do not just mainly provide funds for the RET but also fund the operations of the energy generation process. To a large extent, however, the financing of operations associated to the operation of the RET after installation is limited as the bulk of the capital is normally allocated to purchasing and installing the RET as well as leasing the land on which the REP is developed. In addition to this, the high level of risk associated with REPs coupled with the lack of understanding regarding the structuring of REPs on the part of many financiers leaves little room for other financing options for REPs.

Painuly (2001) conducted studies on barriers to the penetration of RETs and along with financial, economic, institutional and social barriers, classified market failures/imperfections and market distortions as important barriers inhibiting the penetration of RETs in developing countries. The author suggested that market imperfections such as a highly controlled energy sector and high investment requirements may lead to lack of investment in RETs and entry barriers for smaller entrepreneurs respectively. The author also suggested that market distortions such as subsidies for conventional fuels and the non-consideration of externalities impact the competitiveness of RETs. This is because they position conventional fuels as more affordable options over energy generated from renewable sources.

The results of this research show that although these imperfections and distortions exist in many African countries and specifically Kenya, Nigeria and South Africa, Nigeria suffers most from the consequences of these barriers. As an oil-producing country, the cost of many conventional fuels derived from crude oil is heavily subsidised by the government, making conventional fuels more affordable than they should be. The result of this process is a widening gap between the prices of conventional fuels and energy generated from renewable sources and in Nigeria. This has translated into a perception that energy generated from renewable sources is highly expensive. This perception fuels the social barrier impacting RE.

Since conventional fuels are less expensive and readily available in comparison to energy generated from renewable sources, the demand for conventional fuels increases steadily

within the country. Moreover, due to the Nigerian government's lack of support for the development of RE through the various systematic support networks for conventional fuels, RE is viewed as a more expensive and unnecessary alternative. Furthermore, low connection to the grid and the lack of policy to increase grid connection are critical barriers to REP development in Kenya and Nigeria.

6.2.4 Hypothesis 1.4: The impact of policy on financing decisions

H_0: The dominant RE policy impacts financiers' decisions on whether or not to finance REPs.

H_A: The dominant policy does not impact financiers' decisions on whether or not to finance REPs.

The results from this research show that the dominant policy instituted by the government of a country impacts financiers' decisions on financing REPs. RE financiers were asked to highlight in the affirmative or negative whether the RE policies in a country influenced their financing decisions. The results showed that as opposed to 6.5% that suggested the dominant policy has no influence on their financing decisions 93.5% of RE financiers suggested that the dominant RE policy the government of a country chooses impacts their decisions on whether or not to enter into agreements with REP developers within the country.

In addition to this, at a significance level of 0.05 the results of the Chi-square test for association which was 0.048 showed that a strong positive association exists between the number of projects and policy influence. In view of the evidence presented, the null hypothesis is accepted.

Bird et al (2003) investigated the policies and market factors driving the development of wind power in the United States (US). In their work, the authors examined the influence of policy drivers such as the Renewables Portfolio Standard (RPS), federal and state financial incentives and concluded that support policies for RE development impacts financing decision. According to the authors, policies such as Production Tax Credit (PTC) the Renewable Energy Production Incentive (REPI) and the Public Utilities Regulatory Act (PURPA) which reduced the risks associated with RE resulted in increased investment in REP development.

Also, incentives such as investment tax credits and accelerated depreciation on RETs influenced financiers' to fund REPs. The results of this research show that while the dominant RE policy influences financiers' decisions, other support policies in the RE policy framework have little or no influence on RE financiers decisions.

In many African countries the dominant RE policy is designed to appeal to large scale financiers and in situations where the RE framework includes complimentary support policies, these are poorly implemented. Some African countries such as Nigeria do not have a reliable framework for RE development. Hence, a vacuum in policy development exists within these countries and this contributes to the lack of RE support policy formulation in these countries.

This research also finds that in many African countries, support policies for RE development are established according to the immediate energy needs of the country. Thus, many African countries tend to be reactive rather than proactive in establishing their policies which are mainly focused on the current state of energy supply within the country.

While developed countries are mainly proactive in crafting supporting polices to augment the main RE policy, forecasting the contribution of the policy in advance, some African countries respond to energy crises within their various constituencies by establishing supporting RE policies. The literature shows that developed countries design support RE policies to cater to long-term challenges for RE development such as the cost effectiveness of RE whereas many African countries are concerned with the stability of electricity supply.

Cherni and Kentish (2007) investigated potential effectiveness of RE policy for electricity market reforms in China focusing on the challenges the local electricity sector faced such as supply shortage, reliance on fossil fuels and environmental contamination. In their work, the authors highlighted the lack of policy direction as a severe factor that influences investment in RE development within China. Additionally, the authors suggest that international investment in RE within China is limited by uncertainty surrounding power purchase agreement (PPA) negotiations, lack of confidence in the legal framework and uncertainty regarding the RE regulatory framework.

Among the three countries studied in this research, the results of the research shows that the energy markets of Kenya and Nigeria share these same attributes with China. Although Kenya has a RE policy framework in place, there are major concerns regarding the stability

of the policy and its ability to deliver on the targets for RE generation proposed by the government of Kenya. In the case of Nigeria, there is a high level of ambiguity surrounding RE development and the lack of policy direction is working to deter both local and international investors from financing REPs within the country.

In addition to this, international investors are concerned about the administrative processes surrounding the PPA negotiations and the limited options for purchasing energy generated from RE sources. Also, the research shows that the unavailability of a pricing mechanism for RE and the lack of policy convergence towards fixing stable prices for energy generated from RE sources results in financiers declining to consider Nigeria as a viable destination for RE investment.

Wiser et al (1997) investigated the policy environment for RE generation amidst objectives for restructuring the US electricity market. In their study, the authors examined the influence of RE policy on finance and the financing dilemma the RE sector faced. The authors suggest that in order to craft successful RE support policies, policymakers should acknowledge the financing difficulties REP developers face and focus on the impacts of policy design on financing.

The results of this study show that while the design elements of RE policies are important, financiers are mainly concerned with the price of renewable electricity the policy promotes and the overall stability of the policy. The results also show that for governments to craft successful RE policies, it is imperative that a consultative approach with the various stakeholders is adopted. Stakeholders in South Africa highlighted the importance of the various departments in government in ensuring that successful RE policies are developed by analysing the RE policy landscape within the country.

Lipp (2007) investigated the efficiency of RE policies in meeting the multiple objectives of energy security, CO_2 reduction and economic development. The author analysed the RE feed-in tariffs in Denmark and Germany and the RPS policy in the United Kingdom (UK). The findings from the authors' research show that the feed-in tariff policies in Denmark and Germany have encouraged investment in RE development and consequently these countries are well on the way to achieving their established objectives. The author concludes that design elements in crafting RE policy are important as they can work to either attract financiers or deter investors from investing in RE development.

The results of this research show that in Kenya the design features of the RE feed-in tariff impacts investment into the local RE sector in the country. Under the RE feed-in tariff in Kenya, the Kenya Power and Lighting Company (KPLC) is obliged to enter into purchase agreements with IPPs and this process guarantees revenue and cash flows for investors.

The results of this research also show that in South Africa, the design elements of the RE auction policy provides similar guarantees for financiers thus encouraging investment in REP development. However, in contrast with the objectives for establishing RE policies in developed countries, rather than focusing on increasing energy security or reducing GHG emissions, this research shows that African countries mainly develop RE policies to promote economic development.

Of the three African countries studied in this research, South Africa is currently the best positioned to reap the benefits of RE development. This is due to the fact that the government focused on the impact of local economic development in shortlisting power producers in its Renewable Energy Independent Power Producers Program (REIPPP) and has established processes by which economic development can be measured.

Frondel et al (2010) investigate the economic impacts from the promotion of RE policies in Germany and critically examine the Energy Sources Act (ESA) established in the 1980s to promote the generation of RE within the country. Focusing specifically on the RE feed-in tariff, the authors find that the policy failed to harness market incentives necessary for the introduction of RE into the country's energy portfolio in a cost-effective manner.

The authors suggest that this has resulted in massive expenditures on the policy which they conclude shows little promise for stimulating the economy, protecting the environment and increasing energy security. The results of this research suggest that the economic benefits of developing RE within African countries are being obtained.

While the African countries with viable frameworks for RE development are few and have less experience in RE than developed countries, African countries have a primary aim of fostering economic development through increasing the stability and reliability of electricity supply as well as improving energy access. As highlighted earlier, South Africa, the most advanced African country in this study in terms of RE development in structuring its RE policy incorporated a component for socioeconomic development which all IPPs had to meet in order to ensure compliance with the regulation.

This has resulted in the increased development in the local economies where REPs are developed. Consequently, stakeholders are satisfied that the RE policy is working to deliver targeted benefits of economic development which is a prioritised objective of the government regarding RE development within the country.

In the literature surrounding policy on RE development, the preference of specific policies by RE financiers and developers is an important theme emerging from studies focused on the performance of RE policies. Scholars have conducted research linking the performance of RE policies to the capacity of policy to attract investment in RE and hence, the emergence of research exploring investors' preference for particular RE policies. In this research, policy preference is investigated as a means to provide a better understanding of the financing decisions of RE financiers as well as the overarching project development objectives of REP project developers.

The results also highlighted an association between the number of projects and preferred policy variables. At a significance level of 0.05, the Chi-square test statistic which was 0.035 confirmed an association between these variables. In the questionnaire, the various selected policies were highlighted and stakeholders were asked to select which policy they preferred. The results of the research show that for RE financiers 51% preferred feed-in tariffs and 24.5%, 23.9% and 0.6% selected PPAs, government subsidies RPS as the preferred RE policy.

Toke and Lauber (2006) investigated the performance of RE policies specifically comparing the impact of the Renewables Obligation (RO) in the UK and the RE feed-in tariff in Germany. The authors contrasted the impact of the two policies on investment in RE development and found that the RE feed-in tariff performed better as a market-stimulating mechanism to achieve the objectives for financing RE development in Germany.

