STRATEGIES FOR INCREASING ACCESS TO ELECTRICITY SERVICES FOR RURAL ELECTRIFICATION IN ZAMBIA

BY

LAVENDER MALAMA

A DISSERTATION SUBMITTED TO THE UNIVERSITY OF ZAMBIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ENGINEERING IN PROJECT MANAGEMENT

THE UNIVERSITY OF ZAMBIA

LUSAKA

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I, LAVENDER MALAMA, do hereby declare that, with the exception of quotations and works of others that have been duly referenced and acknowledged therein, this dissertation is a result of my own work. I further declare that it has never been previously submitted for the award of the degree at any other university.

Author's Full Name: Lavender Malama

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CERTIFICATE OF APPROVAL

This dissertation by **LAVENDER MALAMA** entitled '**STRATEGIES FOR INCREASING ACCESS TO ELECTRICITY SERVICES FOR RURAL ELECTRIFICATION IN ZAMBIA'** is approved as partially fulfilling the requirements for the award of the degree of Master of Engineering in Project Management of the University Zambia.

	NAME	SIGNATURE	DATE
Supervisor:	……..	……..	……..
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ACKNOWLEDGMENT

I wish to convey my utmost gratitude to several individuals and organisations whose efforts and contributions enabled the completion of this project.

First and foremost, I would like to acknowledge and give my warmest thanks to my supervisor, Dr. Chabota Kaliba, who made this possible. His patience, unwavering commitment, wealth of wisdom, and advice carried me throughout the process.

Secondly, special thanks go to Dr. Erastus Mwanaumo (UNZA) and Mr. Obery Katungu (National Assembly) for all the help and guidance.

I am forever grateful to all the people who granted me interviews, responded to my questionnaires, and those who contributed in any way. To SMEC Zambia, Ministry of Finance, Rural Electrification Authority, ZESCO Limited, Bicon Consultants, and Engineering Institution of Zambia, I say continue with the same spirit of providing a platform for knowledge transfer.

Finally, I extend my gratitude to several other people too numerous to mention, especially my lecturers, my fellow students, friends, and family who played a role in enabling me to successfully work and subsequently compile this report.

Above all, to God be the Glory for his ever-present grace, without which, all my efforts in conducting this work would have been in vain.

DEDICATION

I dedicate this work to; My husband and best friend in life, Dickson, you believed in me even when I did not believe in myself, My Children - Taonga, Joshua, and Elijah for every moment I took away from you, it was worth it, My entire family and friends - in whose love and patience I bask, I salute you Above all, I thank the Almighty God for his abounding grace in the undertaking of this journey to the finish.

ABSTRACT

Access to electricity is one of the main drivers in the process of sustainable development. Access to energy transforms the lives of people, communities, and nations. The main issue facing developing countries is the lack of access to affordable and reliable electricity supply for their population, and it is often the rural population that is most affected. Despite the Government of the Republic of Zambia (GRZ)'s efforts to create developmental policies aimed at increasing access to electricity, access to electricity in rural areas remained low at 8.4% as of 2018 (CSO, 2018). This study thus aimed at establishing strategies for increasing access to electricity services through Rural Electrification (RE) in Zambia. The concurrent embedded design which considers both qualitative and quantitative approaches was adopted for this study. Using participants mainly from the Energy Sector which included, policymakers, developers, implementing agencies, consultants, and regulators, data was collected and analysed. There are several desirable conditions for successful rural electrification. These desirable conditions were instrumental in the development of electrification strategies. The research established four key electrification strategies i) to deploy an energy generation mix with solar, biogas, and wind energy as alternative sources to hydropower based on a needs analysis. ii) mitigating the four key constraints (lack of key stakeholder participation, insufficient domestic funding, poor policy implementation, and external interference) as one strategy to enhance electrification iii) enhancing financial support to policy and regulation administration iv) enhancing the provision of subsidies for the rural community.

The research recommends (i) that the government should exploit the use of cost-reflective tariffs as a way to improve private sector participation, (ii) improvement in the administration of the REA Act towards the provision of energy services to all rural areas, (iii) expanding the source of project funding for rural electrification to equity, debt, guarantee, and tax relief.

Keyword:
rural electrification, electricity access, energy sector, rural community

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LIST OF ABBREVIATIONS AND ACRONYMS

CEC	Copperbelt Energy Corporation Plc
DoE	Department of Energy
ERB	Energy Regulations Board
EIZ	Engineering Institute of Zambia
GRZ	Government for the Republic of Zambia
IEA	International Energy Agency
IFAD	International Fund for Agricultural Development
IPP	Independent Power Producers
KPLC	Kenya Power and Lighting Company
LCMS	Living Conditions and Monitoring Survey
MEWD	Ministry of Energy and Water Development
MoE	Ministry of Energy
NEP	National Energy Policy
NAMA	Nationally Appropriate Mitigation Actions
NGO	Non-Governmental Organisations
ONE	Office National d'Electricité
OPPPI	Office for Promoting Private Power Investment
OECD	Organisation for Economic Co-Operation and Development
ODA	Official Development Assistance
PERG	Global Rural Electrification Program
RE	Rural Electrification
REA	Rural Electrification Authority
REB	Rural Electrification Board
REF	Rural Electrification Fund
REMP	Rural Electrification Master Plan
REP	Rural Electrification Program
RET	Renewable Energy Technologies
SNDP	Seventh National Development Plan
SNDP	Sixth National Development Plan
WTP	Willingness to Pay
ZESCO	Zambia Electricity Supply Corporation (now "ZESCO Ltd." officially)
ZDA	Zambia Development Agency

CHAPTER ONE

INTRODUCTION

1.1Background

Electricity as consumption and an intermediate good has been linked to income growth, and therefore, a causal relationship exists between income and infrastructure. Rural Electrification (RE) promises a brighter future for many rural communities and in the long term, the benefits of providing electricity to rural households can be high (Bhattacharyya, 2013). Research study outcomes have given evidence indicating the positive relationship between electricity consumption and gross domestic production. This correlation has been reflected by the relationship existing between the electrification rate in a country and the percentage of households who are living above the poverty line of two dollars per day (Independent Evaluation Group World Bank, 2008).

In this context, one of the main issues facing developing countries is the lack of electricity access by their population, and it is often the rural population that is most affected by a lack of affordable and reliable electricity supply (UNDP, 2014). Developing countries, on the other hand, struggle with economic and societal growth due to, in part, a lack of access to this vital resource. Southeast Asia and Africa are areas most affected by this problem. At 23%, Africa has the lowest electrification rate, or percentage of residents with electricity, among modern world regions (Wolde-Rufael, 2006). A history of energy consumption in the world over the past three decades shows an increase in every region except for sub-Saharan Africa, which has experienced no increase at all. As the population of sub-Saharan Africa increases rapidly, the projected date for 100% electrification is extended further into the future, with the most recent predictions being 2087 or later (Wolde-Rufael, 2006).

Due to this lack of full electrification in Africa, each year US$17 billion is spent on inefficient, dangerous, and polluting energy fuels like kerosene (Rugman and Doh, 2014). Additionally, many developing governments spend millions of dollars in taxes to import energy from developed countries. Efficient and reliable sources of electricity are necessary for sub-Saharan Africa to achieve a sustained rate of economic and social growth and begin eliminating its high rate of poverty. As a developing country in Africa, Zambia is endowed with a wide range of

energy sources, particularly, woodlands and forests, hydropower, coal, and renewable sources of energy. Petroleum is the only energy source that is wholly imported (MEWD, 2007). Zambia has the second-largest potential for solar power in the world, currently virtually unused, and an abundance of rivers and water resources in the rural areas (UNPD, 2014).

The Government of Zambia in the late 90s had taken positive steps to increase electricity access to 15 % by the year 2030 in the rural areas. In 1994, the Rural Electrification Fund (REF) was created (MFNP, 2006). One of the major steps was the enactment of the Rural Electrification Act No. 20 of 2003 which provided for the establishment of the Rural Electrification Authority (REA). According to the Act, the Authority administers and manages the REF which it uses to implement the rural electrification programs. The overall mandate of REA was to provide electricity infrastructure to rural areas using appropriate technologies in order to increase rural electricity access rate and contribute to improved productivity and quality of life for the rural population (REA, 2003).

In 2006, the access rate to electricity in Zambia was 22 % at the national level distributed at 23 % in the urban areas and 3 % in the rural areas (MFNP, 2011). Further improvement in electricity access rate was reported in 2016 as 67.7 % in the urban areas and 3.7 % in the rural areas (CSO, 2016). The slow progress was despite the huge potential and government efforts of putting in place the rural electrification framework. The World Energy Outlook Report (2015) shows Zambia to be among countries with low access to electricity, refer to Appendix E: Electrification rate in Africa. Perhaps the low levels of electrification can be attributed to low funding levels to the institutions entrusted with the responsibility of electrifying the country or maybe policy framework and operationalization. The Rural Electrification Master Plan (REMP) reports that GRZ started electrifying rural areas in the early 1900. However, in 2008, the follow-up electrification program was set out in the REMP itself whose target plan was to spend a total of US$1.1 billion equivalent to about K4.4 trillion during the period 2008-2030, an annual expenditure of US$50 million equivalent to about K200 billion over the same period. Once this investment was made, the rate of electrification was expected to increase from 3% to 51% by the year 2030 (Jica/Mewd, 2009). However, from inception, the REF had not been funded to this tune with the REA receiving an average of K80m per annum from 2012 to 2016. The K80m was equivalent to 6% of the required resource (REA, 2019). The creation of the REA was a good initiative; however, its creation had not yielded its intended results as a special purpose vehicle to spur rural electrification and consequently increase rural electricity access rate.

The challenge of rural electrification was how to make electricity available to areas and communities which lack access to a grid-based power supply. The primary constraints as to why many people in the world remain unconnected to the grid are typically financial and physical. While the latter deals with the challenges of geography, (for example, hilly areas, large tracts of dense forest land, long distances to reach remote areas) and availability of resources (for example., oil/gas, water, sunlight, biomass), the former refers to the economic challenges which developing countries face in investment funding, service costs, revenues, and collection. It is noted that, it is often financially prohibitive to extend existing power infrastructure into rural areas, via power grid extensions (Haanyika, 2006). Cost-effectiveness is particularly a problem in sparsely populated countries where distances may be long and therefore grid extension costs are high, with the extension resulting in the provision of grid access to a limited number of remote communities. These problems are not unique to Zambia: Zambia is a landlocked country whose population is scattered across the country. The communities may be clustered in some areas, but the majority of the rural population lives in smaller family-like structures.

From the foregoing, this research sought to establish strategies for increasing access to electricity services for Rural Electrification in Zambia thereby improving the livelihood of the rural community.

1.2 Problem Statement

It has been widely acknowledged by the international community that access to electricity is one of the main drivers in the process of sustainable development (Clark, 2012). As such, many governments have embarked on projects to provide electricity to its citizens, especially in rural areas. Zambia is no exception. The Zambian government established REA in 2006 to increase access to electricity by rural communities. However, access to electricity in rural areas is still low with figures at 8.4% in 2018 (ZamStats, 2020) from 3% in 2004 (CSO, 2016). As of 2008, GRZ through the REMP had intended to spend a total of US$1.1 billion equivalent to about K4.4 trillion on the electrification program during the period 2008-2030 (Jica/Mewd, 2009). However, since inception, the Rural Electrification Fund has only been receiving an average of 6% of the required resources which was not sufficient to meet the target of increasing the electrification rate to 51% in the rural areas by 2030. It was against this background that this study embarked on establishing strategies for increasing access to electricity services for rural electrification in Zambia thereby improving the livelihood of the rural community.

1.3 Objectives

1.3.1 Main Objective

This study aimed at establishing strategies for increasing access to electricity services for rural electrification in Zambia thereby improving the livelihood of the rural community.

1.3.2 Specific Objectives

To achieve the aim of the study, the following were the specific objectives: -

i To review and analyse the current mechanisms governing electrification in Zambia.

ii To determine the shortcomings of RE.

iii To determine factors that are necessary for increased access to RE.

1.4 Research Questions

i What are the current mechanisms governing RE in Zambia?

i What are the shortcomings of RE?

ii What factors are essential for increased access to RE?

1.5 Significance of Study

The Leaving Conditions and Monitoring Survey Report (2016) reports that access to electricity rate was 3.7% in 2015 from 3.0% in 2006. Concerted efforts to boost RE and create improved conditions for socio-economic development in rural areas started as far back as 1994 when the GRZ established the Rural Electrification Fund (REF) by allocating 3.45% of the sales tax on electricity consumption to the Fund to finance RE projects. Despite these efforts, the pace of RE was slow, resulting in only 8.4% of the rural population having access to electricity as of 2018 (CSO, 2018). As energy is the driving force of any economy, these statistics indicate slow progress. It is with this view that this research sought to establish strategies for increasing access to electricity services for RE in Zambia thereby improving the livelihood of the rural community in the rural parts of the country. Amongst the strategies is the promotion of the private sector and community participation in the energy sector. This would provide a relief on government resources and significantly improve electricity access rate.

1.6 Summary of Research Methodology

The research study made use of both qualitative and quantitative approaches. The combination of the two approaches made it possible to analyse the collected data. Various data collection tools were used such as desk study, document review, and mixed type of questionnaire survey, research study site visits, discussions, measurements, calculations and observations on the current situation and the prospects of rural electrification. The approach enabled data triangulation and verification of the information obtained in order to draw valid conclusions and recommendations.

1.7 Organisation of the Thesis

The thesis consists of seven (7) chapters namely: -

i ***Chapter 1:*** Outlines the background, rationale, aim, and objectives of the study. It also suggests the application of the research.

ii ***Chapter 2:*** Lays a foundation of the study through presenting the background of electrification in general.

iii ***Chapter 3:*** presents a review of literature relevant to Knowledge Creation and Integration.

iv ***Chapter 4:*** Highlights the various research methodologies and the justification for the methodology adopted for the study.

v ***Chapter 5:*** Presents the findings and results.

vi ***Chapter 6:*** presents a detailed discussion of the results.

vii The dissertation ends with ***Chapter 7*** which presents the conclusions, limitations, and recommendations of the study.