The authors also found that RO failed to perform as efficiently as the government of the UK hoped it would and this resulted in the slow development of RE in the region. The authors concluded that stakeholders in the RE sector preferred the RE feed-in tariff over RO as the RE feed-in tariff policy provided opportunities for new market entrants to compete with older market participants with greater knowledge of the industry.

The results of this research show that in Kenya, the feed-in tariff is the most preferred RE policy although stakeholders are concerned about the structure of the feed-in tariff.

Government incentives such as rebates and grants are preferred by non-governmental organisations (NGOs) focused on developing local communities by increasing energy access through RE. The results of this study also show that within the country, smaller REP developers also prefer government incentives over the RE feed-in tariff as by design, the structure of the feed-in tariff is better adapted to larger REP developers.

Burer and Wustenhagen (2009) investigated the policy preferences of venture capitalists and private equity fund managers located in Europe and North America involved in financing REPs. The authors found that these financiers perceived RE feed-in tariffs as the most effective RE policy. In addition to this, the authors found that the preference for RE feed-in tariffs was stronger among financiers located in Europe, attributing this to higher exposure to RETs.

Building on the work of Burer and Wustenhagen (2009), Hoffman and Huismann (2011) investigated the popularity of RE policies in relation to the 2008 financial crisis. The authors found that while the RE feed-in tariffs were still considered the most preferred policy among financiers, the popularity of the policy had declined due to the changing preferences of a number of financiers.

The results of this study show that investors' policy preferences mainly occur due to changes in the regulatory environment which subsequently impacts the performance of the market. While investors are consistently watching financial markets in order to structure financing offers accordingly, rather than the financial markets, the overall regulatory environment impacts the policy preferences of RE financiers. The performance of the financial markets in turn impacts the flow of investments into REP development.

Masini and Menichetti (2010) investigated the behavioural factors in the RE investment decision-making process in efforts to highlight the importance of the various factors that impacted investors' decisions on financing REPs. The authors conclude that the effectiveness of policy aimed at mobilising investments in RE is a critical factor investors take into consideration. In agreement, the results of this research show that investors normally prefer one RE policy over others, based on their understanding of the policy and the implications for their investments.

As gathered in this research, evidence from the South African RE program in which financiers committed large amounts of capital to fund REPs, supports the findings of Masini

and Menichetti (2010) as the proposed stability of policy played a critical role. The results of this research also corroborate the findings of Luthi and Prassler (2011) who analysed policy support instruments for RE development. These authors concluded that the value of policy measures in promoting RE development depends on the specific existing environment and this may vary from one country to another.

Couture and Gagnon (2010) analysed various RE feed-in tariff remuneration models in order to highlight the implication of the policy design on investment in RE development. The authors broadly categorised RE feed-in tariffs as either dependent on or independent of electricity prices. They conclude that the various RE feed-in tariff models have different implications for investor risks and the overall deployment of RE. The results of this study show that financiers of REPs in African countries prefer market-based RE feed-in tariffs in which the government sets the price of renewable electricity and guarantees purchase through PPAs.

Considering the high level of risk associated with financing REPs in African countries, the results of the research suggest that investors prefer the fixed remuneration model as the prevailing electricity prices contribute to lower investment risks. Particularly in South Africa, the results of the study show that premium price RE feed-in tariffs help to create incentives for generating electricity from renewable sources. Also, the selection of a remuneration model is based on the objectives of the government for RE development within the country.

Olmos et al (2012) studied the selection of policy to support the promotion of RE within countries and increase the diffusion of RETs. Approaching RE finance from an innovations perspective, the authors find that government incentives such as loans, tax credits and rebates as well as equity financing from the private sector are the most suitable policies for the development of RE. The results of this research show that government incentives in promoting RE development are necessary, mainly in the early stages of developing RE within a country.

In the African countries studied for the purpose of this research, however, the aim of governments in providing incentives is not to increase the generation of renewable electricity but to orientate the market and familiarise potential stakeholders with the benefits of RE. This said, especially in Kenya and Nigeria, incentives for RE provided by the governments of these countries were found to mostly target rural populations and were implemented on a small scale.

The results of this research show that this situation stems from the needs of these countries to increase energy access to their populations hence the strategy for implementing these policies is focused on the energy-poor population. Regarding the use of equity financing to promote RE development, stakeholders in South Africa suggest that the RE industry has not developed to the point where equity financing is viable. This is based on an assessment of the risks still inherent in RE financing as well as the overall growth of the market, which is yet to reach maturity.

6.3 Other Research Findings

This section highlights the propositions established in the methodology chapter and details the findings from the research in relation to the propositions. Propositions as concepts in studies on RE development are derived from theory. In this study, the results of the research are used to probe propositions so as to highlight findings from the research.

6.3.1 Traditional and Innovative Financing Methods

The following analysis seeks to address Proposition 1 which says traditional financing methods for RE are driven by the motivation for profits, policy support and localised RE market trends while innovative financing methods are driven by the local culture on repayments of loans issued, motivation to promote economic development and donor funding. Daube et al (2008) studied the suitability of financing models for REPs in Germany and found that in financing REPs, investment risk alleviation is an important factor for financiers.

Borgonovo et al (2011) conducted research on the value creation process and risk alleviation in investment projects using project finance, and concluded that RE financiers mainly select traditional financing methods in order to reduce the risk associated with financing REPs. In agreement with the findings of these authors, the results of this study show that REP financiers select traditional financing methods, especially project finance, as a means to reduce risks associated with financing REPs.

Wiser et al (1997) and Wholgemuth and Painuly (1999) conducted studies on innovative financing for RE development and found that REP financiers use specific financing methods to alleviate investment risks. Concurring with the findings of these authors, the results of this study shows that financiers are concerned about the risks inherent in financing REPs and the impact of this on the profitability of their investments.

In Nigeria, financiers from larger financial institutions which are more likely to engage traditional financing methods expressed scepticism about financing REPs without the support of the government. In Kenya and South Africa, financiers from large financial institutions engaged in financing REPs suggested that the decision to fund REP development is strictly a financial decision based on logic for which the primary motivation is to make profits. While these financiers highlighted the economic development prospects financing REPs can bring about, they suggested that the agenda for economic development comes secondary to profits.

The findings of Beck and Martinot (2004) highlight the importance of policy frameworks for the development of small and large REPs in countries. In consistence with the findings of these authors, this research shows that policy support is critical to both large and small financiers. However, the results of this research show that the requirements for policy support differ between large and small financiers.

While larger financiers require support for the main RE policy from the government to guarantee the safety of their investments, smaller financiers are more concerned with the capacity of support RE policies to the impact development of local communities. Evidence from financiers on the RE situation in Nigeria shows that financiers from larger financial institutions decline to invest in RE development due to the lack of a viable RE framework.

According to the financiers in Nigeria, the lack of a regulatory framework presents additional risks to the process of financing RE development as this creates a high level of uncertainty without any form of guarantees on investments. In contrast, the stable policy environment and clearly articulated regulatory framework of RE development in South Africa encouraged investment in the RE sector by large financial institutions which funded the country's REIPPP.

The literature on RE finance presents the drivers of innovative financing highlighted as repayment culture for loans issued, the need to promote economic development and the impact of donor funding. Wholgemuth (2000) and James (2012) conducted studies on innovative financing and found this method of financing to be instrumental to REP development. The results of this study are consistent with the findings of these authors but however also show that not all of the aforementioned factors are drivers of innovative financing. In South Africa, the existing culture of loan repayment could drive innovative financing of RE.

This research however shows that the innovative financing mechanisms used in the country are not specifically designed to target the energy-poor. Kenya and Nigeria have poor loan repayment cultures; hence the use of specific innovative financing mechanisms such as dealer credit and consumer credit is largely unpopular in these countries. However, the fee-for-service and leasing models, though largely unpopular, are viewed by stakeholders in RE development as more efficient innovative financing methods for these countries.

6.3.2 Value Measurement and Financing Objectives

This analysis seeks to address Proposition 2 which says traditional methods take into account the performance of investments in making financing decisions and value is translated as profits while innovative methods consider the impact on society in terms of economic development and social wellness over profits as value is in the form of the overarching benefits of sustainable development.

The findings of Sorge (2004) suggests that project finance is a more attractive financing option for financiers based on its capacity to reduce credit risk and impact the performance of investments positively. Concurring with this finding, in the results of this study, financiers highlight the performance of investments in RE as a means of measuring the value obtained by traditional financers engaged in financing REPs. Hence, RE financiers mainly perceive the performance of their investments as a measure of the value contributed to RE development.

Megginson (2010) found that traditional financiers mostly measure value in terms of the profitability of investments. The results of this study show that in South Africa, financiers suggest that financing REPs is mainly an opportunity for their institutions to diversify their investments and build competencies in the emerging area of RE finance. This is in order to develop critical skills needed to compete favourably as the industry grows over time. As with any other large financial transaction, the viability of transactions for REPs are analysed through a fixed process in a bid to ascertain the level of profitability that can be obtained.

Gujba et al (2012) suggest that in order to impact economic development, financing mechanisms for REPs should target end-users, with the impact on development measured in terms of social and economic progress. In agreement with this finding, the results of this study also showed that some smaller financiers measure the performance of their RE investments in terms of the economic contribution. The results of this study however show that larger financiers do not target end-users of REPs in making their financing decisions.

The findings of Luthi and Prassler (2011) and Holburn (2012) suggest that policy to promote investment in RE should be designed to reduce investment and regulatory risks. In agreement with this finding, the results of this study show that in measuring the value of REP investments, financiers in Nigeria singled out regulatory risks related to the lack of a clear framework for RE development as the prime reason why RE finance is currently unviable. In addition to this, the financiers suggested that while financing REPs might be considered a socially responsible act, engaging in the process at this point in Nigeria, in light of the principle of risk assumption and trade-offs for profits would be illogical.

On the process through which innovative financiers measure value, the results of this research show that economic development and social wellness of communities are important objectives. Some financiers in this category measure value mostly in terms of the economic returns on investment, akin to social entrepreneurial endeavours.

Concurring with the findings of Bystrom (2008) which suggests that innovative financing can help to accelerate economic development, the results of this research show that innovative financiers show a higher level of obligation towards contributing to spur economic development through their financing operations. Evidence from this research shows that in comparison to traditional financiers, innovative financiers invest smaller amounts of capital in REPs. In essence, these financiers are prone to less risk considering the scale of their investments.

6.3.3 Traditional Financiers and Smaller REPs

The analysis in this section seeks to address Proposition 3 which says traditional financiers do not see value in financing small and medium sized REPs in semi-urban and rural areas considering the barriers to REP development. In line with the findings of Farrell (2003) and Sterling (2004) which suggest that risk reduction is an important component of entire financing decisions made by financiers, the results of this study show that traditional financiers prefer to finance large scale REPs that are connected to the national grid. This is mainly due to the fact that financiers consider these REPs less risky than small and medium scale off-grid RETs.

Traditional financiers mainly fund these large scale RETs based on the guarantees provided by the government in terms of the regulatory structure providing policy stability and

agreements to purchase power generated, contributing to assuring consistent revenue over the lifespan of their investment.

The findings of Sonntag-O'Brien and Usher (2004) suggest that financiers mainly consider the profitability of a REP in making RE financing decisions. In concurrence, the results of this study show that for some financiers, estimated cash flow and revenue from projects contributes to influencing financing decisions. Consequently, without guarantees such as grid connection and PPAs in place as is the case with off-grid distributed RETs, traditional financiers see no financial value in financing small and medium scale REPs.

The findings of scholars such as Del Rio (2007), Sovacool and Drupady (2011) Stevanovic and Pucar (2012) suggest that finance for RE development is mainly channelled to larger REPs. In support of this finding, the results of this study show that traditional financiers suggest financing small and medium scale REPs is largely risky and unprofitable.

As highlighted in studies conducted by Ayoub and Yuji (2012) and Baris and Kucukali (2012), traditional financiers prefer to follow the lead of the government in deciding whether or not to finance REPs. The results of this research are consistent with the findings of these authors and show that the financing decisions of RE financiers are influenced by the policy established and implemented by the government.

Most financiers already consider REP financing to be high risk investments and the lack of support in the form of government policy as is the case with small and medium scale REPs, tends to increase investment risks. The results of this study show that based on implementation of policy to support investment, traditional financiers choose to finance large REPs which may have low revenue margins but are considered stable and less risky, based on the support and guarantees provided by the government.

In addition to the issues raised, the results of this research show that traditional financiers are not involved in financing small and medium sized REPs due to the fact that there is no clear model for generating energy from these classes of REPs in South Africa. In Kenya, traditional financiers are concerned about the possibility of scaling up the MFI lending model, expressing doubts over the ability to monitor credit issues and recoup capital invested in issuing loans. Additionally, the results of this research show that questions surrounding the scalability of this model focused on the supply of appropriate technology, whether or not the

technology could be manufactured locally or imported impact the decisions of traditional financiers.

Studies by Foley (1992), Foster-Pedley and Hertzog (2006) and Delina (2011) suggest that since commercial financiers do not consider smaller REPs to be viable investments, development finance institutions (DFI) can play an important role in financing smaller REPs. In agreement with this finding, the results of this study show that multilateral financial institutions as well as local DFIs carry out their mandate to fund small and medium scale REPs mainly reduce the impact of the lack of commercial finance for smaller REPs.

6.3.4 Innovative Financing and Economic Development

The analysis in this section seeks to address Proposition 4 which says increasing the impact of innovative financing methods may lead to greater sustainable economic development outcomes and accelerated adoption of RETs. The findings from studies by Wholgemuth (2000) and Saunders et al (2012) on innovative finance and sustainable development suggest that since innovative financing mostly takes place at the community level, it has the potential to impact the lives of people positively. In agreement, the results of this study highlight innovative financing methods as a critical link to sustainable development that can contribute to improving the social, environmental and economic wellbeing of people in Africa.

The findings of Monroy and Hernandez (2005) and Gujba et al (2012) suggest that REP financing is more effective when the focus of financing initiatives is placed on the end-users. Concurring with this finding, the results of this study show that increasing the impact of innovative financing for REPs can spur tangible sustainable development outcomes to improve the living conditions of communities. Zerriffi (2011) conducted studies on financing small REPs in rural communities and suggests that innovative financing methods are suitable for increasing rural electrification levels.

Concurring with this finding, the results of this research show that traditional financiers have not engaged the process of innovative financing for small and medium REPs. Glemarec (2012) suggests that smaller REPs are a better option for impacting community development. The results of this research show that small and medium scale REPs can impact communities by reducing the energy access challenge, thus contributing to the sustainable development of these communities.

Painuly (2001), Painuly et al (2003) and Pegels (2010) also suggest that greater sustainable development outcomes can be obtained through increasing the impact of innovative financing. Agreeing with this finding, the results of this research show that countries have to eliminate barriers that impede the growth of innovative financing for small and medium scale REPs.

Specifically, in Kenya and Nigeria, for innovative financing of small and medium scale REPs to contribute significantly to sustainable development, issues relating to credit guarantees and monitoring of loans must be resolved. An efficient credit issuing structure can help to improve the loan disbursement process, increasing access to formal financial services for people. Additionally, an improved credit issuing structure can help to bolster investor confidence and consequently, impact the amount of investment in small and medium scale REPs within these countries.

With the current reformation of its electricity sector, Nigeria is positioned to implement support for energy service companies (ESCOs) as aspects of electricity generation, transmission and distribution have been localised. However, the political will to drive this process is lacking as Nigeria is heavily dependent on crude oil and its derivatives to satisfy the energy needs of the country.

6.3.5 REP Financing and Sustainable Development

This analysis seeks to address Proposition 5 which says combining the impact of traditional and innovative financing methods may lead to greater sustainable development outcomes in terms of RE development than either method. Gibbs (1996) and Ghezloun et al (2012) suggested a framework of different policies to finance RE development.

Concurring with this finding, the results of this research also shows that the combined impacts of traditional and innovative financing can deliver sustainable development outcomes faster than either method in isolation can. Thus, the results of this research establishes that the combined impact of traditional and innovative financing can result in the accelerated diffusion of small and medium scale REPs with higher potential to impact sustainable development within various benefitting communities.

Himri et al (2009) suggest that knowledge networks are important in building policy frameworks for financing REP development commercially. In agreement with this finding, the results of this research show that for the combined impact of traditional and innovative

finance to be realised, the barriers to commercialising small and medium scale REPs must be eliminated. Additionally, the results of this research concur with the findings of Karakosta and Askounis (2010) which suggest the development of REPs as a systematic strategy for sustainable development, large scale financing of small and medium scale REPs is necessary to achieve higher sustainable development impacts.

Without policy to support the development of smaller REPs, traditional financiers with access to capital may not commit to invest any funds as the current unviable model of financing small and medium scale REPs is not regarded to be worthy of major investments. The impact of policy can help to transform the current ineffective innovative models of financing REPs within African countries to attract larger investments.

In aiming to achieve this, traditional financiers in the private sector would need to understand the processes associated with commercialising small and medium scale REPs. This is to allow for the identification of channels through which value in terms of profits can be made from investing in this category of REPs.

The results of this research contrast with the findings of Kronenberg and Bergier (2012) which suggest that RE development should be pursed as a part of an agenda to mitigate the impacts of climate change. However, in agreement with the findings of Karekezi (2000) who suggested the financing of REPs as a means to achieving sustained economic development, the results of this study show that African countries can pursue a strategy for RE generation by investing in small and medium scale REPs. Focusing on social and economic development, the overarching aim of this strategy would be to increase sustainable development outcomes. In time, this could positively impact the environmental aspect of sustainable development.

Scholars of sustainable development such as Lu et al (2010) and Zhao (2011) specifically in the areas of energy and environmental economics, highlight carbon taxes and carbon trading as innovative market-based mechanisms for financing RE development. In addition to this, the literature on RE finance and development suggests that these mechanisms have the potential to reduce GHG emissions and foster the transformation from fossil fuel-based energy to RETs and many other low carbon-producing technologies.

The results of this research show that while these market-based mechanisms are indeed innovative financing options for the diffusion of REPs to deliver sustainable development

outcomes, they are currently unviable in many African countries. Stakeholders in RE development agree that implementing these mechanisms would impact the cost of doing business in a country by increasing the operational costs of firms.

Particularly for African countries, the costs of implementing carbon trading and taxing schemes may in the short-term outweigh the potential benefits that can be derived from instituting these systems. This is mainly regarding the impacts and practical implications of carbon trading and taxing systems on the economic systems of African countries.

6.4 Summary of the Chapter

This chapter presented the findings from the research conducted. The chapter began with an analysis of the findings in relation to the hypotheses established in the methodology chapter. The hypotheses were derived from the literature on the various aspects of RE finance and development. It is however important to note that these hypotheses were crafted to investigate the theories on which the research questions were established.

Additionally, the hypotheses were investigated by highlighting the results of related inferential statistics and using the data collected to probe the hypotheses. This resulted in a process which involved comparing and contrasting theories in the literature with findings from the research. Considering this, points of convergence with and divergence from the literature were highlighted and explained in detail. In addition to this, propositions as concepts derived from the literature were explored using the results of data analysed for the purpose of this research.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This chapter presents a conclusion of the research conducted for the purpose of this study. The conclusions highlighted in this chapter are presented as cohesive coherent synopses of the research undertaken, the processes followed and the findings derived from the research in relation to the literature on renewable energy (RE) finance and sustainable development. In the following sections, the linkage between the various chapters in this research, specifically from the introductory chapter to the chapter on the analysis of findings is highlighted in order to demonstrate that the established objectives of the research have been realised.

Also, the contribution to knowledge in the area of RE finance and sustainable development is detailed in this chapter. Recommendations for policy to support the development of RE in African countries are presented; these recommendations focus mainly on the process of financing renewable energy projects (REPs) in order to increase their impacts on sustainable development in African countries.