CHAPTER TWO

RURAL ELECTRIFICATION IN ZAMBIA

2.1. Introduction

The previous Chapter outlined an overview of the research. The rationale and objectives of the study were also presented. This chapter presents the context of the study with respect to rural electrification in Zambia. The Chapter begins by presenting the background and then examines a broader perspective of what issues affect access to electricity.

2.2. Background on Rural Electrification and the Electricity Industry

Rural electrification is the process of bringing electricity supply to rural and remote areas. The challenge of rural electrification is how to make electricity available to areas and communities which lack access to a grid-based power supply. Cost-effectiveness is particularly a problem in sparsely populated countries where distances may be long and therefore grid extension costs are high, with the extension resulting in the provision of grid access to a limited number of remote communities. Therefore, mini-grids are often used as a least-cost long term solution for rural electrification and the use of renewable energy to power mini-grids had become increasingly popular (United Nations Development Program, 2014).

Financing institutions such as the World Bank believed that reforms could help improve the technical and financial performance of the power sector and as such, incorporated conditions for reforms in lending agreement for electrification programs. The need for financing and in some cases conviction that the reforms could bring about improvements had resulted in a number of developing countries taking steps to reform their power sectors in the 1990s (WorldBank, 1993). Further, funding plays a significant role in the formulation of Renewable Energy Technologies (RETs) policies. The majority of advanced and electric RETs are not affordable to most of the population in Africa who are poor, with poverty degrees of between 50 to 70% (WorldBank, 2010).

The need for increased investments in rural infrastructure and other key public services that are necessary for achieving growth and reducing poverty in rural areas has been underscored by various stakeholders (World-Bank/IEG, 2008). In response to increased investments, initiatives and programs were noted for those countries that achieved an increased electricity access rate. Refer to Appendix A for the electrification rates for Africa as of 2018.

An initiative that had worked in promoting electricity access in the rural areas in Kenya was the "Umeme Pamoja", which translates as "Electricity Together". This campaign sought to establish a joint group of households, to connect them collectively to the grid, thus saving costs. This scheme was financed by a group settlement electrification scheme created by the Kenya Power and Lighting Company (KPLC). According to them, this scheme was aimed at making electricity connections easier, affordable, and faster (Kenya Power and Lighting Company, 2006).

In Africa, countries such as Algeria, Tunisia and/or Morocco were able to do RE by entrusting this electrification mission and the management of dedicated financial resources to their national electricity companies with the condition that they delegate part of this mission to the private sector (Masse', 2010). To do this, these governments not only showed very strong political will, but were also able to secure, from their assets, the larger part of the necessary financing and sustained this effort for decades. As an example, the financial scheme of the Global Rural Electrification Program (PERG) in Morocco included a 55% contribution from the Office National d'Electricité (ONE), a 20% contribution from local communities, and 25% contribution from beneficiaries amounting to a budget of approximately 1.8 billion Euro which made it possible to bring the global electrification rate from 18% in 1995 to 95.4% in 2008. As investment pre-financing and pending the effective mobilisation of the various stakeholders on a national scale, the ONE contributed 53% from its equity, while 47% were mobilised from international lenders as concessional loans guaranteed by the Moroccan government (Masse', 2010). Lessons from Morocco, i). Morocco pursued reforms in a selective and incremental manner. For instance, policy makers were selective in their approach to privatizing electricity distribution that reinforced existing territorial monopolies, rather than full or partial divestiture of municipal utilities. ii). Morocco's power sector institutional arrangements performed commitment, coordination, and cooperation functions to achieve objectives of attracting private investments to boost installed generation capacity and output. iii) Morocco was

able to pursue socio-economic objectives in the power sector due to its strong and growing economy.

Sadly, few African countries can apply the Moroccan or Tunisian models today because they do not have a sufficient industrial and urban electric sector capable of sustaining an internal financial transfer scheme to the benefit of the electric sub-sector and to mobilise concessional loans for RE, possibly guaranteed by the State (Masse', 2010).

This research takes cognisant of the statement issued by *Kanayo F. Nwanze*, the President of IFAD when launching IFAD's New Financing Framework for Investment in Poor Rural Communities, where he said that, "This framework provides the means to leverage additional funding for our work in remote areas where few others venture" (Katie Taft, 2015). The focus of this study is to identify these strategies to increase energy access for the rural population.

2.3 Electrification in Zambia

Zambia is a land locked country in Southern Africa. It is a member of the Southern Africa Development Community; below is the geographical (refer to Figure 2.1) and economic data for Zambia.

Figure 2.1:Location Map of Zambia

i. Location: Southern Africa
ii. Land Area: 752,618 km^2
iii. Population: 17.3 million people
iv. Languages: 73 Ethnic groups
v. Official Language: English
vi. GDP: K297, 553million (2019*)*
vii. Industries: copper mining and processing, construction, foodstuffs, beverages, chemicals, textiles, fertilizer, and horticulture.

Zambia is situated in south-central Africa with 66.5 % of forest land and abundant rivers and lakes (WorldBank, 2015). It is surrounded by eight neighbouring countries. Zambia is one of the world's richest nations if wealth is measured by natural resources. It was Africa's second largest copper producer in 2021 and produced in excess of 880.8 thousand metric (M Garside, 2022). It is endowed with many natural resources including several rivers, birds, and woodlands. With the many rivers, Zambia's main energy sources are premised on hydro power generated on the rivers.

As of 2016, the country's installed capacity was 2,493 MW and accounted for 97 % from hydro and 3 % from other sources. The peak generation sent out was 1281MW against a peak demand of 1949MW, thus giving a deficit of 668MW (Bridle, Klimscheffskij and Siwabamundi, 2018). This situation resulted from the limited investment in generation over the years, which was also compounded by non-cost-reflective tariffs. Further, the deficit was exacerbated by the effects of climate change on the availability of water, considering that Zambia was highly dependent on hydropower. The 2017 projections indicated that growth in demand would increase by 150 MW to 200 MW per annum. In the Seventh National Development Plan (7SNDP), it was reported that, to increase supply, there was a need for additional investment in energy generation (MFNP, 2017). It was envisaged that other sources of energy which included geothermal, wind, solar and coal would grow to about 15 % of the energy mix by 2030. In 2020, the national installed electricity capacity increased to 3,011.31 MW from 2,981.31 MW in 2019. Despite this, only 1,500 MW was available for generation capacity against a peak demand of 2,310 MW recording the highest deficit of 810 MW in 2020 (Energy Regulation Board, 2020).

2.4. Institutional Framework

There are many actors in the energy sector. These are institutions that play a role in the implementation process of electrification including a wide range of government institutions and organisations, both at the central and local levels, private enterprises, non-governmental organisations (NGOs) and local institutions of the project areas. The electricity utility in Zambia is under the jurisdiction of the Department of Energy and operates based on the policies established by the Ministry of Energy and water Development (MEWD) now Ministry of Energy (MoE). The Energy Regulation Board (ERB) under the same Ministry supervises the power companies per the Electricity Act of 2003 and the Energy Regulation Act of 2003 of the laws of Zambia (Energy Regulation Board, 2020). The Governmental Institutions governing the Rural Electrification portfolio in Zambia are listed under organisations and regulation with the key players shown in figure 2.4.

2.4.1. Ministry of Energy (MoE)

The MoE is responsible for the development and management of energy resources in a sustainable manner for the benefit of the people. The mandate and portfolio functions of MoE as outlined in the government Gazette Notice No.836 of 2016 are as follows:

- Development of Renewable Energy Sources;
- Electricity;
- Energy Policy;
- Nuclear Energy Policy;
- Oil Pipeline and Refineries;
- Petroleum; and
- Petroleum Storage and Pricing.

In executing its mandate, the Ministry supervises the following statutory bodies and parastatals: Energy Regulation Board (ERB); Rural Electrification Authority (REA); Zambezi River Authority (ZRA); INDENI Oil Refinery; TAZAMA Pipelines Limited and ZESCO Limited. ZESCO Limited and INDENI Oil Refinery are supervised by Industrial Development Corporation (IDC). In the MoE, the Department of Energy is a key player in facilitating the development and implementation of Energy Policy and Programmes. The Department was established in 1982 by a Cabinet decision and commenced its operations in early 1983 (Ministry of Energy, 2022). The Electricity portfolio is managed under the Department of Energy (Energy Regulation Board, 2020).

2.4.2. Zambia Electricity Supply Company Limited (ZESCO Ltd)

ZESCO Limited is a vertically integrated electricity utility, which generates, transmits, distributes, and supplies electricity in Zambia. It is a public utility, with the Government of Zambia (GRZ). The GRZ through IDC is the sole shareholder of ZESCO Limited. ZESCO Limited was formed in 1970 after the Zambia Electricity Supply Act was passed in Parliament. This Act brought together the electricity undertakings that were previously managed by the local authorities. The Corporation traces its origins to 1906 when a small thermal station was established in Livingstone to serve a small section of the town. In 1994, the name of Zambia Electricity Supply Corporation Limited was changed to ZESCO Limited. This was to reflect their re-commitment to providing a high quality of customer service. The Permanent Secretaries of the Ministry of Finance and MoE

represent the Government on the ZESCO Limited Board of Directors (International Renewable Energy Agency, 2013).

2.4.3. Office for Promoting Private Power Investment (OPPPI)

The Office for Promoting Private Power Investment (OPPPI) was founded in 1999 as a part of the then Ministry of Mines, Energy and Water Development. Its mandate is the promotion of private investment in the generation and transmission of electricity. It aims at the efficiency of the sector, the development of the largely untapped hydro-electrical potential, the improvement of rural electrification and the use of least-cost technologies as well as renewable energy. As a result, the office manages all planning, procurement and awarding of large electricity projects (Office for Promoting Private Power Investment, 2014).

2.4.4. Energy Regulatory Board (ERB)

The Energy Regulation Board (ERB) is a statutory body established under the Energy Regulation Act of 1995, Chapter 436 of the Laws of Zambia which was repealed and replaced by the Energy Regulation Act No. 12 of 2019.The ERB commenced its work in 1996. The ERB is responsible for the licensing of Independent Power Producers, the definition of petrol prices and electricity tariffs, the development of technical standards, follow-up on customer complaints, arbitration of conflicts arising among the sector's stakeholders and the promotion of new grid connections with particular focus on low-income households (Energy Regulation Board, 2020).

2.4.5. Zambia Development Agency

The Zambia Development Agency (ZDA) is an important contact point for foreign investors. The ZDA was established in 2006. Its mandate includes the promotion of trade and investments. It is a platform providing investors access to information and services for their market entry. The agency supports investors in the acquisition of land, the subscription to and procurement of water, electricity, and means of communication as well as transportation, the application for the legal immigration status and the application for licenses necessary for the sector they are active in (Ministry of Energy, 2022).

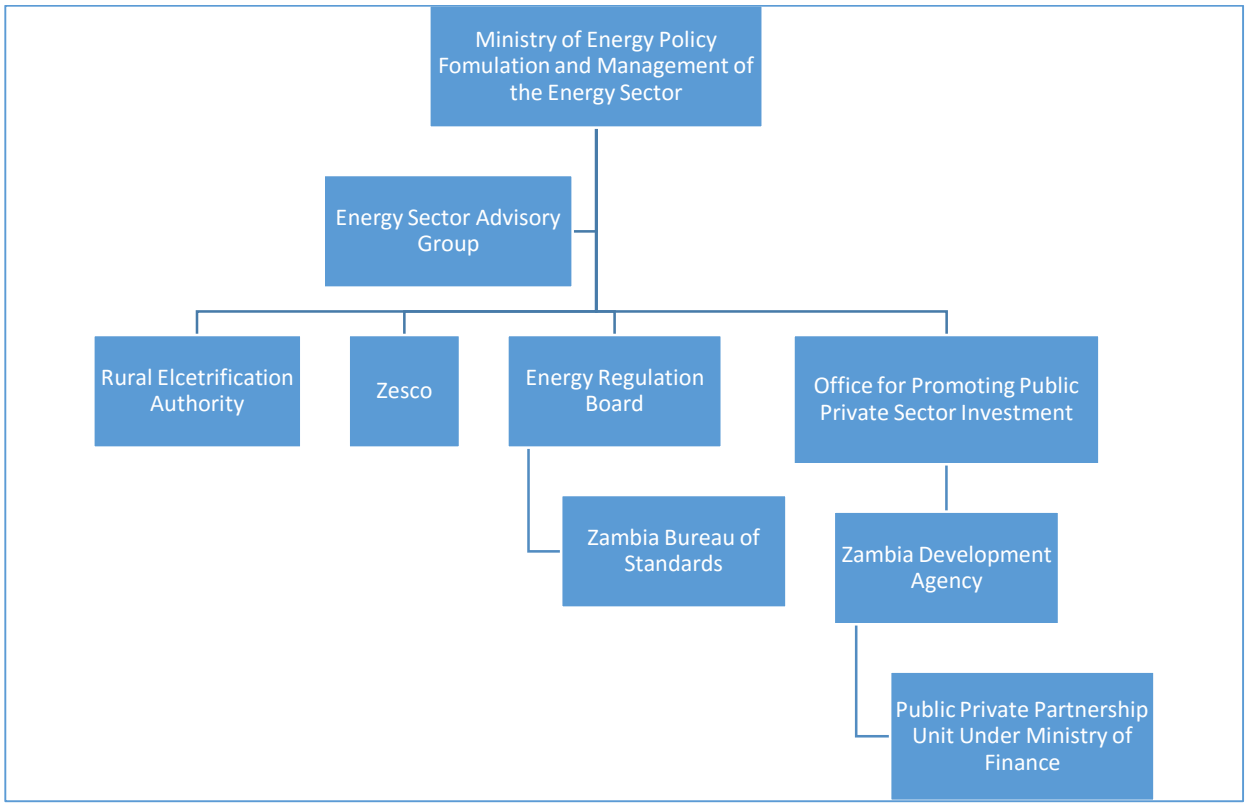
2.4.6. Rural Electrification Authority

The GRZ enacted the Rural Electrification Act No. 20 of 2003 dedicated to the promotion of rural electrification by the administration of the Rural Electrification Fund which had been under the Department of Energy since its establishment in 1994. Consequently, Rural Electrification

Authority (REA) was founded in 2004 to manage the REF mandated by the Act. REA implements approved electrification projects as well as monitors projects that have been contracted to third parties for implementation (REA, 2003).