Furthermore, policy guidance focusing on reducing barriers to financing the widespread development of REPs is presented. This represents the crux of the challenge regarding RE development. Finally, other research areas that can contribute to the body of knowledge surrounding RE finance and sustainable development, derived in the process of completing this research, are listed for future research consideration.

7.2 Summary of the Research

Evidence based on academic research suggests that renewable energy technologies (RETs) can play a crucial role in increasing social and economic development while preserving the environmental conditions of African countries. Hence, the thrust of this research was to explore ways in which RETs can contribute to sustainable development. The aim of this research was to investigate the models of financing suitable for the widespread diffusion of REPs in African countries. Also, the research was aimed at exploring the impact of established policy options available to help promote the financing of, and investment in REPs.

Financiers mainly in the private sector are motivated to finance REPs based on the estimated return on investment obtainable. Also, the effectiveness of RE policy is dependent on the

capacity to attract and retain investment in RE development over an extended period of time. For RE policies to attract investment in RE development successfully, they must address the long-term investment concerns of potential financiers. Hence, policymakers should have an in-depth understanding of the decision-making processes of potential REP financiers in relation to the motivation to finance and the perception of investment risks. The provision of finance to fund REPs or lack thereof both have relevant implications at the micro and macroeconomic levels for African countries seeking to exploit RE sources.

At the micro level, the provision of finance for REP development can result in local communities obtaining the benefits of sustainable development which RETs offer. Similarly, under the macroeconomic perspective, the provision of finance for REP development can result in African countries benefitting from the overall impacts of increasing energy access. Additionally, improving the stability and reliability of energy provision within the respective countries is considered to be an important macroeconomic benefit. Hence, policy to support investment in REP development is crucial.

It is clear that African countries can benefit greatly from adopting RETs as a means to increase access to electricity and diversify the energy mix, with finance as the driver for REP development. Also, considering the on-going call for the transition to low carbon technologies in order to realise the objectives of sustainable development, the transition to RETs offers African countries the opportunity to derive social and economic benefits. In this respect, African countries with low electricity penetration rates and energy systems built on fossil fuels have the opportunity to increase local economic development through the financing of off-grid distributed REPs.

There is a lack of rigorous empirical studies examining these issues in the energy policy and management literature. Especially in the African context, this research represents one of the first attempts to fill this gap. This research examines the financing models suitable for the widespread diffusion of RETs and the elements of RE policy that can support increased investment in REP development within Africa. Since the concept of financing REP development is fairly new, regarding appropriate policy implementation and investment, this research is an early attempt to build empirical evidence-based knowledge necessary to drive large scale RE development in Africa.

7.3 Financing and Policy Preferences

Essentially, this research has established that in African countries, various RE financiers and developers prefer different financing methods. In Africa, traditional financing methods, and more specifically project finance, is the main financing method RE financiers have adopted to finance REPs they invest in. Financiers of large REPs prefer project finance to other financing instruments based on its capacity to reduce the risks associated with financing REPs, especially in Africa where large scale RE development is still very new. In contrast REP developers prefer corporate finance based on the ease of structuring financing deals using this model. Also, since in using corporate finance investments made by financiers reflect on the balance sheet as assets, REP developers prefer this method as it tends to promote a higher level of commitment from partnering financiers.

The research also revealed that although project finance is the preferred method for financing REPs, since it is the most widely used financing method, in its current form, project finance is used mainly to finance large scale REPs. Large scale REPs are mostly connected to the grid and electricity from these power stations is generated mainly to supplement the supply of electricity within countries. Hence, large scale REPs that are currently underfinanced in many African countries cannot deliver on the objective of increasing energy access to spur local economic development especially in rural and semi-rural settlements.

Importantly, the research finds that rather than the financing of a few large scale REPs, innovative financing of numerous off-grid small and medium scale REPs would increase the diffusion of REPs in African countries. Based on the nature of the financial markets of some African countries, credit issuing systems are poorly managed. Hence, the use of large scale credit-based innovative financing methods such as dealer and consumer credit is challenging. Ultimately, innovative financing through energy service companies (ESCOs) are more suitable for the widespread diffusion of small and medium scale REPs. These REPs have the potential to increase sustainable development outcomes within localised communities.

Also, the research revealed that large scale financing of ESCOs with experience in finance and RE development would help foster the diffusion of REPs. The research also found that aggregation financing and project finance are suitable financing methods that can result in the accelerated growth of ESCOs in African countries. However, this process may not be entirely straightforward since issues concerning electricity generation, transmission and distribution are heavily politicised in a number of countries where the government takes a central role in

implementing structural reforms. In many African countries, the generation, transmission and distribution of electricity is centrally managed by the government. Hence, policies to support the establishment and growth of ESCOs would be required in order to attract investment in small and medium scale REP development.

In addition to this, the research revealed that traditional financiers are largely motivated to finance REPs based on the profitability of specific projects. Also, innovative financiers are also motivated to finance REPs based on the profits obtainable from projects but to a lesser extent than traditional financiers, since an important focus of innovative financiers is to impact their local economies. In this respect, traditional financiers do not finance small and medium scale REPs mainly due to the risks associated with offering credit in some African countries.

Additionally, the research revealed that traditional financiers find the process of funding smaller REPs cumbersome especially due to poor credit systems in some African countries. Also, for traditional financiers, the current model used to finance small and medium scale REPs in many African countries is not scalable. Hence, traditional financiers do not see value in committing financial resources to fund this category of REPs.

The research also showed that the primary objective of developing RE in many African countries is to increase access to electricity so as to impact the social and economic dimensions of sustainable development. Unlike with developed countries where the primary objective of developing RE is to accelerate the transition to low carbon technologies in an effort to reduce greenhouse gas (GHG) emissions, the governments of many African countries are more concerned about the impact of developing RE to increase economic development. In essence, the research revealed that increasing traditional and innovative financing of REPs would accelerate electricity penetration and help to realise sustainable development outcomes more rapidly.

Furthermore, the research revealed that the preferences for policies to support the financing of REPs differ between RE financiers and developers. RE financiers mainly prefer fixed RE feed-in tariffs driven by the government over market-based RE feed-in tariffs. This is based on the structure of fixed price feed-in tariffs which guarantee the purchase of electricity from the independent power producers (IPPs) over a period of time as stated by the government. RE financiers prefer this feed-in tariff structure as the government is the procurer of generated electricity and this reduces the risk of investing in REP development.

Also, using this feed-in tariff structure, financiers are able to project the revenue and cash flow from REPs more easily and profitability of REPs is estimated to be more stable. Essentially, for RE financiers this tariff structure lowers regulatory risk and is a better policy instrument for countries that are new to REP development, since the government is at the centre of the entire process.

For REP developers, the preferred RE policy must focus on stabilising renewable electricity generation. Hence, rather than the actual policy, the design elements of the policy are more important for REP developers. The most important element of a suitable RE policy for REP developers is the power purchase agreement (PPA) between IPPs and the procurer, which in most African countries is the state-owned electricity utility. Without an agreement to purchase generated renewable electricity, REP developers would struggle to attract funding for their projects.

In essence, for REP developers, suitable RE policies must be stable in providing the comfort of longevity and should be acceptable to RE financiers responsible for investment in REP development. In addition to the issues highlighted, the research revealed that established policy for developing RE is mainly focused on financing large scale REPs.

7.4 Contribution of the Study

This study makes a contribution to the literature on management, energy policy, development finance and sustainable development. The study also highlights important implications for management practice and policymaking. Firstly, by providing results that are robust and highlight the relationship between RE finance and sustainable development, the research corroborates the existing literature by providing necessary empirical evidence on a topic that is highly under-researched.

Secondly, the research employs the mixed methodology approach in collecting and analysing data based on the fact that research in this field is fairly new. Studies of this nature normally employ either the quantitative or qualitative approach. Hence, this study makes a contribution in terms of its approach encompassing concepts in RE finance and sustainable development. Additionally, the development of a conceptual model that incorporates elements of traditional and innovative financing models as well as the drivers of these models as they impact REP diffusion; is an important methodological contribution.

Thirdly, the purpose of the research was to investigate which financing models are suitable for the widespread diffusion of REPs and the policies that support the large scale financing of REPs. As RE markets are regulated under several policy schemes, understanding which policies are preferred by REP financiers and developers is critical.

This study contributes to the knowledge on RE policymaking by highlighting the regulatory risks perceived by RE stakeholders and presenting the design elements of specific RE policies that have the capacity to attract investment into REP development. In essence, the study provides policymakers with a better understanding of the motivations of RE financiers in the process of making decisions on whether or not to finance a REP.

The study also contributes to the theory on financing methods for REPs. As observed by Derrick (1998) and Wiser and Pickle (1998), various financing mechanisms for RE may exist but the suitability of a financing mechanism is largely dependent on the policy structure surrounding RE development. By investigating the linkage between finance and policy in fostering the widespread diffusion of REPs in the African context, this research fills this gap, providing insights into financiers' perspectives.

Finally, the results of this research are also relevant for stakeholders in the RE sector. The structure and design of RE policy is critical in attracting investments for REP development. This research presents RE financiers with an understanding of the design elements of RE policy that can guarantee the stability of RE markets, thereby contributing to lowering the overall risk associated with investing in REPs.

7.5 Policy Implications and Recommendations

The findings from this research show that many countries in Africa have similar challenges with establishing systems to support the development of RE. The findings also highlight the following policy implications for African countries with similar challenges regarding the development of RE in the short term as well as in the long term.

7.5.1 Energy Planning Paradigm

Firstly, it is important that the governments adopt a planning philosophy or paradigm that is orientated towards developing long term goals for RE development. The South Africa experience which highlighted efforts of the government to reduce pressure on the national grid and avoid power cuts by supporting solar water heating (SWH) programmes is a case in

focus. In that situation, the government reacted by offering a temporary solution to a critical problem. This is not to imply that temporary solutions are unnecessary, however if they must be implemented, they must be designed to complement the overall agenda for electricity generation over time.