2.5. Regulatory Framework - Act, Policies and Regulations

Policy and regulation of the rural electrification program is a preserve of the GRZ through the MoE in consultation with stakeholder institutions, Refer to Appendix 5 for the regulatory framework governing the energy sector in Zambia. Policy development in Zambia is done through a consultative process with government instructions leading the process. The policy development in Zambia is guided as per Figure 2-2 (REA, 2018).



Lufunda Muzeya (2015)

Figure 2. 2 : Policy Development Framework

The Government has funded electrification projects from annual national budgets since the early1980s. In January 1994, the Government established the REF under the MEWD to increase funding and improve the management of the rural electrification program. A levy of 3.45% on electricity consumption was introduced and the MEWD was charged with ensuring that the funds

allocated to the REF were disbursed in accordance with the best principles of transparency and accountability.

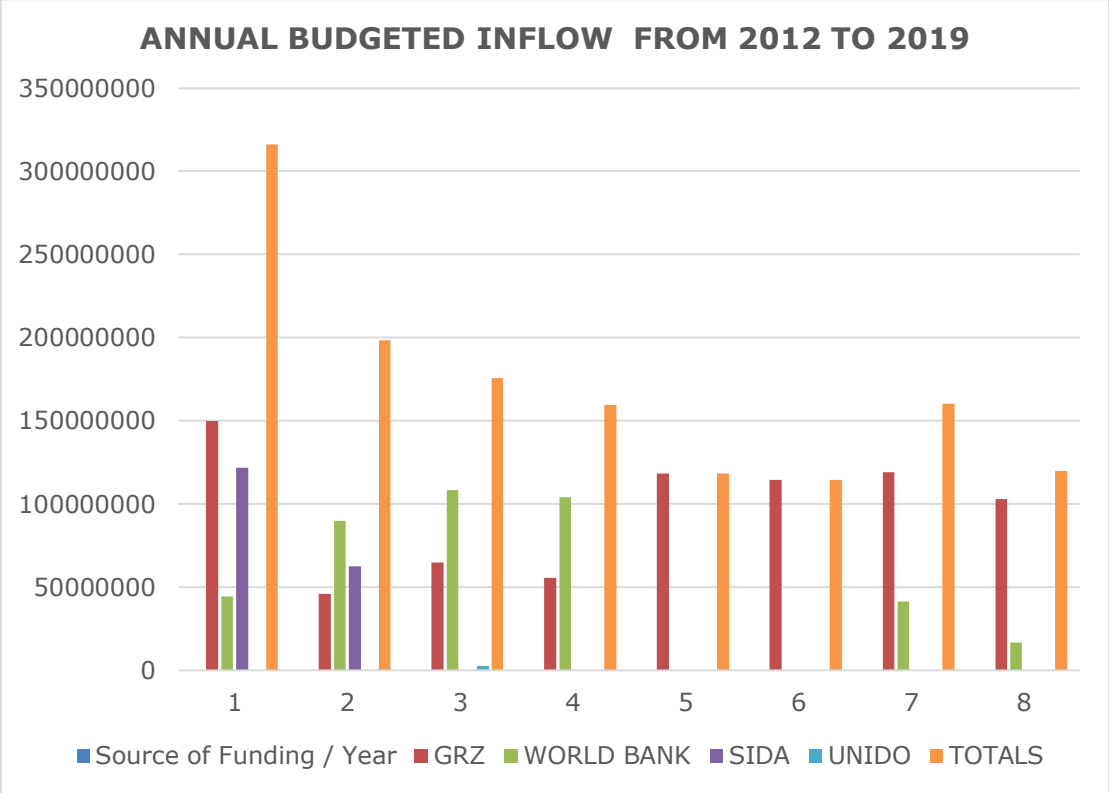
Accordingly, in January 1995, MEWD issued the "Guidelines on Selection of Rural Electrification Projects for Funding by Government", which outlined the procedure of selecting projects proposed by Provincial Planning Units for support from the REF (Jica/Mewd, 2009). The 3.45% of sales tax on electricity consumption was changed to 3% electricity levy in 1998 following the introduction of Value Added Tax (VAT).

It can be noted in figure 2.3, that the contribution by Government to the REF had been reducing over the years. The Government contribution fell the sharpest in 2012 from a peak of K150 million to K46 million in 2013, refer to table 2.1. From the institutional perspective, this drop assumed special significance because it reversed the rising trend of the previous year's funding intended to ramp up the electrification program financing to the figures projected in the REMP (Jica/Mewd, 2009).

Table 2.1:Annual Budgeted Inflow to the REF from 2012 to 2019

Sourcing of Funding/ Year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
GRZ	150,000,000	46,000,000	65,000,000	55,599,000	118,290,876	114,516,305	118,963,565	102,958,900
WORLD BANK	44,500,000	90,028,421	108,293,382	103,950,111	-	-	41,232,943	16,933,509
SIDA	121,646,000	62,508,105						
UNIDO	-	-	2,376,597					
TOTAL	**316,146,000**	**198,536,526**	**175,669,979**	**159,549,111**	**118,290,876**	**114,516,305**	**160,196,508**	**119,892,409**

Source: (REA, 2019)



(Adapted from the REA Annual Report 2019)

Figure 2. 3 : Funding to the REF for 2012 to 2019

From figure 2.3, from 2013 to 2015, the Sixth National Development Plan (6NDP) had projected expenditures of K160million, K169million, and K230million respectively. However, the budgetary allocations from Government for the REA for the same period, 2013 to 2015, were K46 million, K65 million and K55.5 million respectively. As of 31st December 2015, GRZ was the only contributor to the REF (Rural Electrification Authority, 2016). The drop continued over the years even both from the government and from the donor community (REA, 2018).

With these efforts, the rural electrification rate which was at 3% in 2004 increased to only 8.4% in 2018 as reported by the Zambia Demographic and Health Survey (Zambia Statistics Agency, 2020).

At present, ZESCO Limited is the largest, and unequalled, electricity company in Zambia, running and operating power stations, transmission lines, and distribution networks. ZESCO Limited shares are owned by GRZ (ZESCO Limited, 2022). In 2003, revision of the Electricity Act, allowed for the participation of private companies in power generation, which subsequently begun selling electricity to ZESCO Limited, generated by their own small hydropower stations. Among the companies that purchased electricity from ZESCO Limited,

was CEC which traces its origin to a company that was established in 1952 called Northern Rhodesia Power Corporation. In 1997, CEC was born out of the privatisation of the ZCCM – Power Division. The company purchases electricity from ZESCO and retails it to copper mining companies. Refer to figure 2-4 for the energy sector players in Zambia.

Source: Adapted from Kapika and Eberhard 2013

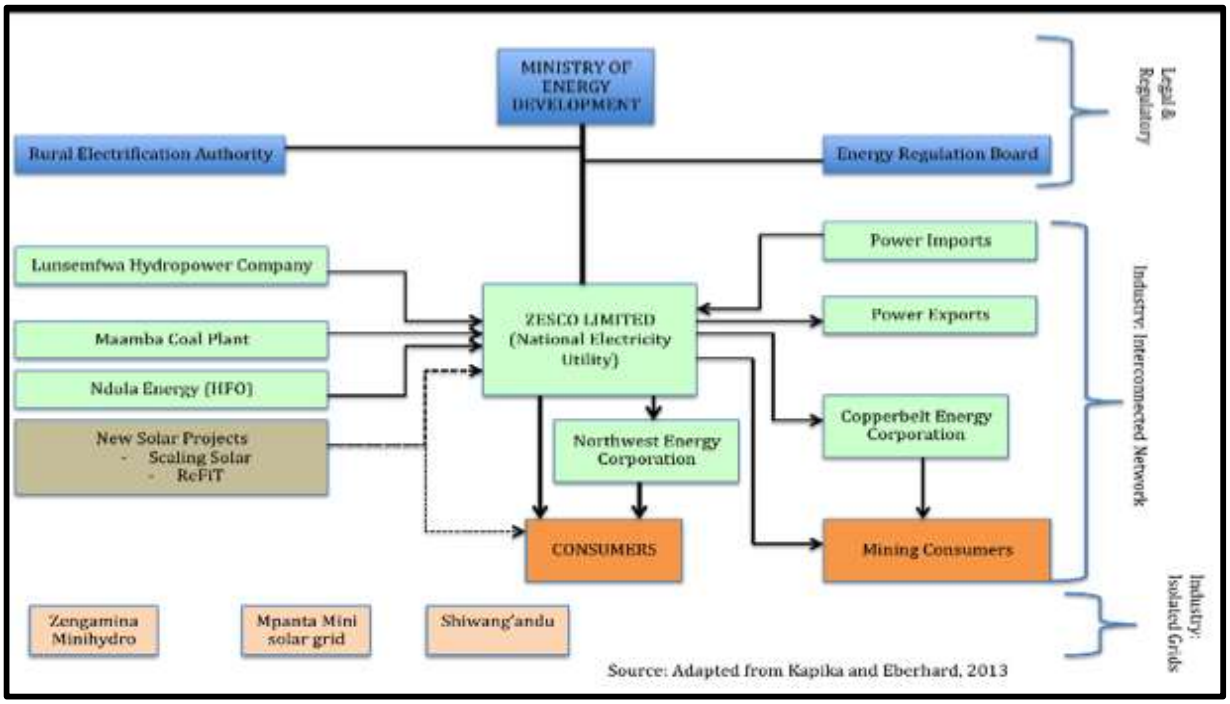


Figure 2.4: Zambia Power Sector

As can be seen from figure 2.4, ZESCO Limited as the vertically integrated institution, it was the centre of activities. The table also shows private sector participation in the industry. The legal framework was supervised and managed by the GRZ.

In Zambia, funding for RE was administered through government instruments, taxes and levies, grants, loans, subsidies, and public-private partnerships. Other instruments were also available including investment funds, guarantees, and insurance which were not exploited for the electrification in Zambia. Refer to the table 2.2.

Table 2.2: Instruments and Sources of Financing for Renewable Energy Projects

Instrument	Sub Category	Function	Source
Equity	Ordinary Shares	Risk capital from developer or sponsor	Sponsor
	Preference Shares	Senior to ordinary shares, typically from tax investors; sometimes providing a cumulative dividend.	Institutional Investors, Investment Funds, Tax Investors
Debt	Subordinated Loan / Mezzanine	Usually fixed-rate, long-term and unsecured. May be considered as equity.	Lenders specialising in mezzanine debt
	Syndicated Loans	The loan provided by two or more lenders, governed by a single loan agreement.	Banks
	Senior Debt - unsecured / secured	Large unsecured loans are only available to creditworthy corporations. Banks tend to limit their risk to 5 - 10 years.	Commercial banks
	Development Loan	Financing provided during the development of the project to a sponsor with insufficient resources.	Lender with project experience
	Intermediary Loan	Export-Import bank lends to a financial intermediary (commercial bank), which in turn lends to the project.	Export Credit Agency
	Private Placement	Direct sale of long-term debt/equity	Investors, insurance companies, pension funds, trading companies
	Eurobond	Issued in amounts averaging $100m without prior registration or approval by any particular government. Terms usually range from 10 - 15 years. Loans may be made in any currency, covenant than syndicated bank loans, and accessible through a large and liquid market.	Capital Markets
Guarantee	Exchange Rate Risk	A commercial lender provides a loan to the project entity (the importing entity), at below-market interest rates. The Export-Import Bank provides compensation for the difference between commercial rate and below-market-rate	Export Credit Agency

Instrument	Sub Category	Function	Source
	Political Risk	Limited protection against risks of sovereign non-performance and certain *Force Majeure* risks.	Word Bank
Tax Relief	Tax Credits Tax Holidays Duty exemption	Individual governments may offer tax incentives	Host governments

Source (Green Rhino Energy, n.d.)

2.6 Policy Review

At the time of this research, Zambia's energy sector was governed by the Energy Regulation Act No.12 of 2019 (Energy Regulation Act), the Electricity Act No.11 of 2019 (Electricity Act), the Petroleum Act chapter 435 of the Laws of Zambia (Petroleum Act) and the Rural Electrification Act No.20 of 2003 (Rural Electrification Act) (Energy Regulation Board, 2020). For this study, policy review was done for the electricity portfolio only. Therefore, the Energy Regulation Act, the Electricity Act, and the Rural Electrification Act have been reviewed in Table 2.3. However, to understand the developments, regulations, and the level of political will over the years, *Muzeya* (2015) points out several developmental programs and initiatives characteristic of the energy sector in the 90s during the leadership of the presidents whose portraits are shown in Figure 2.5. The figure presents Acts, policies and regulatory efforts made towards improving the status of electrification across the country (Muzeya, 2015).

President Kaunda (1964-1991)	President Chiluba 1991-2002	President Mwanawasa 2002-2008	President Banda 2008 – 2011	President Sata 2011 – 2016
 i *Infrastructure Development* ➢ *Power stations (i.e., Victoria Falls, Kariba Dam & Kafue Gorge* ➢ *Tazama Pipeline (Tanzania Zambia Mafuta Pipeline)-1968* ii State control - Nationalisation of Mines, power infrastructure (e.g., ZESCO 1970) iii Central Africa Power Corporation (CAPCO)-Joint Company Zambia & Zimbabwe	 i *Energy Policy – 1994* ii *Rural Electrification Fund – 1994* iii *The liberalisation of the Energy sector;* ➢ *Electricity Act 1995* ➢ *Energy Regulation Act 1995 which established the Energy Regulation Board in 1997* ➢ *The commercialisation of ZESCO Ltd* ➢ *Privatisation of Zambia National Oil Company (ZNOC)* iv *Power Rehabilitation Programme*	 i *Enactment of Rural Electrification Act in 2003 which facilitated establishment of Rural Electrification Authority in 2003* ii *Amendment of;* ➢ *Electricity Act 1995 in 2003* ➢ *Energy Regulation Act 1995 in 2003* iii *Vision 2030 formulated in 2006* iv *Revision of Energy Policy– 2008* v *Rural Electrification Master Plan (2008)* vi *Fight against Corruption attracted more investments in energy*	 i *Development of Power Systems Development Master Plan (2008-2030)* ii *Biofuels Industry* iii *360MW Kariba North Power Plant commenced construction in 2008* iv *750MW Kafue Gorge Lower Construction commenced in 2011* v *360MW Itezhi-tezhi power plant construction commenced in 2011* vi *Launch of uniform fuel pump pricing across the country* vii *Promotion of PPP in infrastructure development*	 i *To increase access to affordable energy in rural areas to reduce poverty and promote economic growth* ii *Continue implementing the REMP and the FYRP.* iii *The government continued to invite investments in the energy sector and endured to create PPP's* viii *360MW Kariba North Power Plant commenced operations in 2016* iv *Commissioned 1MW Shiwang'andu small min hydro plant in 2013*

Figure 2.5 : Energy Developments in the 1900s

The developments over the years show political and government commitment to the energy sector in Zambia from as early as 1994. In the period up to 1991, focus was on construction of infrastructure including generation plants. Thereafter, two presidents, Chiluba and Mwanawasa concentrated on policy developments. This caused a gap in generation infrastructure and could have been a reason for the power outages in later years from 2015. Fortunately, the error of Presidents *Banda* and President *Sata* saw new developments commencing for power generation infrastructure and a renewed drive towards improving the status of electrification across the country.

Table 2.3: Policy review on access to electricity areas

No.	Policy Description	Function of the Policy	Status of implementation
1	Energy Regulation Act No 12 of 2019	to provide for the licensing of enterprises in the energy sector;	Process is on-going,
2	Electricity Act No 11 of 2019	to regulate the generation, transmission, distribution, and supply of electricity to enhance the security and reliability of the supply of electricity	Process is on-going
3	Rural Electrification Act 2003	the Rural Electrification Authority and to define its functions; to establish the Rural Electrification Fund; and to provide for matters connected with or incidental to the foregoing.	Process is on-going. Under first revision.
4	Energy Policy – 2007	to create conditions that will ensure the availability of an adequate supply of energy from various sources, which are dependable, at the lowest economic, financial, social, and environmental cost consistent with national development goals	Process is on-going. Under revision, development of National Energy Strategy (NES) underway

The National Assembly of Zambia maintains an archive of Acts passed by the Parliament to Zambia (National Assembly of Zambia, 2022).

2.7 Chapter Summary

Zambia is endowed with rich natural resources like sunshine, water and forests from which energy can be harnessed. Governments have explored, to a limited extent, these potentials by constructing power generation facilities for both domestic and commercial use. Institutions have been put in places, Laws and guidelines developed to manage these facilities The overall objective of these development is to deliver power to the country citizenry. Despite these efforts, the rural population has only received 8.4% electricity coverage.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

This chapter presents a review of the available literature on electricity globally and narrows to what other researchers have concluded on access to electricity. A critique of the validity of existing theories and literature is also presented.

3.2 Rural Electrification in Literature

In the journal on the Chinese Electricity Access Model for Rural Electrification, Bhattacharyya and Ohiare (2012) present China as a role model for countries wishing to achieve universal access to electricity. This study was aimed at finding out how China had financed rural energy projects and achieved near 100% electrification. The study was based on an extensive literature review. The study reports that China used a phased development through a bottom-up approach where local resources and village level development played a significant role. This integrated rural development acknowledges the state as providing overall guidance and financial support. The study concludes and calls this the "Chinese Model". Two lessons can be drawn from this study; that community participation is key to rural energy development and that the state retains the responsibility for direction and financial support (Bhattacharyya and Ohiare, 2012).

The study further states that it is widely recognised in the development policy circle that access to clean energy is a prerequisite to the economic development of developing countries. The Executive Director, *Maria Van Der Hoeven* at the International Energy Agency (IEA) supports this finding in the report titled "A focus on the energy prospects in Sub-Saharan Africa". The report provides a most comprehensive analytical study of energy in Africa with a view to contributing to a better quality of life. The IEA Report (2014) highlights that every advanced economy has required secure access to modern energy to underpin its development and growing prosperity. Further, it goes on to say that modern, high quality and reliable energy provides services such as lighting, heating, transport, communication, and mechanical power that support education, better health, higher incomes and all-round improvements in the quality of life (Africa Energy Outlook, 2014).

The studies by Bhattacharya and Ohiare (2012) and the International Energy Agency (2014) both conclude that China provides a role model for rural electrification strategy and both share the same thought on improved living standards on the basis of increased access to electricity services. In the same vein, Barnes and Foley (2004) on the summary of lessons from successful rural electrification programs indicates that community engagement and involvement contributed immensely to the success of the program. Bangladeshi, Thailand, and Ireland were the main contributors to the conclusion (Barnes and Gerald Foley, 2004). The access rate for Bangladeshi, Thailand and Ireland were 78%, 100% and 100% respectively as of 2018 (World Bank, 2021).

From a policy perspective, two studies by Markandya and Wilkinson (2007) and Haanyika (2005) agree that the electricity industry is made up of a complex system where different factors interact to influence the demands of the different consumers. Key among these factors are the institutions for the delivery of electricity services and the provision of reliable services particularly (Markandya and Wilkinson, 2007) and (Haanyika, 2006). Country governments play a major role as they are responsible for establishing policy in the form of new laws and regulations that promote, accelerate, or improve electricity services amongst their citizens.

Chowdhury (2008), in his Journal on Impact and Sustainability of Community Development Programmes in Developing Countries, notes that sustainability of development projects including energy projects require qualified human capital. He concludes that most REP policymakers have limited resource mobilisation skills and are often not even looking for funds that are available locally, preferring to wait for international donors to approach them. The study highlights that the lack of resources was not only attributed to a lack of financing but also a lack of qualified human capital (Chowdhury 2008).

Masse' (2010), in his report titled "Financing for Rural Electrification programs in Africa" notes that the WorldBank as a lender community, believed that reforms for financing institutions would help improve the technical and financial performance of the power sector and as such, incorporated conditions for reforms in lending agreements for electrification programs. Both Chowdhury (2008) and Masse' (2010) conclude that qualified human capital and financing were a prerequisite to increase rural electrification. Zambia was one of those countries that reformed the energy sector

by liberalisation of the Energy sector, enacting the Electricity Act in 1995 and the Energy Regulation Act in 1995 (WorldBank, 1993) as can be referred to in figure 2-5. More studies including Elojärvi et al (2012) in a conference paper entitled "Review on Rural Energy Policy: Nepal, Ghana, Bangladesh, and Zambia" acknowledge the need for resource mobilisation and qualified human capital.

Kankam and Boon (2009) report that in countries where energy supply policies encouraged greater access to modern energy services through market mechanisms, the policies had evolved in tandem with broader energy sector reforms opening up to more private sector participation (Kankam and Boon, 2009).

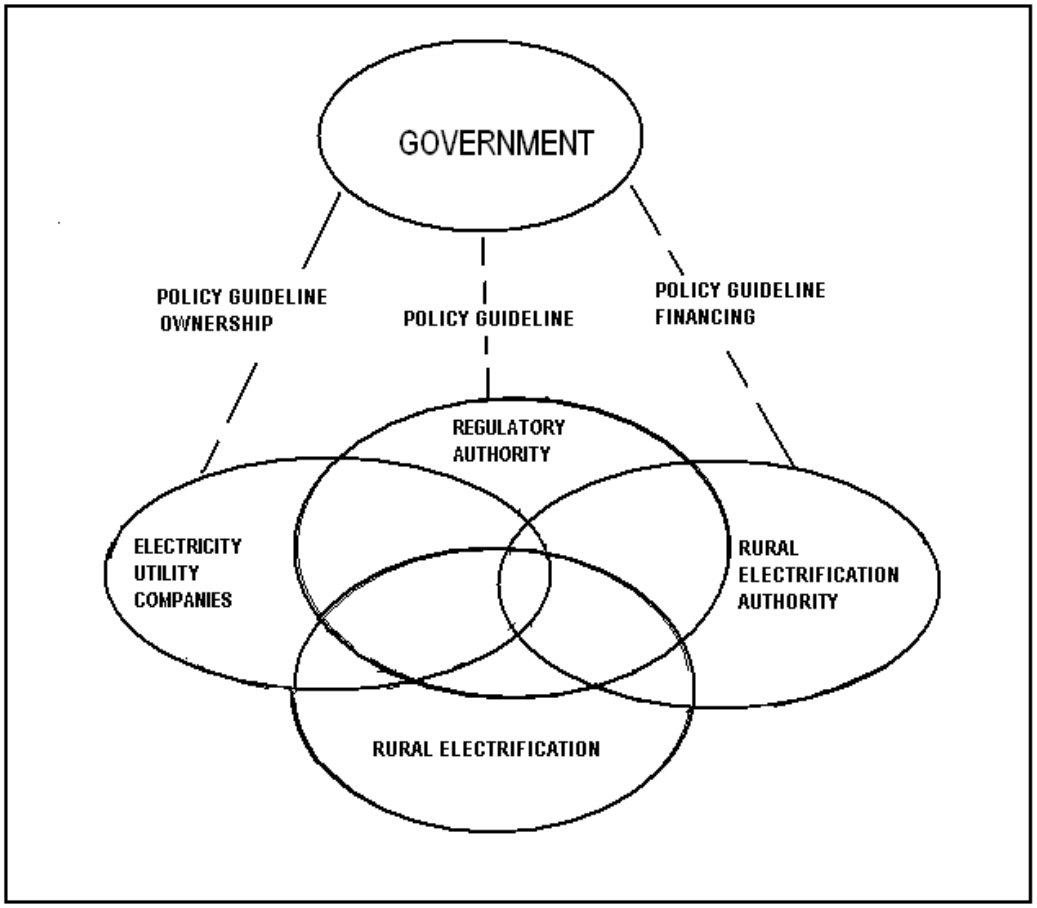
The UNDP in its NAMA report (2014) acknowledges that the challenge of rural electrification is how to make electricity available to areas and communities which lack access to a grid-based power supply. Cost-effectiveness is particularly a problem in sparsely populated countries. Haanyika (2005) supports this call that electrification of rural areas is a challenge due to the high costs associated with extending electricity grids and developing decentralised systems. He further observes that RE in developing countries had mainly been affected by poor policy, institutional weaknesses and limited financing, a situation he concludes as true for the Zambian energy sector (Haanyika, 2006).

Daye et al (2016) acknowledge that affordability is a critical constraint for the rural population to gain energy access. Capital subsidies and microloans are the most economically used financing mechanism in rural electrification by lowering upfront cost barriers as well as providing access to capital. Their model suggests that both capital subsidies and microloans should be provided to induce long-lasting impacts of electrification as the capital subsidy is considered for the short-term as a stopgap measure only (Daye et al, 2016).

Chirambo (2016) asserts that, every country in Africa has surplus energy resources, but financing difficulties have prevented the vast majority of countries from being able to fully exploit their energy potential. He further suggests that the continent's low levels of energy access are a manifestation of the dynamic relationship between costs, income levels, grid connectivity and

energy policy among others (Chirambo, 2016). However, the International Energy Agency, argues that despite the financing difficulties, Sub-Saharan Africa was yet to conquer the challenge of energy poverty and that the barriers to doing so are surmountable and the benefits of success are immense (Africa Energy Outlook, 2014).

Haanyika (2005) was of the view that RE continued to experience many challenges such that in 2003, the government enacted the Rural Electrification Act leading to the establishment of an agency dedicated to RE (Haanyika, 2006). He further observed that, with reforms, government utilities and emerging RE authorities and regulatory bodies took the centre stage in the power sector in general and in facilitating and ensuring RE, refer to figure 2.5. The Figure 3.1 shows the relationship between what Haanyika identified as the main stakeholders in RE in Zambia.



Source: (Haanyika, 2005)

Figure 3. 1 : Rural Electrification Fund Scheme in Zambia

While most of the administrative state centres in Zambia, were provided with electricity either through on-grid or off-grid systems, rural electrification had not made much progress because of high capital cost and the sparse population (RES4AFRICA Foundation, 2021), the report points out that, in part due to the late establishment of ERB, the liberalisation of the power sector failed to bring a noticeable increase in financing for rural electrification (Haanyika, 2006). In 1995 MEWD published a guideline, based on the scoring model, for the selection of government-funded projects (Government of the Republic of Zambia, 2004).

Despite these efforts, Elojarvi et al (2014) reports that rural electrification did not become a success. This in his study was attributed to part of the tax or levy meant to come to the REF, going to the Governments general account (Elojärvi *et al.*, 2014). The Energy Regulation Board of Zambia reports that the tax and levy still go to the Governments general account as of 2016 (Rural Electrification Authority, 2016).

Many financing initiatives exist for funding energy projects in Africa, and these could be private or public depending on the scale and type of project. The power sector in most African countries is normally financed through national budgets, yet the finances are not usually enough to improve the distribution and transmission network to expand electricity access.

Gujba et al (2012) reports that the problem of financing is compounded by the little or no private funding presence in this sector as many of the power utilities in Africa are plagued by low rates of return on investment due to high operating costs and low consumption. They further observe that the financing mechanisms for these funds include grants, co-financing, loans, equity, Official Development Assistance ODA) technology assistance (Gujba *et al.*, 2012).