Moreover, temporary solutions to critical electricity challenges should be well planned and feasible during an established lifespan within the overall energy planning framework. It is important that while adopting temporary solutions using RETs, governments align these with the long-term objectives for electricity planning and generation.

7.5.2 RE in Energy Frameworks

This policy implication is specifically for Kenya and Nigeria. In developing capacity to increase the contribution of renewable electricity to the overall levels of generated electricity, these governments should develop holistic energy frameworks to incorporate the contribution of RE. Energy planning units should align the framework for RE development with the overarching objectives for energy generation within the country.

In Kenya specifically, the structure and design of the RE feed-in tariff should be revisited in view of its performance and capacity to attract investment. However, measuring the performance of the RE feed-in tariff against the investment in REP development and the diffusion of REPs would provide a different view to restructuring the policy to attract higher levels of investment.

This research has established that private capital is needed to grow the RE sector. In order to attract private capital, the government of Nigeria should develop a viable policy framework for RE development highlighting long term goals for generating renewable electricity within the country. In doing this, the government should adopt a consultative approach to the process to obtain the views of potential REP financiers, developers and other stakeholders concerned with RE development.

For Nigeria, in developing a RE policy framework, policymakers would also have to take into cognisance the impact of policy design and structure on investment. The merits and demerits of the various RE polices and designs should be analysed in view of the objectives for RE development which is mainly to increase energy access and foster economic development.

7.5.3 Policy Instruments for Off-Grid REPs

In developing RE frameworks to support the financing of RE, governments should ensure that the proposed design for the RE framework includes policy instruments to support investment in off-grid small and medium scale community-based REPs. The objectives of most African countries in developing RE is to increase economic development and accelerate energy access and this is possible using off-grid RETs.

Currently, policies to support RE development are focused on increasing the capacity to generate electricity through large scale REPs. Most REPs in this category are extremely expensive, hence it would be difficult to replicate this model for RE development across every community, local government area or municipality in most African countries. Distributed off-grid REPs provide countries with the opportunity to decentralise electricity generation at highly affordable costs while fostering development through increased access to electricity within localised communities.

7.5.4 Support for ESCOs

Depending on the objectives of governments within developed electricity planning frameworks, collaborations or business partnerships between RE firms and microfinance institutions (MFIs) can be promoted. Collaborations can target constant cooperation between MFIs with knowledge of finance and RE firms with expertise in small and medium scale REP development.

Alternatively, a differing model in which one firm has competencies in finance and RE development can be established to promote smaller community-based REPs. In order to achieve this, specifically, governments can support the development of various models of ESCOs as a means to increase access to electricity within the population. Developing policy to support and structure the regulation of ESCOs as an integral component of the overarching electricity system can work to change the perception of value regarding the financing of smaller off-grid REPs.

7.5.5 Investment Infrastructure for Smaller REPs

It is also pertinent that governments drive the RE development process especially through issuing support policies for small and medium REP development in order to bolster the confidence of investors and attract investment. Additionally, in this regard, it is in the interest

of African countries to strengthen their credit issuing systems in order to broaden the financing options for REPs as well as to increase the possibility of implementing a range of innovative financing models. Innovative financing models are capable of increasing the diffusion of small and medium scale REPs with the capacity to deliver sustainable development outcomes.

Hence, it is critical that the objectives for RE development are aligned with the overall agenda for economic development. In this respect, governments can provide incentives tied to the generation of renewable electricity for financiers and developers of REPs. The framework for incentives in this regard can include options such as production credits and tax credits as a means to ensure that capacity for small and medium scale REPs is developed.

7.5.6 Approach to RE Policy Development

Policy design is an intricate part of policy formulation. This is mainly because stakeholders such as REP financiers and developers who in this case are critical for the development of RE within African countries, respond to structured policies from their own perspectives. With differing objectives in RE development, it is clear that particular groups of stakeholders understand their positions best.

Hence, by virtue of their experience and understanding of critical issues as they relate to other stakeholders, policymakers in government, for instance, cannot claim to know what may be beneficial to REP financiers and developers. In adopting a consultative approach, different stakeholder groups present their views and stated objectives and negotiated outcomes are balanced to address the objectives of the different stakeholders. Regarding energy planning, in many African countries, the consultative approach is lacking and this results in poor policy formulation which fails to attract diverse investments.

7.5.7 Financing Smaller Off-Grid REPs

Evidence from this research has shown that there are vast opportunities for profitmaking in financing small and medium scale REPs. While commercial REP financiers thrive on guarantees through established policy from government which are indeed necessary for growth in the financing of small and medium scale REPs, smaller financiers such as MFIs thrive on relationships with their customers as well as knowledge of their customers' borrowing behaviours.

The experience and knowledge of the local community represents an advantage for local financiers to exploit the financing gap that exists in the financing of smaller community-based REPs. Larger commercial REP financiers with larger balance sheets can partner with smaller financiers with a wealth of experience regarding community finance and small and medium scale REP development to finance this category of REPs and make profits in the process.

7.5.8 Process Evolution for REP Developers

As with many other bottlenecks the growth of RE in Africa is faced with, this research shows that early development of off-grid REPs within rural African communities would serve as a learning process for many REP developers. The learning obtained from experience-based community REP development can be integrated into project cycles for smaller REPs over time. Although African communities are diverse and culturally different, the learning process for REP developers is arguably consistent.

Integrating the learning from project development processes into the scope of developing rural REPs can provide a broad set of operational guidelines for REP developers. As REP developers expand their reach, these guidelines would be refined and frameworks for the development of smaller REPs in African communities may emerge. This can help to simplify the process of rural REP development, increasing the chances of replicating projects in other settlements.

7.6 Limitations and Further Research

As with many other studies, this research is not without limitations. One limitation of this study is that due to the limited resources available, travel for semi-structured interviews was restricted to a few countries. Also, based on the stage of RE development in many African countries, data from the survey was collected from fewer respondents. Additionally, due to restrictions regarding communication, respondents mainly from Anglophone countries were considered for interviews in this research.

The West and Central regions of Africa are predominantly French-speaking; hence potential respondents from countries in these regions who could not communicate in English were not considered for interviews in this research. Summarily, only English-speaking respondents from Anglophone countries were considered for this study.

Two broad directions considered for continuing this work in future are centred on specific innovative RE finance methods and policy to support these methods. Firstly, the dimension of the future work focusing on innovative RE finance methods would seek to explore the viability of aggregation financing and project finance as financing methods with the potential to increase the development of small and medium scale REPs. Essentially, this future work would investigate the willingness of RE financiers to finance smaller REPs in view of policy implementation to support the growth of this category of REPs.

Secondly, the dimension of future work focusing on policy to support small and medium scale REP development would seek to explore innovative policy options to attract investment in this category of REPs. This research dimension would focus on the impact of policy on investment in small and medium scale REPs, particularly ESCOs to impact localised economic development through increased energy access for communities.

7.7 Summary of the Chapter

This chapter began with a summary of the research conducted. The objectives of the research were revisited in line with the purpose of the study. In this respect, the two main research questions posed in the introductory chapter of this study were highlighted as the basis of inquiry in conducting this research. Also, the major findings and contributions of the study were summarised. Additionally, implications of findings for RE stakeholders were presented along with the recommendations to policymakers in government. Finally, the limitations of the study as well as the dimensions for future work on this research were presented.

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Appendix A: List of operationalised variables

Variable	Operationalised Definition	Variable Details	Survey Question
Number of projects	The total number of REPs a firm has financed.	Collapsed categories are 0 – 10 projects and 11 projects and above – 0 – 10 projects = less than 5 and between 5 and 10; 11 projects and above = between 11 and 20 and 20 and above.	Q1
Method of financing	The dominant financing method a firm uses to finance REPs.	Collapsed categories are traditional and innovative finance – traditional finance = project finance, mezzanine finance, senior debt and equity; innovative finance = consumer credit, dealer credit, fee-for-service and other.	Q3
Financing method motivation	The motivation for which a firm engages in financing REPs.	Collapsed categories are risk and energy access – risk = increase in profit, reduction of risks and investment is easy to monitor; energy access = faster rate of technology adoption, increase in energy access and other.	Q4
Barriers to financing REPs	The impediments to financing REPs which a financier experiences.	Collapsed categories are financial barriers and economic barriers – financial barriers = high capital costs, high interest rates and low credit repayments; economic barriers = low access to capital, lack of awareness of RETs and others.	Q5
Value measurement	The measure of satisfaction a firm obtains from financing REPs.	Collapsed categories are not in economic terms and in economic terms – not in economic terms = in financial terms and other; in economic terms = in financial and economic terms and in economic terms.	Q6
Average investment per project	The average amount of money a firm invested in financing a REP.	Collapsed categories are less than $1000 and more than $10001 – less than $1000 = less than $1000 and $1001 to $10000; more than $10001 = $10001 to $20000 and $20000 and above.	Q7
Total investment	The total amount of money a firm has invested in financing REPs.	Collapsed categories are small investment, medium investment and large investment – small investment = less than $1000 and $1001 to $100000; medium investment = $100001 to $10000000; large investment = $10000001 and above.	Q8
Policy influence	The impact of policy on financiers in making REP financing decisions.	Collapsed categories are some influence and no influence – some influence = yes; no influence = no.	Q13
Preferred policy	The policy most preferred by financiers in financing REPs.	Collapsed categories are feed-in tariffs, RE certificates, PPAs, other incentives – feed-in tariffs = feed-in tariffs; RE certificates = renewable energy certificates; PPAs = power purchase agreements; other incentives = tax reduction, rebates, grants, production credits and other.	Q14