Elojarvi et al (2014) presents an example of a financing mechanism in Bangladesh. The government of Bangladesh founded the Rural Electrification Board (REB) in 1977 based on the recommendation made by two United States (US) companies in 1970. The REB was based on the US cooperative model that had electrified rural America in the 1930s. REB was placed as a central statutory agency under the government, and it was responsible for organising financing, administering, and monitoring the activities of the rural electric cooperatives that implemented the

rural electrification. The principal objective of the REB was to ensure democratic participation of the people in policy formulation to provide reliable, sustainable, and affordable energy to the rural residents (Paatero, 2014). The World Bank group and cooperating partners agree that Bangladeshi's 87% electrification rate makes a good example of significant progress at electrification to learn from (United Nations Statistics División, 2019).

In the case of China, Wuyuan and Jiahua (2006) reports that China presents a good example of a developing country that had successfully embarked on rural electrification and energy projects and achieved almost 100% electrification rate (Wuyuan and Jiahua, 2006). They further report that China used a phased development through a bottom-up approach where local resources, village-level development and empowerment played an important role. In the integrated rural development approach, the government provided the overall guidance and financial support to produce local-level solutions that were subsequently integrated to produce an alternative development pathway. The main contributors to the success were the strong government commitment, active local participation, technological flexibility and diversity, a strong emphasis on rural development through agricultural and industrial activities and an emphasis on capacity building and training.

Poon (2015) also presents the Chinese model as an inspiration for other developing countries towards promoting universal electricity access. He concurs with Wuyuan and Jiahua (2006) by stating that rural electrification projects in China were usually not financed by market mechanisms; rather, they were financed by the government or with the help of international funding. The Chinese government provided specific low-interest loans for rural energy development to its people (Poon, 2015).

The large-scale electrification program in Morocco demonstrates the technical feasibility of decentralised rural electrification based on photovoltaic technology, as well as the soundness of a contractual and financial framework. Morocco's decentralised rural electrification program, which represents 10% of its entire rural electrification scheme, makes it one of the most advanced countries in the world in this field (French Global Environmental Facility, 2005). Ivan Nygaard et al (2016) agrees with this perception on Morocco and cites three factors that contributed to the rapid evolution of levels of electrification namely (1) the clear vision and a continuing political

commitment to follow a plan; (2) an institutional framework that brought into action the strength of the national utility and of both national and international actors; and (3) the finance model that included all stakeholders and international financial institutions (Nygaard and Dafrallah, 2016).

Davis (1995) and Haanyika (2009) opined that rural electrification projects are relatively expensive both in terms of initial and operating costs. He also observes that low population densities, long transmission lines, and difficult topographical conditions all mean that installed costs per consumer are much higher than for urban areas. Additionally, Davis observes that large transmission losses, high maintenance costs, and low load factors all mean that the recurrent costs of supplying electricity to rural areas are again substantially higher than for urban areas. Not only are costs high, but revenues are low because of low demand and slow growth in demand. This is accentuated by pricing policies with tariffs that do not reflect the full costs of supply (Davis, 1995). Davis' description of the nature of rural electrification projects is an exact fit of Zambia's situation. Two studies by Kankam and Boon (2009) and Barnes and Foley (2004) concur with Davis' findings and futher state that investment in rural areas was hamppered by a percieved low income from the distribution networks.

The Policy Report on the Electricity Sector in Zambia (2016), reported that, historically, Zambia had one of the lowest electricity tariffs in Southern Africa at the time and that the root of the electricity crisis was in the non-cost-reflective tariffs which had deterred new investments in the power sector for decades (Owen, 2016).

3.3. Factors Affecting Rural Electrification Progress

According to The Merriam-Webster Dictionary a constraint is a limitation or a restriction. A constraint is binding if changing it also changes the optimal solution (The Merriam-Webster Dictionary International Edition,, 2016). Hirmer (2014) observes that understanding the user's perceived value is important because: (a) mechanisms to implement rural electrification projects are far from perfect as problems with dissemination and sustainability in rural areas had not abated and (b) rural electrification was gradually becoming more commercial as the sector moved toward a market-based approach (Hirmer and Cruickshank, 2014). When the user does not have a buy-in to the activity, it becomes a constraint to progress.

Haanyika (2005) reports that public financing, donor support, and state-owned utility finances were traditionally the main sources of RE funds while private financing had been limited. He further states that governments continued to face financial constraints thus making it difficult to allocate financial resources to RE against other competing needs. Similarly, the commercialisation and privatisation of state-owned companies had limited availability and allocation of utility funds to RE in Zambia (Haanyika, 2006). Haanyika further states that attending to recurring maintenance requirements and having the managerial and technical skills to operate energy delivery systems was essential for the long-term sustainability of electricity infrastructure. In Zambia, development assistance to the energy sector had mainly been directed towards fixed capital assets, with comparatively small amounts earmarked for maintenance and capacity building.

A study by Rehman et al (2017) reports that energy subsidies could lead to market distortions resulting from infrastructural and institutional deficiencies, consequently, some private players were inhibited from entering the markets due to a lack of willingness to pay for the actual cost of the service. They conclude that these top-down subsidies to grid-connected electricity had also imposed severe restrictions on the popularization of rural off-grid electrification (Rehman *et al.*, 2017).

3.4. Critique of Literature Reviewed

As reported by Md Mizanur et al (2012), the current financing mechanism for rural electrification in Zambia is sufficient for the challenges in conducting rural electrification. This can be argued in that the document guiding rural electrification was drafted in 2006 and operationalised in 2008 and had not been revised as of 2016. The technologies that were promoted then have evolved and improved significantly. It can also be argued that the choice of electrification method has shifted depending on developments in specific areas i.e., some areas were small and remote and earmarked for development using solar but have transformed into small towns. There was no complete guidance on all the technologies but for Hydro, grid extension and solar. Even with the development of the Grid Code in 2008 and the Power Systems Development Master Plan for Zambia in 2011, it is not agreeable that, the current financing mechanism for rural electrification in Zambia is sufficient to counter the challenges otherwise the electrification rate could be much higher.

From the Guidance paper on Financing Structure and its Management for Rural Electrification, NAMA, rural communities have low finances and cannot afford the cost of household electrification. Additionally, from an economic perspective, rural electrification is not necessarily profitable and as such, most business entities will shun the sector. Yes, it is advisable to gunner financial support from the international community, and it is usually available though at times with conditions. In my opinion, the cost of administering these moneys must be included in the package as well as a sustainability component regarding developing human capacity and competence. s

The rural electrification process must be guided by government policy and work in close liaison with all stakeholders including utilities and regulatory bodies. RE authorities must work with regulators to design appropriate tariff structures and cross-subsidies for rural areas, they should also facilitate the development and application of appropriate technologies through training and development of relevant skills. These are good observations which some countries like China have adopted, unlike the access rates posted by most African countries. In some instances, the electrification adopted was not cost-effective as it used an expensive choice of technology for most areas. Haanyika (2005) notes that a key challenge for RE authorities is to improve financing. Yes, this is true looking at the figures presented as annual disbursement to the REA and the targets set in the REMP. The authorities needed to pursue new financing arrangements with various stakeholders and where necessary make recommendations to the government to ensure that policies and legal/regulatory frameworks were more supportive. This was true for the promotion of collaboration with regulators and standards bodies to ensure that appropriate codes and standards were in place. However, the actual financing fell short of the recommended figures in the REMP resulting in slow progress across the country. The figures in the REMP were too ambitious compared to the national budget allocation which called for adjustments in both target and budget.

The World Bank (Winrock International, 2008) in the Final Report submitted by Winrock International titled “Final Report Policy and Governance Framework for Off-grid Rural Electrification with Renewable Energy Sources” reports that the options available to policymakers seeking to accelerate electrification have developed significantly in recent years. Decreasing costs and improving reliability had led to off-grid renewable energy technologies to become the most

cost-effective option for electrification in most rural areas. And this was true for Zambia though the actual rollout was slow.

Why then has China made steady development and considerable progress in rural electrification? Wuyuan and Jiahua (2006) are of the view that the success of rural electrification in China is a result of Governments' emphasis on providing electricity (Wuyuan and Jiahua, 2006). It is noted that China's rural electrification has developed with funds from multiple channels, multiple levels and under multiple modes, with funds sourced from an investment made not only by central and local government but also by rural residents. Many researchers agree with the World Bank's findings that China's near 100% electrification is attributed to the multi-level approach on rural electrification management and funding.

3.5 Chapter summary

This Chapter has reviewed literature on the status of rural electrification from a global perspective and narrowed down the scenario to Zambia. It further defines rural electrification (RE) in developing countries from three fronts, policy, institutional framework, and financing. Refer to Appendix 5 for compilation and conclusions on literature reviewed.

Several studies reviewed acknowledge the causes of the poor state of rural electrification as being that of poor policy, institutional weakness, and limited financing. These studies have been used as the basis for comparison for the Zambian situation. The next Chapter centres on the methodology used in the study.

CHAPTER FOUR

METHODOLOGY

4.1. Introduction to the methodology and design

This chapter presents the choice of method and the reasoning behind it. It is presented in the following order: research design, data collections methods, scope of the study and its limitations, Figure 4.1 summaries the approach taken.

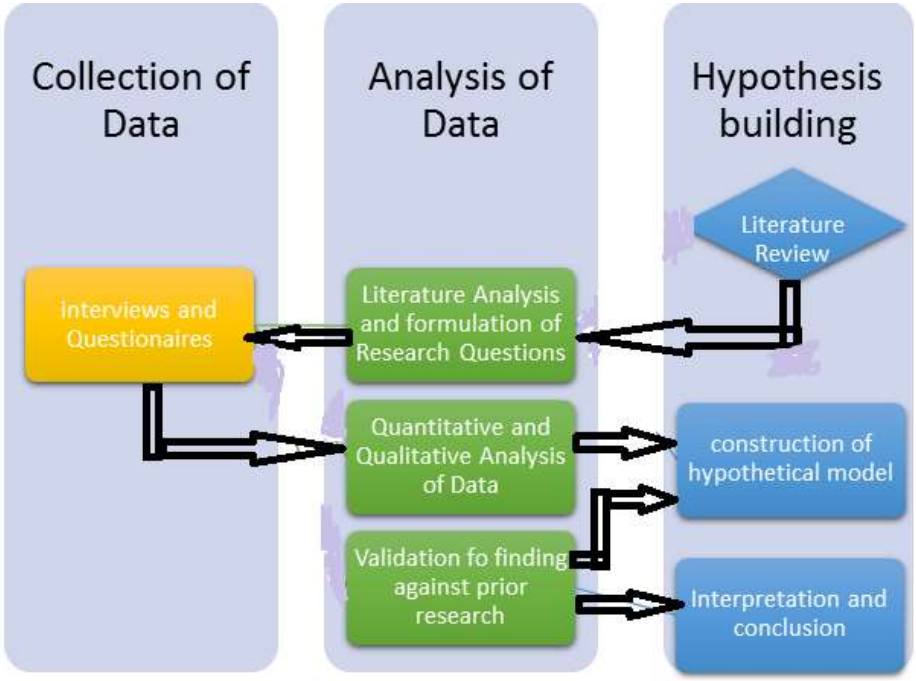


Figure 4. 1 : Summary of the Methodology

The mixed research methodology approach called concurrent embedded design was used to collect data in this study. The concurrent embedded design was the most appropriate design for this study as it enabled both qualitative and quantitative data to be collected at the same time. The primary method of data collection was qualitative. Therefore, the qualitative data guided the data collection processes while the quantitative data as a secondary method was embedded within the qualitative data collection tool and aimed at addressing different sets of questions.

4.1.1. Reasons for Choosing Mixed Research Methodology

The choice of the mixed research methodology was arrived at considering that according to Dawson C. (2007) neither qualitative nor quantitative research is better as both approaches are just different, and they have their strengths and weaknesses (Dawson, 2007). Further, according to Creswell J.(2009), the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone (Creswell, 2009). A major strength and advantage of utilising the qualitative method part in this study was the unique opportunity of accessing the many and different sources of quality data and scholarly information available about rural electrification across the globe.

4.1.2. Sampling of Respondents

A group of people and areas that would best provide information and participate in the research was purposefully selected. The sampling procedure was such that these individuals were in the energy sector. Several purposeful sampling strategies were available, each with a different purpose, however, expert purposive sampling was used with key informants. In the inclusion criteria, the respondents were working in public and private institutions within the energy industry and other stakeholder institutions. These were experienced professionals above the age of 18, with a minimum of two years industry experience They were classified as Registered Engineers, holders of a minimum of a degree qualification in engineering. The strategy approach was to use homogeneous sampling of these individuals to select the sample frame. The population covered engineering professionals with a survey population of electrical engineers from across the country. According to the Engineering Institute of Zambia (EIZ) data base, there were 1619 registered electrical engineers. The number of electrical engineers that were actively practicing was 1189 as per EIZ records, served as the sample frame. A study of the available experts was done by obtaining their classification from the EIZ database to confirm their suitability for the study. According to Beckstein et al (2014) calculations for determining, selection and sample calculation, sample size aim to select the number of participants in an experiment as economically as circumstances allow. Several calculation models have been proposed to determine the sample size of studies (Beckstein *et al.*, 2014).

For the sample size on the quantitative study, Hair J. et al (2017) suggest a rule of thumb of 10 samples per every measurement variable. Therefore, for the first questionnaire, 24 out of the 36

participants were available and made their contribution to this research. The responses from the first questionnaire were used to generate a second tool (Joseph F. Hair, William C. Black, Barry J. Babin, 2017).

For the quantitative, total population of 1619, a sample frame of 1189, the calculated sample size was 218. This was based on a sampling technique by Qualtrics XM an online calculator where the confidence level was set at 95 percent, referring to the amount of uncertainty that can be tolerated and a margin of error of 6 percent (Qualtrix XM, 2022). The standard deviation was set to 0.5 as this is useful in estimating how much the responses would vary from each other and from the mean number. As best practice for standard deviation, 0.5 was safe.

4.2. Research Methods

4.2.1. Introduction

Qualitative methods were used to identify the experts using purposive sampling. This was followed by a desk study to review available literature about the study subject. The desk study was used as a basis to design a questionnaire which was administered to key experts. The questionnaire was designed to collect information from the identified experts. The results from the study were analysed quantitatively.

4.2.2. Primary Sources of Data

Primary data was mainly collected by Qualitative Methods and included the following:

i Questionnaires - Questionnaires were designed to collect information quantitatively. The questionnaire was designed with three areas of focus, first part on the status of rural electrification, financing situation and lastly on the possible strategies for an improved rural electrification strategy. The questionnaires were used to gain feedback from the identified experts in the field, yet there was no definitive format for the questionnaire.

ii Semi-structured interviews - Preliminary investigations were carried out using semi-structured interviews to identify key issues relevant to the study. Case sampling was used to identify respondents (experts and individuals) who provided information according to their expertise in the energy sector. The respondents were drawn from key institutions including both the public and private sectors such as, ZESCO, Ministry of Energy, Ministry of Finance, Rural Electrification Authority, SMEC Pty Ltd, Bicon Zambia among others. The interview was

structured with questions tailored to aid the respondents about the study.

4.2.3. Secondary Sources of Data

Secondary data was collected by both quantitative and qualitative methods. The qualitative data was obtained through newspapers, diaries, transcripts, among others, while the quantitative data was obtained through survey, financial statements, and statistical information. A Desk Study was used to compliment the primary data, while secondary data sources were drawn from already existing literature. Secondary data was developed from desk review to fill in the gaps in the existing body of knowledge from the field data collected. Information reviewed during desk study included, textbooks, encyclopedias, news articles, articles, published academic papers, government documents, statistical databases, and historical records among others. Secondary data sources were used to develop a strategy for execution of the study.

4.3. Data Analysis

The process began with loosely structured questions and moved toward more quantifiable data patterns. Qualitative data collected from the questionnaires was analysed through thematic analysis by organising text data into categories. The categorised data constituted the primary data which was used to develop a secondary tool - questionnaire. Microsoft Excel was used to analyse the data by counts, frequencies, and percentages.

4.4. Scope and Limitation of the Study

The study was limited to the energy sector in Zambia. It covered rural electrification in general, narrowed down to rural electrification in Zambia, its challenges, and prospects. Access to local data and information on rural electrification in Zambia was a challenge. Documentation to support some arguments put forward by the experts was also a major issue of concern as it was not always possible to find supporting literature. When questionnaires were administered to the respondents, the responses took longer than anticipated and so due to the limited time for the research the researcher opted for interviewer-administered and online questionnaires. This is where the researcher records responses based on each respondent's answers. Lastly, the number of hard copy questionnaires collected/ received back was less than the number administered because not all respondents managed to complete answering the questionnaire due to their own personal commitments. The process was time-consuming. The data collection was generally successful.

CHAPTER FIVE

RESULTS

5.1. Data Collection Instruments

This chapter presents the results and analysis of the research findings concerning the research questions. It further captures the background of experts involved in the research, their qualifications, and their input to the research. The chapter is structured with the data collection instruments, response rate and bio data documented in section 5.1 and the results in sections 5.2 and 5.3.

The instruments used for data collection were hard copy and online questionnaires. The first questionnaire was used to solicit information on what was currently obtaining and also to provide guidance on weather rural electrification was a success or not. The second questionnaire was used to identify the gap and to suggest strategy for the best way to move forward. The number of questionnaires administered was based on the sample sizes presented in Chapter 3. The distribution of research tools was successfully conducted with the output presented in Table 5.1.

Table 5.2:Data Collection and Survey Response rate

No.	Description	Stage of administration	Administered / conducted	Received/ recorded	Response rate (%)
1	Print questionnaire	1	36	24	67
2	Online Questionnaire	2	218	151	69
3	Total	-	254	175	68

Once the respondents were selected, the first instrument was designed to select and understand the status of rural electrification and build a scope of the research. Due to the covid pandemic the first questionnaire did not yield the number of required responses. Therefore, the questionnaire was revised and moved to online presentation the list of respondents was secured from the EIZ database; it showed the number of registered engineers and those that were actively practicing engineering disciplines. The list is highlighted in Table 5.2

Table 5.3: Data Collection Instrument Administration

No	Institution/Sector	Respondents	Nature of participation
1	Engineering Institute of Zambia	2	Consultation to qualify participants
2	ZESCO limited	6	Questionnaire 1
3	Rural Electrification Authority	6	Questionnaire 1
4	Ministry of Finance	4	Questionnaire 1
5	Ministry/Department of Energy	6	Questionnaire 1
6	SMEC	1	Questionnaire 1
7	University of Zambia	3	Questionnaire 1
8	National Assembly	1	Questionnaire 1
9	All Energy Sector	151	Questionnaire 2

5.2 Stage 1 Results: Hard Copy Questionnaire 1

The findings indicate that RE had not performed well. Refer to Figure 5.1.

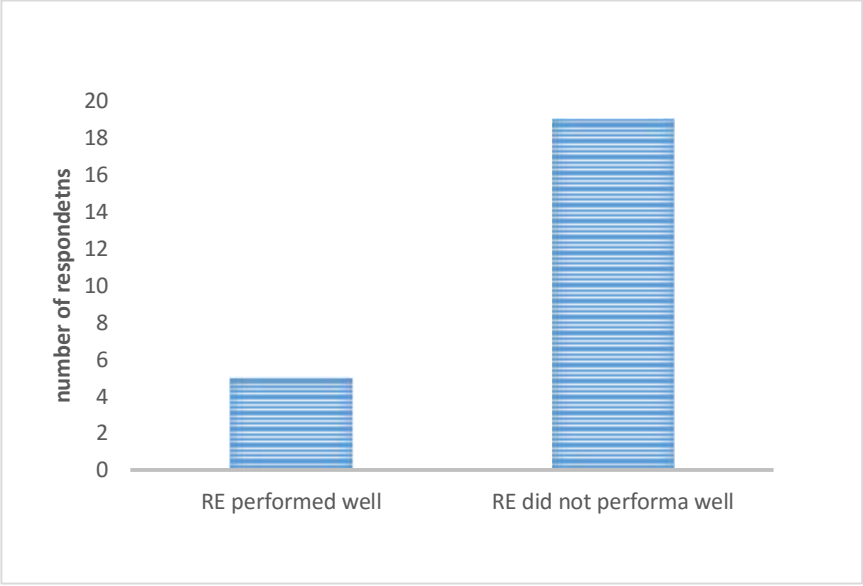


Figure 5. 1:Performance of Rural Electrification in Zambia

The feedback indicate that the majority of respondents were of the view that the RE had not performed well as highlighted in figure 5. The rest of the results are summarised in Table 5.3.

Table 5.3: feedback from questionnaire 1

No.	**what are the merits in terms of guideline and policy?**
1	clear policy and guideline supported by legal and institutional framework
2	policy guideline available
No.	**What are shortfalls?**
1	low funding for electrification requirement, to review management approach
2	low funding, high poverty levels
3	inadequate resource
4	REA hands over infrastructure to ZESCO at no cost
5	grid extension not good for current generation capacity,
6	priority list marred with political influence
7	slow progress
8	lack of funding
9	slow electrification, targets not met
No	**What are available sources of funding?**
1	Government support/appropriation
2	Donor Funds
3	Grants
4	Carbon Funds
5	Cooperating Partners
No	**Sustainable models to be adopted**
1	Revolving fund to finance new projects
2	Building on sustainable hybrid systems
3	A combination of private and public financing
4	Smart subsidy enhancement
5	Rural Electrification to return to being part of ZESCO with a focus on sustainable energy
6	Private public partnerships
7	Enhance legal framework
8	Fee for service model

5.3 Stage 2 and Final Results: Online Questionnaire 2

The second instrument: questionnaire 2 was developed based on the results of questionnaire 1. The results of questionnaire 2 are as follows;

5.3.1 Biography of Respondents

The results of the research culminate into the following results.

5.3.1.1 Distribution of Respondents by Sex and Age for Questionnaire 2

The survey showed that 67% of the correspondent were male while 33% were female, it showed that 60% of the correspondents were between the age of 37- 44 years, 30% of correspondents were between the age of 26-36 years, 10% were above 45, whereas no respondents were between 18-25 years. Refer to Figure 5.2.

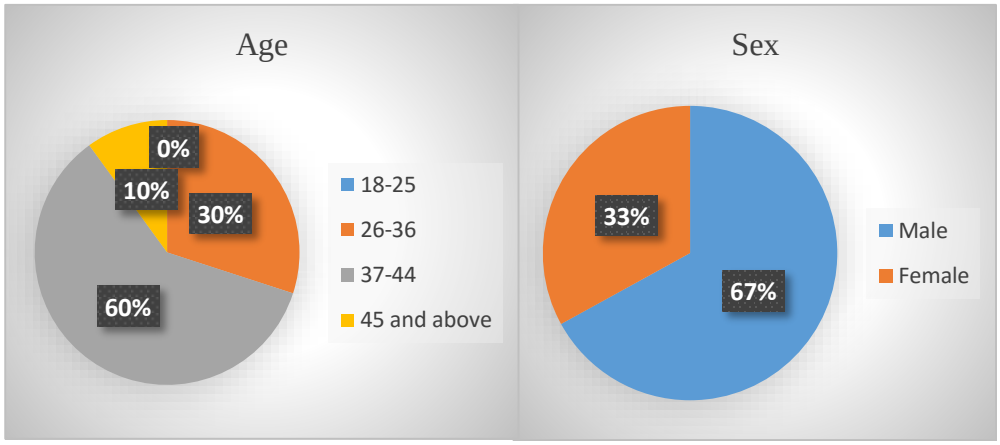


Figure 5. 2: Age and Gender Distribution of Respondents

5.3.1.2 Distribution of Respondents by Location and Connectivity

Figure 5.3 shows the distribution of correspondents by location and connectivity to electricity. The research showed that about 97% of the respondent were connected to the national electricity grid with only 3% not connected to the national grid. The results also show that the majority of the respondents were based in the urban area accounting for 63% and 37% in the rural area. The results showed a high connectivity rate in the urban areas compared to the rural area.

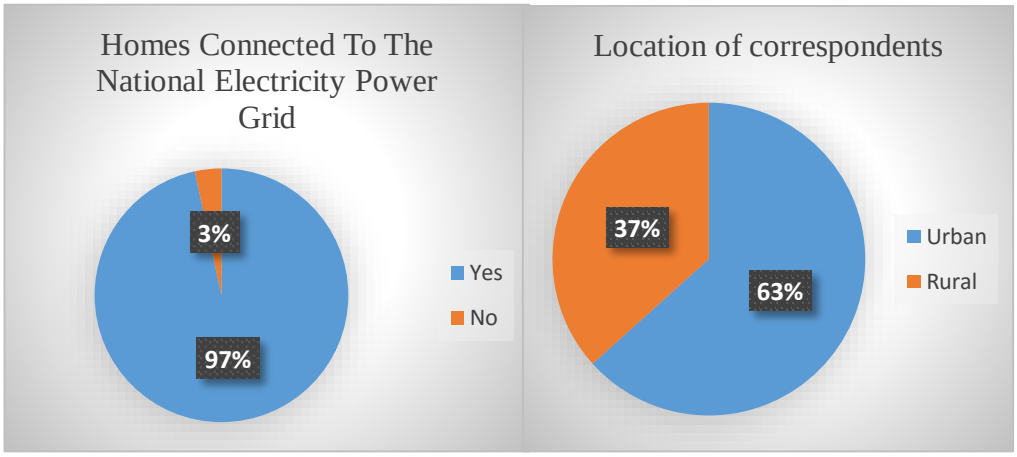


Figure 5. 3 Geographical and Connectivity status of Respondents

5.4. Stagnation in Rural Electrification in Zambia

The research results indicate short comings associated with the slow progress and stagnation of the electrification program in Zambia. From the desk review, successes in the electrification of both urban and rural areas were from 3% and 22% in 2006 to 3.7% and 67.7% in 2015 respectively. In 2006, the population of Zambia was 12.17million. The population rose to 15.6 million in 2015 and 18.38 million in 2020, at a point when the access rate was reported as 8.4% for the rural and 69.1% for the urban area (Zambia Statistics Agency, 2020).

5.5. Sources of Power

The study found that 91% of the respondent agreed that alternative sources of power would help increase rural electrification in Zambia. The respondents were aware of the alternative sources of energy such as solar, biomass, and wind. The respondents perceived that alternative power source would influence electrification rate positively as per Table 5.4.