Financing period	The length of time a firm invests its financial resources in funding REPs.	Collapsed categories are 10 years and below and 11 years and above – 10 years and below = less than 5 years and 5 to 10 years; 11 years and above = 11 to 20 years and 21 years and above.	Q22
Location of projects	The areas where firms' financed REPs are situated.	Collapsed categories are urban and rural areas – urban areas = urban areas and semi-urban areas; rural areas = rural areas and others.	Q24
Company age	The number of years a firm has been fully operational.	Collapsed categories are 10 years and below and 11 years and above – 10 years and below = 5 years or less and 6 to 10 years; 11 years and above = 11 to 20 years and 21 years and above	Q34
Company type	The particular category a financing firm belongs to.	Collapsed categories are large financial institution and small financial institution – large financial institution = commercial bank, development bank and investment bank; small financial institution = hedge fund, private equity fund, microfinance bank, venture capital and other.	Q35
Number of years in RE	The number of years a firm has operated in the RE industry.	Collapsed categories are 1 – 5 years and 6 – 20 years – 1 – 5 years = experience of less than 5 years; 6 – 20 years = experience of 5 – 10 years and experience of more than 10 years.	Q38
RE sources	The main RE category a financier funds REPs within.	Collapsed categories are main RE sources and others – main RE sources = solar and wind; others = geothermal, biofuels, biomass, hydropower, ocean and others.	Q39

Appendix B: Additional responses from respondents

Additional responses from RE financiers (n = 155)

Variable	Frequency	Percentage	Source
Source of capital			Q2
Government grants	2	1.3	
Foreign donations	11	7.1	
Private capital	138	89.0	
Others	4	2.6	
Contribution to LED			Q9
Some contribution	146	94.2	
No contribution	9	5.8	
Impact on local communities			Q10
Some impact	152	98.1	
No impact	3	1.9	
Economic profile of communities			Q11
Some improvement	124	80.0	
No improvement	31	20.0	
Change observed in communities			Q12
Higher societal status	22	14.2	
Better standards of living	105	67.7	
More disposable income	6	3.9	
Others	22	14.2	
Impact of RE policy autonomy			Q15
Yes	73	47.1	
No	82	52.9	
Policy and specific financial rewards			Q16
Yes	127	82.0	
No	28	28.0	
RET barrier removal			Q17
Not important	91	58.7	
Highly important	64	41.3	
Sustainable development acceleration			Q18
Yes	121	78.1	
No	34	21.9	
Contribution to climate change mitigation			Q19
Significant contribution	44	28.4	
Insignificant contribution	111	71.6	
Contribution to GHG alleviation			Q20
No role	8	5.2	
Important role	147	94.8	

Variable	Frequency	Percentage	Source
Environmental protection			Q21
Not important	108	69.7	
Important	47	30.3	
Effectiveness of operations			Q23
Localising RE policies	32	20.6	
Reducing cost of capital	52	33.5	
Increasing access to finance	63	40.6	
Others	8	5.3	
Incentives for semi-urban and rural areas			Q25
Power purchase agreements	72	46.4	
Increasing electricity prices	33	21.2	
Feed-in tariffs	35	22.6	
Others	15	9.8	
Perceived value			Q26
Significant	138	89.0	
Insignificant	17	11.0	
Semi-urban and rural policies			Q27
Yes	117	75.5	
No	38	24.5	
Value and estimated time frame			Q28
Short term	2	1.3	
Medium term	27	17.4	
Long term	126	81.3	
Age group			Q29
Below 30 years	12	7.7	
31 to 40 years	47	30.3	
41 to 50 years	71	45.8	
51 years and above	25	16.2	
Gender			Q30
Male	93	60.0	
Female	62	40.0	
Company size			Q31
Below 50 employees	43	27.8	
Above 50 employees	112	72.2	
Function at firm			Q33
Advisory	44	28.4	
Risk management	6	3.9	
Investment analysis	67	43.2	
Operations management	12	7.7	
Accounting & finance	26	16.8	

Variable	Frequency	Percentage	Source
Educational background			Q36
Social science	88	56.8	
Pure science	39	25.2	
Engineering	22	14.1	
Law	6	3.9	
Experience in RE			Q37
Less than 10 years	89	57.4	
More than 10 years	66	42.6	

Additional response from REP developers (n = 63)

Variable	Frequency	Percentage	Source
Source of capital			Q2
Government grants	2	3.2	
Foreign donations	4	6.3	
Private capital	56	88.9	
Others	1	1.6	
Contribution to LED			Q9
Some contribution	54	85.7	
No contribution	9	14.3	
Impact on local communities			Q10
Some impact	48	76.2	
No impact	15	23.8	
Economic profile of communities			Q11
Some improvement	52	82.5	
No improvement	11	17.5	
Change observed in communities			Q12
Higher societal status	16	25.4	
Better standards of living	33	52.4	
More disposable income	10	15.9	
Others	4	6.3	
Impact of RE policy autonomy			Q15
Yes	53	84.1	
No	10	15.9	
Policy and specific financial rewards			Q16
Yes	61	96.8	
No	2	3.2	
RET barrier removal			Q17
Not important	17	27.0	
Highly important	46	73.0	

Variables	Frequency	Percentage	Source
Sustainable development acceleration			Q18
Yes	41	65.0	
No	22	35.0	
Contribution to climate change mitigation			Q19
Significant contribution	34	54.0	
Insignificant contribution	29	46.0	
Contribution to GHG alleviation			Q20
No role	14	22.2	
Important role	49	77.8	
Environmental protection			Q21
Not important	44	70.0	
Important	19	30.0	
Effectiveness of operations			Q23
Localising RE policies	2	3.2	
Reducing cost of capital	49	77.8	
Increasing access to finance	11	17.4	
Others	1	1.6	
Incentives for semi-urban and rural areas			Q25
Power purchase agreements	37	58.8	
Increasing electricity prices	7	11.1	
Feed-in tariffs	12	19.0	
Others	7	11.1	
Perceived value			Q26
Significant	42	66.7	
Insignificant	21	33.3	
Semi-urban and rural policies			Q27
Yes	57	90.5	
No	6	9.5	
Value and estimated time frame			Q28
Short term	3	4.8	
Medium term	16	25.4	
Long term	44	69.8	
Age group			Q29
Below 30 years	5	8.0	
31 to 40 years	33	52.4	
41 to 50 years	21	33.3	
51 years and above	4	6.3	
Gender			Q30
Male	55	87.3	
Female	8	12.7	

Variables	Frequency	Percentage	Source
Company size			Q31
Below 50 employees	12	19.0	
Above 50 employees	51	81.0	
Function at firm			Q33
Advisory	15	23.8	
Risk management	12	19.0	
Investment analysis	7	11.1	
Operations management	21	33.3	
Accounting & finance	8	12.8	
Educational background			Q36
Social science	30	47.6	
Pure science	9	14.3	
Engineering	23	36.5	
Law	1	1.6	
Experience in RE			Q37
Less than 10 years	41	65.0	
More than 10 years	22	34.4	

Appendix C1: Research questionnaire for REP financiers

A questionnaire on the factors influencing financiers' choice of methods in financing renewable energy projects in Africa

Purpose of the questionnaire

In this research, it is hypothesised that the financing of renewable energy is critical for widespread dissemination of renewable energy technologies (RETs). The questionnaire aims to obtain information on the preferences of renewable energy project (REP) financiers on the financing of REPs in Africa. The questionnaire aims to gather data on which financing models REP financiers prefer and perspectives of REP financiers on the impact of varying methods and mechanisms through which projects are financed on their operations. The information is necessary to develop theories in which finance would play greater roles in increasing the adoption rates of RETs.

Confidentiality

Please note that all responses would be treated confidentially and only an aggregation of results would be presented at the end of the research. Respondents would remain anonymous as a means to protect their identities. Respondents would receive a copy of aggregated results at the end of the research and responses would be benchmarked against the average. Kindly provide your email address on the last page of the survey. Email addresses would not be used for any other purpose than to provide you the respondent with results of the research.

Section 1: Methods of Financing Renewable Energy Projects

1. How many renewable energy projects has your firm financed since beginning operations?

- ☐ Less than 5
- ☐ Between 5 and 10
- ☐ Between 11 and 20
- ☐ Above 20

2. What is the source of capital for financing renewable energy projects at your firm?

- ☐ Government grants
- ☐ Foreign donations
- ☐ Private capital
- ☐ Other (please specify) _____

3. What method is mostly used to finance renewable energy projects at your firm?

- ☐ Project finance
- ☐ Mezzanine finance
- ☐ Senior debt
- ☐ Equity
- ☐ Consumer credit
- ☐ Dealer credit
- ☐ Fee-for-service
- ☐ Other (please specify) _____

4. What is your firm's motivation for choosing this method?

- ☐ Increase in profits
- ☐ Reduction of risks
- ☐ Faster rate of RET adoption
- ☐ Investment is easy to monitor
- ☐ Potential to increase energy access
- ☐ Other (please specify) _____

5. What is the most important barrier to increasing financing operations of renewable energy projects for your firm?

- ☐ High capital costs
- ☐ High interest rates
- ☐ Low credit repayment rates
- ☐ Low access to capital
- ☐ Lack of awareness on RETs
- ☐ Other (please specify) _____

6. How does your firm measure value obtained from financing renewable energy projects in communities?

☐ In financial terms ☐ In economic terms

☐ In both financial and economic terms ☐ Other (please specify) _____

7. Please select the average amount your firm invests in financing a renewable energy project.

☐ Less than $1000 ☐ $1001 to $10000

☐ $10001 to $20000 ☐ $20001 and above

8. Please select the total amount your firm has invested in financing renewable energy projects.

☐ Less than $1000 ☐ $1001 to $100000

☐ $100001 to $10000001 ☐ $10000001 and above

Section 2: Renewable Energy Finance, Economic Development and Policy

9. Do you think your renewable energy financing operations has contributed to developing communities economically?

☐ Yes ☐ No

10. How would you rate the impact of renewable energy financing by your firm on communities?

☐ Insignificant ☐ Below average ☐ Average ☐ Above average

11. Have you observed any improvement in the economic profile of communities since commencing financing operations of renewable energy projects?