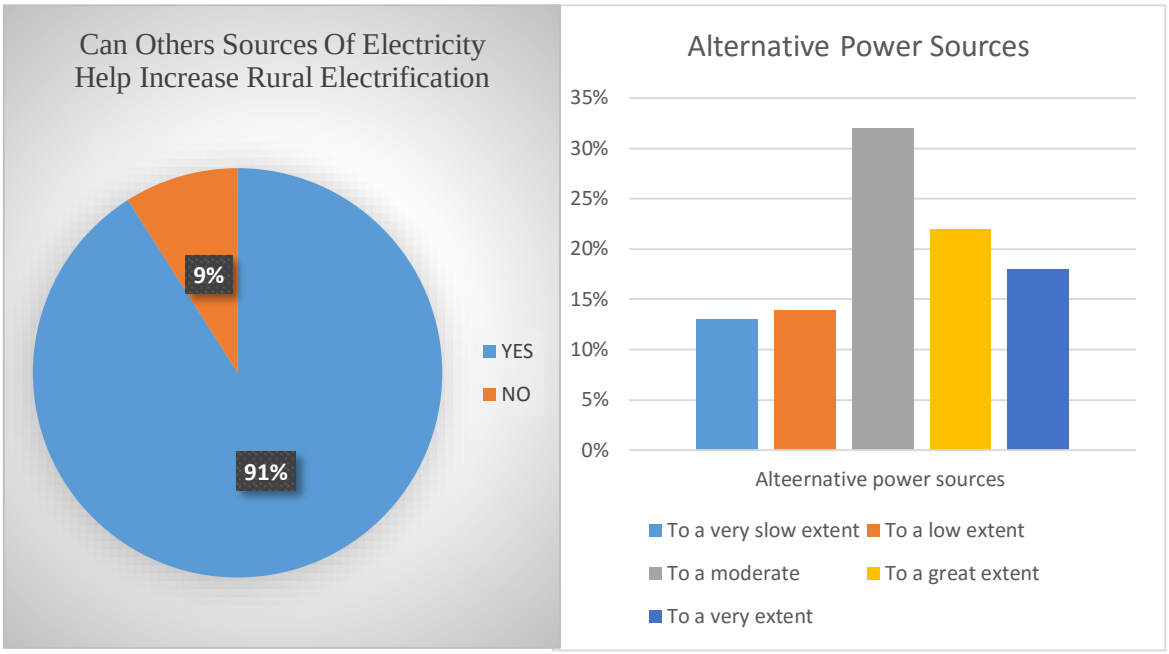


Figure 5. 4 : Impact of and Alternative Power Sources

The alternative power sources are seen as being relatively cheaper compared to extending the national grid.

The results show that others sources of energy were well accepted as an option to increase rural electrification. The survey results indicate that the time taken for a household to be provided with a service connection to electricity was generally long with 71% reporting that it took more than 90 days. The research also established that the rural electrification program did not achieve its mandate to electrify targeted facilities from 2015 to 2021, only 65% of the facilities were connected and 35% were not connected, refer to figures 5.5 and 5.6.

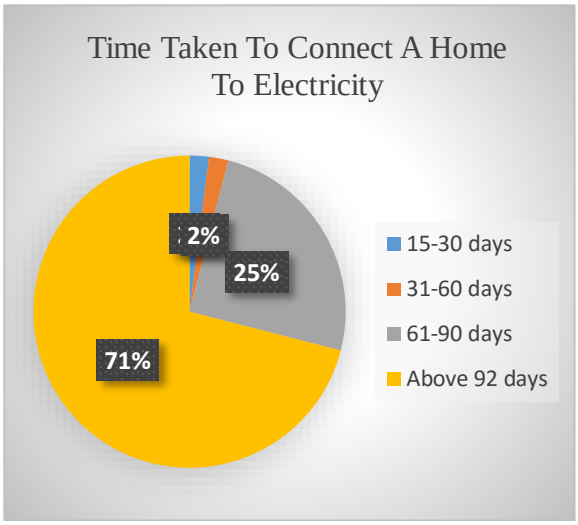


Figure 5. 6: Electricity Connection Time

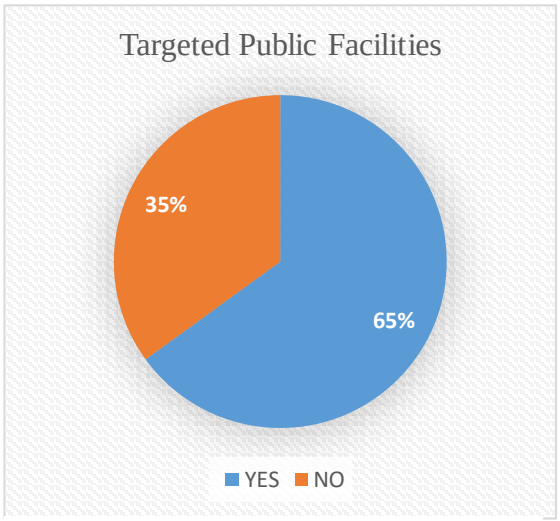


Figure 5. 5: Connection to electricity of Respondents

Figure 5.7 shows the power sources which were established under rural electrification program; hydro power was at 44 %, windmills at 41% and solar power at 16%. The responses indicate that alternative sources of power had been introduced but the actual uptake, installation and usage was still low. Therefore, the majority of the respondents still indicated that the RE program had not done well in Zambia at 51% while 49% thought that the program had done well.

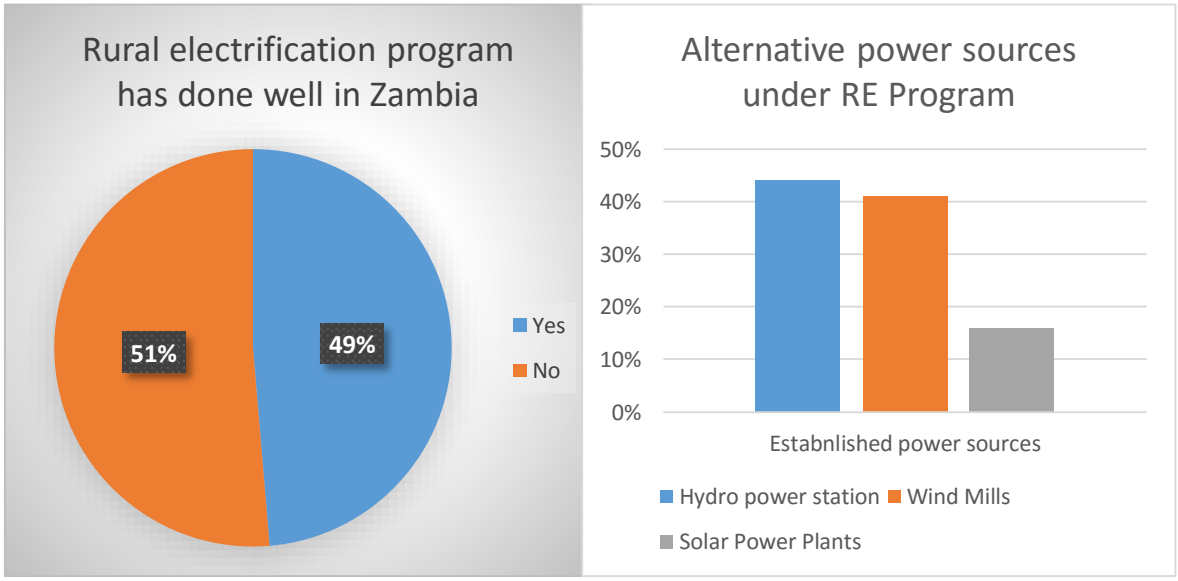


Figure 5. 7 : Perception of the Status of Electrification and available Power Sources

5.6 Shortcomings in the provision of rural electrification services

The critical shortcomings from questionnaire 1 were collected and revised into questionnaire 2. The results obtained are presented in table 5.8, these were the major hindrance to progress in rural electrification.

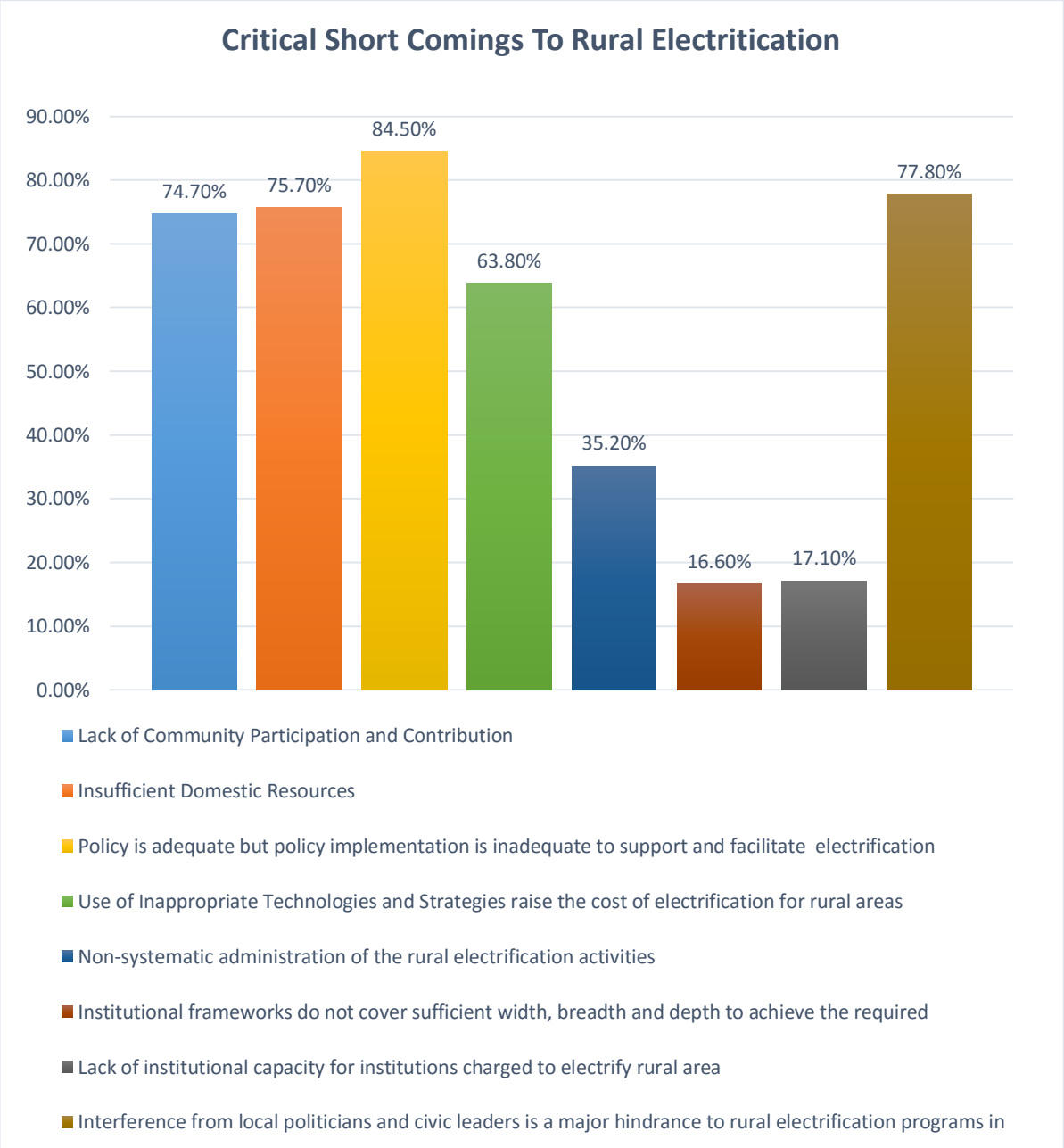


Figure 5.8 : **Shortcomings of the Rural Electrification Program**

The shortcomings were group together into four constraints as seen in Figure 5.10

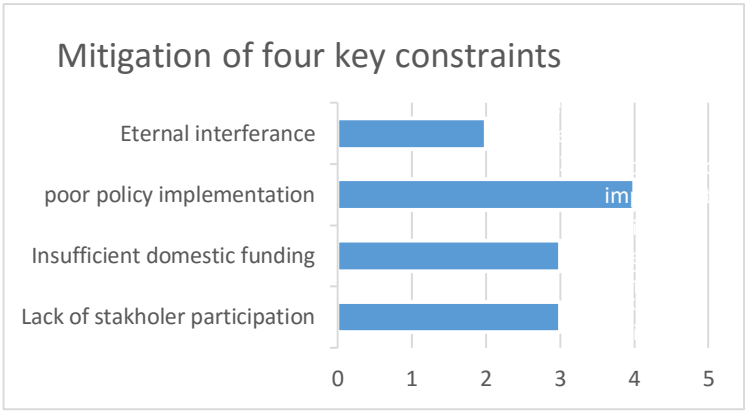


Figure 5.9: The four key constraints

The research should that mitigating he four constraints was one strategy to enhance electrification

5.7 Strategies to enhance access to electricity services

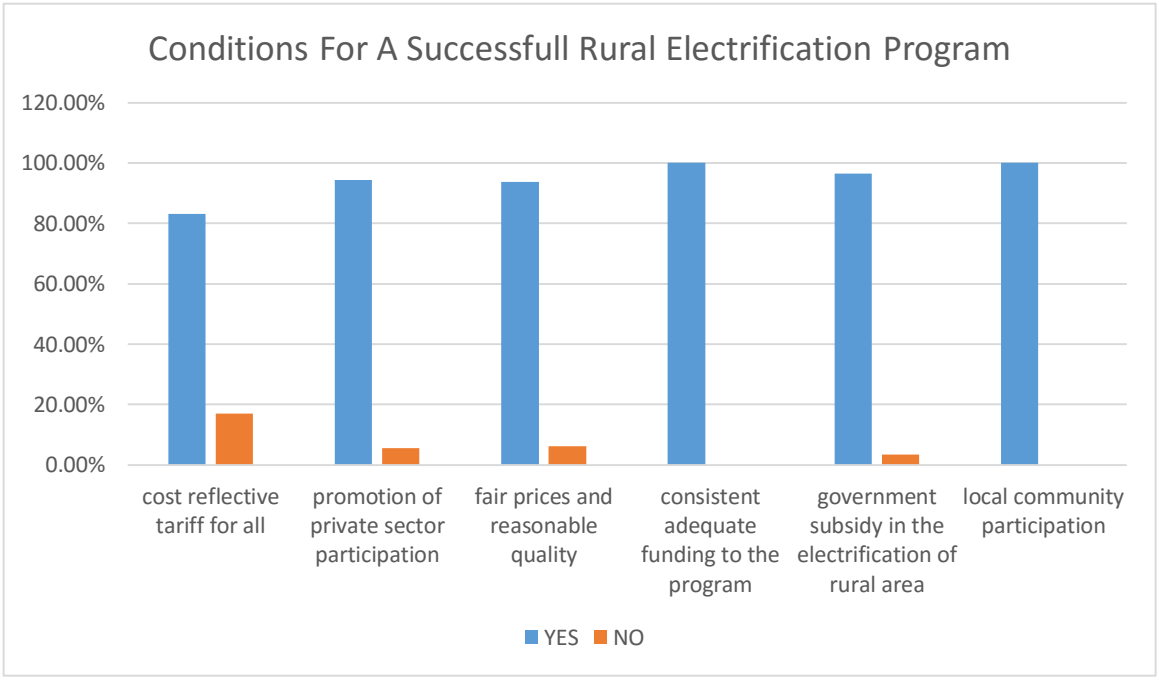


Figure 5.10: Strategies for a Successful Electrification Program

There were conditions which were preferred as necessary for a successful electrification. These have been proposed as strategy to achieve and improve rural electrification. The conditions that presented as success factors were seen as drivers to the promotion of the provision of electricity to

rural areas, which included, cost reflective tariffs, promotion of private initiatives and competition, fair price and consistent funding among others.