☐ Yes ☐ No

12. What is the most common change observed in the communities due to the availability of renewable energy?

☐ Higher societal status ☐ Better living standards

☐ More disposable income ☐ Other (please specify) _____

13. Does the local renewable energy policy influence your firm's choice of financing methods?

☐ Yes ☐ No

14. What renewable energy policy best triggers an increase in renewable energy project financing operations at your firm?

☐ Feed-in tariffs ☐ Renewable energy certificates

☐ Tax reduction ☐ Rebates

☐ Grants ☐ Production credits

☐ Power purchase agreements ☐ Other (please specify) _____

15. If autonomy in renewable energy policy establishment was provided to states/provinces, would this increase financing activities at your firm?

☐ Yes ☐ No

16. If renewable energy policies focused on specific financial rewards for specific technologies, would this influence your decision on what technology to finance?

☐ Yes ☐ No

Section 3: Renewable Energy Finance, Technology Adoption and Environmental Protection

17. How important is the role of your firm in financing renewable energy to remove barriers to technology adoption?

☐ Not important ☐ Indifferent

☐ Moderately important ☐ Highly important

18. Do you think that increasing finance for renewable energy projects can accelerate efforts to achieve the objectives of sustainable development?

☐ Yes ☐ No

19. Please estimate the contribution of renewable energy financing operations in increasing technology adoption for climate change mitigation?

- ☐ No contribution
- ☐ Contribution is insignificant
- ☐ Contribution is significant
- ☐ Contribution is highly significant

20. What role does your firm perceive the financing of renewable energy projects to play in the alleviating the production of green-house gases?

- ☐ No role
- ☐ Indifferent
- ☐ Important role
- ☐ Highly important role

21. How important is the concept of environmental protection to your firm in making decisions to finance renewable energy projects?

- ☐ Not important
- ☐ Indifferent
- ☐ Moderately important
- ☐ Highly important

Section 4: Renewable Energy Finance for Semi-Urban and Rural Areas

22. What is the average time frame your firm considers when financing renewable energy projects?

- ☐ Less than 5 years
- ☐ 5 – 10 years
- ☐ 11 – 20 years
- ☐ 21 years or more

23. How can your firm's renewable energy financing operations be made more effective?

- ☐ Localising renewable energy policies
- ☐ Reducing cost of capital
- ☐ Increasing access to finance
- ☐ Other (please specify) _____

24. Where would your firm most probably choose to finance renewable energy projects in?

- ☐ Urban areas
- ☐ Semi-urban areas
- ☐ Rural areas
- ☐ Other (please specify) _____

25. What incentives would result in your firm considering financing renewable energy projects in semi-urban and rural areas?

☐ Power purchase agreements ☐ Increasing electricity prices

☐ Tax reductions ☐ Production credits

☐ Feed-in tariffs ☐ Other (please specify) _____

26. How would you rate the performance of your financing operations in terms of value as you perceive?

☐ Below average ☐ Moderate ☐ Good ☐ Excellent

27. If favourable policies/conditions were established would you consider financing renewable energy projects in semi-urban and rural areas?

☐ Yes ☐ No

28. When does your firm expect to obtain value from renewable energy projects it finances?

☐ Short-term ☐ Medium-term ☐ Long-term ☐ Other

Section 5: Demographics

29. Please specify your age group:

☐ Under 30 years ☐ 31 – 40 years ☐ 41 – 50 years ☐ 51 and above

30. Please specify your gender:

☐ Male ☐ Female

31. How many employees does your firm employ?

☐ 10 employees or less ☐ 11 – 50 employees

☐ 51 – 200 employees ☐ 201 employees and above

32. What country is your firm and project located in?

Two dropdown list of countries from which respondents can choose from will be provided

33. What function do you currently perform at your firm?

- ☐ Advisory
- ☐ Investment analysis
- ☐ Accounting & Finance
- ☐ Risk management
- ☐ Operations management
- ☐ Other (please specify) _____

34. How long has your company been operating?

☐ 5 years or less ☐ 6 – 10 years ☐ 11 – 20 years ☐ 20 years and above

35. What type of company do you work for?

- ☐ Commercial bank
- ☐ Investment bank
- ☐ Private equity fund
- ☐ Venture capital fund
- ☐ Development bank
- ☐ Hedge fund
- ☐ Microfinance bank
- ☐ Other (please specify) _____

36. What educational background do you have?

- ☐ Economics
- ☐ Business administration
- ☐ Engineering
- ☐ Multidisciplinary
- ☐ Finance
- ☐ Legal
- ☐ Science
- ☐ Other (please specify) _____

37. How many years of experience do you have in the renewable energy finance sector?

- ☐ No experience
- ☐ Experience of 5 – 10 years
- ☐ Experience of less than 5 years
- ☐ Experience of more than 10 years

38. How long has your firm been operating in the renewable energy finance sector?

- ☐ No experience operating
- ☐ Less than 5 years
- ☐ 5 – 10 years
- ☐ More than 10 years

39. What renewable energy resource is your company mostly involved in financing?

- ☐ Solar
- ☐ Wind
- ☐ Geothermal
- ☐ Biofuel
- ☐ Biomass
- ☐ Hydropower
- ☐ Ocean
- ☐ Other (please specify) _____

Appendix C2: Research questionnaire for REP developers

A questionnaire on the factors influencing financiers' choice of methods in financing renewable energy projects in Africa

Purpose of the questionnaire

In this research, it is hypothesised that the financing of renewable energy is critical for widespread dissemination of renewable energy technologies (RETs). The questionnaire aims to obtain information on the preferences of renewable energy project (REP) developers on the financing of REPs in Africa. The questionnaire aims to gather data on which financing models REP developers prefer and perspectives of REP developers on the impact of varying methods and mechanisms through which projects are financed on their operations. The information is necessary to develop theories in which finance would play greater roles in increasing the adoption rates of RETs.

Confidentiality

Please note that all responses would be treated confidentially and only an aggregation of results would be presented at the end of the research. Respondents would remain anonymous as a means to protect their identities. Respondents would receive a copy of aggregated results at the end of the research and responses would be benchmarked against the average. Kindly provide your email address on the last page of the survey. Email addresses would not be used for any other purpose than to provide you the respondent with results of the research.

Section 1: Methods of Financing Renewable Energy Projects

1. How many renewable energy projects has your firm developed since beginning operations?

- ☐ Less than 5
- ☐ Between 5 and 10
- ☐ Between 11 and 20
- ☐ Above 20

2. What is the source of capital for financing renewable energy projects at your firm?

- ☐ Government grants
- ☐ Foreign donations
- ☐ Private capital
- ☐ Other (please specify) _____

3. What method is mostly used to finance renewable energy projects your firm developed?

- ☐ Project finance
- ☐ Mezzanine finance
- ☐ Senior debt
- ☐ Equity
- ☐ Consumer credit
- ☐ Dealer credit
- ☐ Fee-for-service
- ☐ Other (please specify) _____

4. Why do you think is the financiers' motivation for choosing this method?

- ☐ Increase in profits
- ☐ Reduction of risks
- ☐ Faster rate of RET adoption
- ☐ Investment is easy to monitor
- ☐ Potential to increase energy access
- ☐ Other (please specify) _____

5. What is the most important barrier to increasing financing operations of renewable energy projects for your firm?

- ☐ High capital costs
- ☐ High interest rates
- ☐ High credit repayment rates
- ☐ Low access to capital
- ☐ Lack of awareness on RETs
- ☐ Other (please specify) _____

6. How does your firm measure value obtained from developing renewable energy projects in communities?

☐ In financial terms ☐ In economic terms

☐ In both financial and economic terms ☐ Other (please specify) _____

7. Please select the average amount your firm has received to finance a renewable energy project.

☐ Less than $1000 ☐ $1001 to $10000

☐ $10001 to $20000 ☐ $20001 and above

8. Please select the total amount your firm has invested in developing renewable energy projects.

☐ Less than $1000 ☐ $1001 to $100000

☐ $100001 to $10000001 ☐ $10000001 and above

Section 2: Renewable Energy Finance, Economic Development and Policy

9. Do you think your renewable energy project development operations have contributed to developing communities economically?

☐ Yes ☐ No

10. How would you rate the impact of renewable energy project financing on communities?

☐ Insignificant ☐ Below average ☐ Average ☐ Above average

11. Have you observed any improvement in the economic profile of communities since establishing renewable energy projects that are externally funded?

☐ Yes ☐ No

12. What is the most common change observed in the communities due to the availability of renewable energy?

☐ Higher societal status ☐ Better living standards

☐ More disposable income ☐ Other (please specify) _____

13. Do you think the local renewable energy policy influences a firm's choice of financing methods?

☐ Yes ☐ No

14. What renewable energy policy would you say could best trigger an increase in renewable energy project financing operations for renewable energy project developers?

☐ Feed-in tariffs ☐ Renewable energy certificates

☐ Tax reduction ☐ Rebates

☐ Grants ☐ Production credits

☐ Power purchase agreements ☐ Other (please specify) _____

15. If autonomy in renewable energy policy establishment was provided to states/provinces, would this increase financing activities for renewable energy project developers?

☐ Yes ☐ No

16. Do you think renewable energy policies focused on specific financial rewards for specific technologies could influence your decision on what technology to engage?

☐ Yes ☐ No

Section 3: Renewable Energy Finance, Technology Adoption and Environmental Protection

17. How important is the role of financiers in financing renewable energy to remove barriers to technology adoption?

☐ Not important ☐ Indifferent

☐ Moderately important ☐ Highly important

18. Do you think that increasing finance for renewable energy projects can accelerate efforts to achieve the objectives of sustainable development?

☐ Yes ☐ No

19. Please estimate the contribution of renewable energy financing operations in increasing technology adoption for climate change mitigation?

- ☐ No contribution
- ☐ Contribution is insignificant
- ☐ Contribution is significant
- ☐ Contribution is highly significant

20. What role do you perceive the financing of renewable energy projects to play in the alleviating the production of green-house gases?

- ☐ No role
- ☐ Indifferent
- ☐ Important role
- ☐ Highly important role

21. How important is the concept of environmental protection to your firm in making decisions on which financier to obtain financing for renewable energy projects from?

- ☐ Not important
- ☐ Indifferent
- ☐ Moderately important
- ☐ Highly important

Section 4: Renewable Energy Finance for Semi-Urban and Rural Areas

22. What is the average time frame your firm considers when obtaining finance for a renewable energy project?

- ☐ Less than 5 years
- ☐ 5 – 10 years
- ☐ 11 – 20 years
- ☐ 21 years or more

23. In what ways do you think renewable energy financing operations be made more effective?

- ☐ Localising renewable energy policies
- ☐ Reducing cost of capital
- ☐ Increasing access to finance
- ☐ Other (please specify) _____

24. Where would your firm most probably choose to develop renewable energy projects in?

- ☐ Urban areas
- ☐ Semi-urban areas
- ☐ Rural areas
- ☐ Other (please specify) _____

25. What incentives would result in your firm considering developing renewable energy projects in semi-urban and rural areas?

☐ Power purchase agreements ☐ Increasing electricity prices

☐ Tax reductions ☐ Production credits

☐ Feed-in tariffs ☐ Other (please specify) _____

26. How would you rate the performance of financing operations in terms of value as you perceive the industry?

☐ Below average ☐ Moderate ☐ Good ☐ Excellent

27. If favourable policies/conditions were established do you think financiers would consider financing renewable energy projects in semi-urban and rural areas?

☐ Yes ☐ No

28. When do you think financiers expect to obtain value from renewable energy projects they finance?

☐ Short-term ☐ Medium-term ☐ Long-term ☐ Other

Section 5: Demographics

29. Please specify your age group:

☐ Under 30 years ☐ 31 – 40 years ☐ 41 – 50 years ☐ 51 and above

30. Please specify your gender:

☐ Male ☐ Female

31. How many employees does your firm employ?

☐ 10 employees or less ☐ 11 – 50 employees

☐ 51 – 200 employees ☐ 201 employees and above

32. What country is your firm and project located in?

Two dropdown lists of countries from which respondents can choose from will be provided

33. What function do you currently perform at your firm?

- ☐ Advisory
- ☐ Investment analysis
- ☐ Accounting & Finance
- ☐ Risk management
- ☐ Operations management
- ☐ Other (please specify) _____

34. How long has your company been operating?

☐ 5 years or less ☐ 6 – 10 years ☐ 11 – 20 years ☐ 20 years and above

35. What type of company do you work for?

- ☐ International development agency
- ☐ International RE developer
- ☐ Energy service company
- ☐ Government institution
- ☐ Local development agency
- ☐ Local RE developer
- ☐ Electricity utility
- ☐ Other (please specify) _____

36. What educational background do you have?

- ☐ Economics
- ☐ Business administration
- ☐ Engineering
- ☐ Multidisciplinary
- ☐ Finance
- ☐ Legal
- ☐ Science
- ☐ Other (please specify) _____

37. How many years of experience do you have in the renewable energy development sector?

- ☐ No experience
- ☐ Experience of 5 – 10 years
- ☐ Experience of less than 5 years
- ☐ Experience of more than 10 years

38. How long has your firm been operating in the renewable energy development sector?

- [ ] No experience operating
- [ ] Less than 5 years
- [ ] 5 – 10 years
- [ ] More than 10 years

39. What renewable energy resource has your company mostly received financing for?

- [ ] Solar
- [ ] Wind
- [ ] Geothermal
- [ ] Biofuel
- [ ] Biomass
- [ ] Hydropower
- [ ] Ocean
- [ ] Other (please specify) _____

Appendix D: Research Interview Outline

Interview Outline for Obtaining Qualitative Data on the Financing of Renewable Energy Projects in Africa

Purpose of the Interview Outline

In this research, it is hypothesised that the financing of renewable energy is critical for widespread dissemination of renewable energy technologies. The proposed interview outline provided in the following pages is aimed at obtaining information on the choices financiers of renewable energy projects in Africa make in selecting models, mechanisms and methods by which they finance projects. The information is necessary to develop theories in which finance would play greater roles in increasing the adoption rates of renewable energy technologies.

Confidentiality

Please note that all responses would be treated confidentially and only an aggregation of results would be presented at the end of the research. Respondents would remain anonymous as a means to protect their identities. Respondents would receive a copy of aggregated results at the end of the research and responses would be benchmarked against the average. You would be asked to provide your email address during the interview. Email addresses would not be used for any other purpose than to provide respondents with results of the research. Please be advised that this research is strictly for academic purposes.

Other Information

Research Topic: Models of Financing Renewable Energy for Sustainable Development: An African Perspective

Degree: Doctor of Philosophy

Year of Study: 2

Institution: University of the Witwatersrand Graduate School of Business

Introduction

For the purpose of my research, I would appreciate having controlled access to senior members of the renewable energy finance team. The main reason I request access to these individuals is to enable me conduct interviews as part of the data collection process which is critical to carrying out the research. From the interviews, I aim to collect data on the interrelated themes of finance, policy economic development, and environmental protection as they impact the financing of renewable energy projects.

Aims of the Interview Process

Financing

To understand the motivation behind the financing of renewable energy projects, such as profitable income and economic development

To understand the process by which projects are selected for financing such as the criteria to be met by benefitting firms and other prerequisites for financing

To get an estimate of the average time frame the firm considers and commits to financing renewable energy projects

To obtain information on the firm's preferred model of financing renewable energy projects as well as the preferred mechanisms by which it chooses to finance its selected projects

To understand why the firm chooses one financing structure over the other – if at all this happens to be the case, regarding the financing renewable energy projects

To obtain information on the progress of renewable energy projects that the firm has financed

To understand the firm's evaluation process developed for the analysis of investment risks associated with the financing of renewable energy projects

Policy

To understand the impact of policy on the firm's decision to finance renewable energy projects

To understand the impact of local and international renewable energy market trends on the firm's financing decisions

To understand how production/tax credits as well as other financial incentives implemented by the government affect the firm's decision to finance renewable energy projects

To understand the policies preferred by the firm to encourage increased investment in renewable energy, particularly in the form of financing renewable energy projects

Economic Development

To obtain information on the firm's evaluation of the benefits of providing finance for renewable energy projects within communities

To understand the role of other external factors such as independent power producer contracts, and the track record and performance of the benefiting institution, in influencing the financing decisions of the firm

To understand the overarching objective for financing renewable energy projects such as profitable income, impacting development, increasing access to energy, contributing towards the development of a green economy

Environmental Protection

To understand the firm's environmental policy – if any, in financing renewable energy projects

To understand the impact of the firm's environmental policy in financing renewable energy projects

To understand the performance system for measuring the effects of the firm's renewable energy financing operations in contributing to the reduction of greenhouse gases and environmental protection

Conclusion

As mentioned earlier in this document, this research is strictly for academic purposes. Information obtained from the process would be kept in the archives of University of the Witwatersrand's commerce, law and management library, as it could comprise a part of the final dissertation. Information on respondents, as well as responses from interviews would not be released to any individual or institution. However, the amalgamated responses would be provided in the section of the dissertation for the purpose of analysis to draw conclusions and proffer logical inferences only. The list of interview questions for REP financiers, developers and policymakers is attached below.

Interview Questions (Policymakers)

Q1. What funding models/mechanisms does your institution mainly support in promoting its renewable energy projects?

Q2. Does your institution encourage financiers to have an environmental policy to which they and their beneficiaries adhere?

Q3. Which renewable energy policy does your institution consider to be the most effective in promoting investment in renewable energy project development and why do you say so?

Q4. What is your institution's motivation for promoting policy to increase the financing of renewable energy projects?

Q5. Do you think that the policies for renewable energy project development your institution supports have impacted renewable energy finance and the communities within which projects are developed?

Q6. Kindly share some benefits your institution has observed in the local communities, through promoting support policies for financing renewable energy projects

Q7. In terms of aiding the financing of renewable energy projects, what renewable energy policy does your firm prefer and why?

Q8. How do you think policy for renewable energy financing can be improved to foster renewable energy technology deployment?

Q9. Do you think the policies your institution establishes to promote renewable energy finance directly or indirectly contributes to mitigating the production of greenhouse gases?

Q10. What metrics, if any, does your institution use to quantify the contribution of policy to local economic development brought about by financing renewable energy projects?

Q11. How do you think renewable energy technologies can be made more accessible to communities?

Q12. Do you think renewable energy technologies have the potential to contribute towards addressing the challenge of energy access prevalent in Africa?

Q13. What do you consider to be the most important barrier to financing renewable energy projects and renewable energy technology dissemination?

Q14. How do you think policy can be improved to promote increased investment in renewable energy projects, particularly from the private sector?

Interview Questions (REP financiers and developers)

Q1. What funding models/mechanisms does the firm mainly employ in financing its renewable energy projects?

Q2. Do the firms your company funds have to have an environmental policy? Also does your firm have an environmental policy in place?

Q3. How many renewable energy projects has your firm financed till date and how many are in the pipelines?

Q4. What is your firm's motivation for financing renewable energy projects?

Q5. Do you think that the renewable energy projects your firm financed have impacted local communities?

Q6. Kindly share some benefits your firm has observed in the local communities, through financing renewable energy projects

Q7. In terms of aiding the financing of renewable energy projects, what renewable energy policy does your firm prefer and why?

Q8. How do you think renewable energy financing can be improved to foster renewable energy technology deployment?

Q9. Do you think your firm's renewable energy project financing operations contributes to mitigating the production of greenhouse gases?

Q10. What metrics, if any, does your firm use to quantify its contribution to local economic development brought about by financing renewable energy projects?

Q11. How do you think renewable energy technologies can be made more accessible to communities?

Q12. Do you think renewable energy technologies have the potential to contribute towards addressing the challenge of energy access prevalent in Africa?

Q13. What do you consider to be the most important barrier to financing renewable energy projects and renewable energy technology dissemination?

Q14. How do you think policy can be improved to promote increased investment in renewable energy projects, particularly from the private sector?