It was noted that these limitations if addressed in a systematic and strategic manner would provide an alternative pathway to increased rural electrification. The limiting factors would be aligned together as listed in figure 5.11.

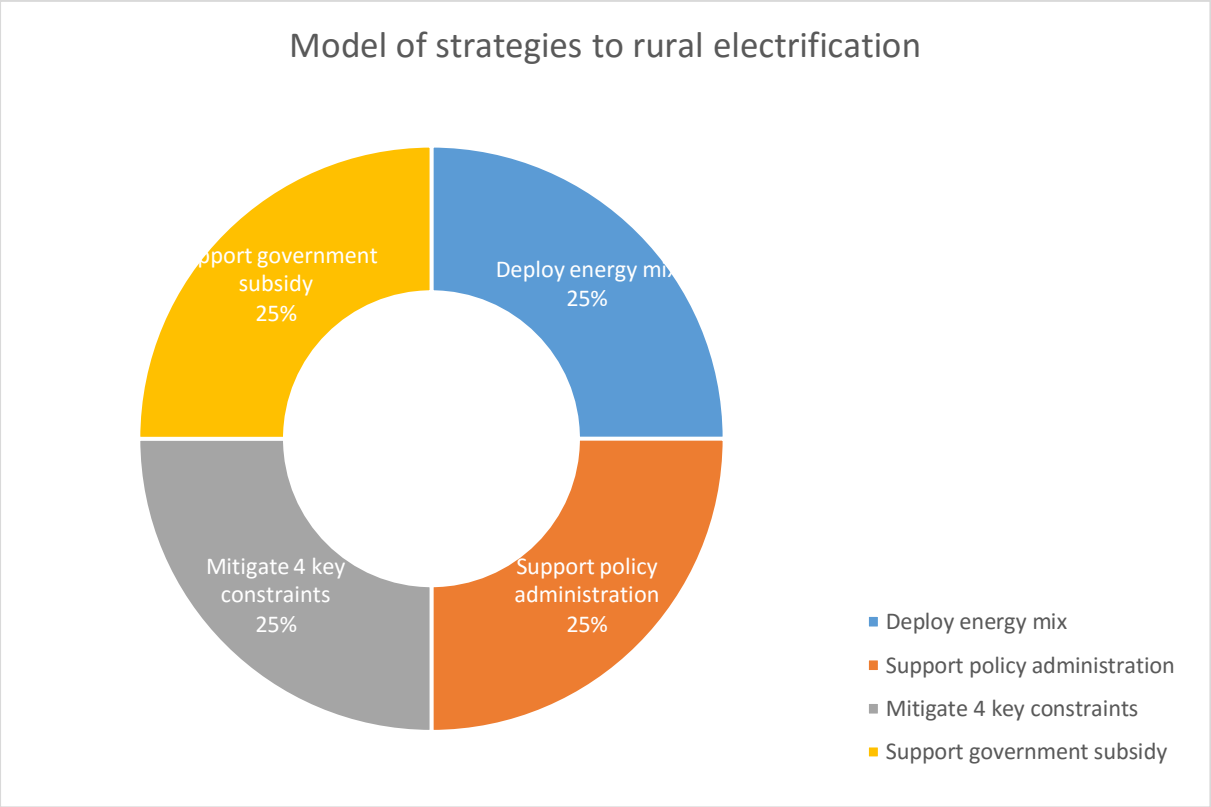


Figure 5.11: Model of Strategies to rural Electrification

Elojarvi et al (2014) asserts that despite the weaknesses, policy measures of RE in Zambia were sufficiently matched to the challenges RE was facing. The result from the questionnaires agrees with this conclusion, however, they go beyond literature by confirming how these challenges can be mapped into a strategy for rural electrification.

5.7 Chapter summary

Chapter 5 collects the results of the research as they were presented. The results are analysed by data triangulation and verification to draw conclusions and recommendations. The results present several challenges in the process of rural electrification.

CHAPTER SIX

DISCUSSION OF THE FINDINGS

6.1 Introduction

This chapter discusses and analyses the findings against the existing body of knowledge on rural electrification. The discussion provides a basis for comparison on how the research fits in to and contributed to the gap in the body of knowledge. The key results vis à vis research questions and objectives are discussed in this chapter.

6.2 Current Mechanisms Governing Rural Electrification in Zambia

As opined by Abdullah and Markandya (2011), Haanyika (2005), and Elojarvi et al (2014), that rural electrification must be governed by government policy direction, this research agrees that rural electrification in Zambia had a policy direction that was guided by government policy and regulation. However, this research further concludes that policy was not implemented as planned. That policy was not being implemented according to vision 2030 plan was seen in results as the targets of 15% rural access rate in 2015 was not achieved. This was seen as RE had not done well. The failure attributed to policy was not cited in literature thus adding to the existing body of knowledge.

The authorities needed to pursue new financing arrangements with various stakeholders, and, where necessary, make recommendations to the government through its responsible organs to facilitate the development and application of appropriate technologies through training and development of relevant skills. As opined by Markandya et al (2007) and Haanyika (2005), both studies observed that there is need for government to ensure that policies and legal/regulatory frameworks were supportive and current. Technology customisation to suit market needs was essential. Customisation of technology that takes into consideration the local user behavior, affordability and user preferences was important for designing successful programs and bringing the cost of electrification down.

As opined in the NAMA (2016), subsidies should be applied only to cushion the capital cost of electrification projects, however, they strongly disagreed with the use of tariffs that did not cost reflect. Grid extension was the most widely used technology for RE in Zambia. It was costly as it did not reflect the needs analysis of the communities in which other technologies like solar, biomass and wind energy could be used. From the repeated rounds of questionnaires, it was noted that RE was costly irrespective of the technology used. This was attributed to the fact that nearly all materials used for electrification, it be grid extension or solar PV, were imported from other countries which agrees with Chirambo (2012) who states that affordability is the major cause of a lack of access to electricity. This was compounded by the sparse population in Zambia whose communities were typically in scattered communities. Clustered communities were usually found around some commonly used facilities and infrastructures like a school, a Rural Health Centre or marketplace.

The key result on the benefits of electricity was that investment in renewable energy space would not only promote the productive uses of energy but also indirectly support other socio-economic and environmental objectives, most notably poverty reduction through employment creation. Investment in the energy sector would also support action on climate change mitigation and adaptation. This position could be confirmed from the lessons learnt on the Chinese electrification where the rural areas were economically significantly developed.

From the reviews, the data showed that rural communities had low finances and could not afford the cost of household electrification. Settlements in rural Zambia were sparsely located in small clusters. Communities considered electrification as the sole responsibility of the government.

As asserted by Ibrahim et al (2017 rural electrification business was not necessarily profitable such that most business entities would shun the sector. Hirmer (2014) agrees with this conclusion and further indicates that the international community provided financing for rural electrification projects through several models and structures to enhance rural energy development. But no significant improvement was recorded. The results agree with literature as the collected data showed very low participation of the private sector in RE programs. Further, there was very little mention of the private sector participation in RE programs.

6.3 Causes of Stagnation in Rural Electrification

The following discussion explains what is causing stagnation in RE as per the findings from the questionnaires.

6.3.1 Non-Systematic Administration of the Rural Electrification Activities

According to the literature reviewed, the overall management of the rural electrification program was vested in the Ministry of Energy. Ideally, the ministry has delegated this responsibility to the Rural Electrification Authority. The Rural Electrification Authority was established by an act of parliament in 2003 as a special purpose vehicle to create electricity infrastructure for the rural areas. However, in practice, other entities were also funded to implement energy projects in the rural space. It was noted that the Ministry of Energy (other sections), Ministry of Education, ZESCO were among the GRZ institutions constructing in the rural areas using different plans other than the REMP. There was duplication and overlapping in the planning and implementation of activities thus implementation was not evenly distributed across the country. This raised a challenge in the allocation of resources to the implementing entities and choice of implementation area. This had also resulted in the slow roll-out of the REMP and had created a backlog of areas to be electrified. This nonsystematic administration of the rural electrification activities made it difficult to achieve the REMP targets and/or distribute electrification programs evenly across the country.

6.3.2 Insufficient Domestic Resources

The REMP was developed to guide the government on the proposed distribution of infrastructure development to cover the country through to 2030. The REMP provides a roadmap with associated project costs. According to the REMP, the government was expected to spend approx. $50,000,000.00 (K230, 000.00) every year from the time of developing the REMP in 2008. However, documented evidence from the Rural Electrification Authority and the government's capital expenditure plan (the yellow book), showed that the government allocated less than 50% of this amount every year from 2006 to 2015. The government through the Vision 2030 Plan had targeted to electrify rural areas to 51% by 2030, but in 2014 the rate was at 3.7%. The implementation plan was behind schedule. The Vision 2030 was backed by the 7NDP.

6.3.3 The High Cost of Infrastructure and Use of Inappropriate Technologies and Strategies

The study concluded that Zambia was focused on conventional 3phase system grid extension to provide electricity to the rural communities. For the sparse population of Zambia, this was not financially justified considering the immediate use of this electricity was mainly domestic. From the review, the cost of rural electrification was considerably reduced when the choice of technology was chosen based on the energy needs analysis of the end users.

6.3.4 Lack of Human Capital

From the interviews conducted, it was noted that donor dependency and its effects on budgeting and implementation was a major challenge. The role of donors was ambiguous in that they pushed for RE and provided major parts of the budget (capital support) while utilities were faced with barriers related to high workload on employees and lack of expert personnel in RE. Donors had provided huge sums of money towards capital expenditure and not towards the management of the same: the situation was improving in the 90s that donors were attaching some amounts of money to Technical Assistance which included training personnel. It was evident that attending to the lack of human capital required proactive and long-term capacity building.

Zambia had inadequate human capacity to effectively implement rural electrification programs with the appropriate technologies and expertise. The inadequate human capacity was attributed to inadequate training institutions specialised in rural electrification technologies and strategies. This study further concludes that where training was available, it was not energy-specific and therefore limited in terms of specialization. In as much as Technical Vocation Centers were involved in training courses in general electricity and specialisation in maintenance of electric equipment at certificate level and Diploma level (college certificates), they were not sufficient.

6.3.5 Lack of Community Participation and Contribution

The study concluded that most communities did not align themselves with electrification projects as electrification was deemed a government responsibility. A lack of participation and ownership

from the rural communities reduced the chance of sustainability of infrastructure. The results indicated that when community where not engaged, there was no buy-in on the projects and chances were high that the implementation would be challenging and sometimes the projects ended up failing. Comparatively, China's success of electrification hinged in part on the participation of beneficiary communities.

The study identified financing sources that were in use as from, cooperating partners, GRZ and the private sector. The funding was administered through several instruments, government funds (taxes and levies), grants, loans, subsidies, and public-private partnerships.

6.4 Strategies to enhance an increase in access to electricity services

According to the World Energy Outlook Report (2015) and United Nations Development Report (2014), one of the requirements of economic growth was to provide energy, particularly electricity to the country population.

The studies by Abdullah and Markandya (2007) and Haanyika (2005) assert that the electricity industry is made up of a complex system where different factors interact to influence the demands of the different consumers. In the same vein, this research concludes in the second and final questionnaire results that there was no single reason for slow pace of rural electrification; there were several issues that need to be addressed together in order to enhance rural electrification. This research collects these factors by a weighted score system which has not been done anywhere in literature thereby contributing to the body of Knowledge.

The results showed that if subsidy and tax were implemented correctly, private and community participation promoted and the electrification was supported politically, great success would be achieved.

However, the desk review noted that, the REMP which is, the guiding document for rural electrification in Zambia was drafted in 2006 and operationalised in 2008, it had not been revised since. Other relevant and current documents included, the NEP, Vision 2030 and the 7SNDP. The technologies that were promoted then had evolved and improved significantly since the operationalisation of the master plans for rural electrification. As of 2008, the choice of electrification method was limited to solar and hydropower development and was area-specific

i.e., some areas were small and remote and earmarked for development using solar and Hydro grid extension for urban and large rural areas. With the lapse in time coupled with new developments in the industry, there was a need to update not only the electrification technologies but the financing mechanisms as well.

From the study, it is noted that the World Bank proposes that the success of rural electrification is a result of Governments' emphasis on providing electricity. The World Bank's recommendation stems from the lessons learned from China's near 100% rural electrification whose government prioritised national electrification. Poon, Chun Yu Jonathan reports that strong government commitment, active local participation, technological flexibility and diversity, strong emphasis on rural development through agricultural and industrial activities and an emphasis on capacity building and training played an important role in the success of rural electrification in China. Electrification projects were usually not financed by market mechanisms; rather, financed by government or with the help of international funding. In comparison, rural electrification in Zambia was low because the government had not dedicated sufficient support and resources as required.

The main proponent of RE in Zambia was politically motivated i.e., when government campaigns and programs played a major role, however, this did not mean sufficient resources. From the literature reviewed, political priorities had the potential to undermine and/or support the RE activities. Priority was the privy of the political and government's interest at the time.

Kenya provides a good example of planning and implementation of the rural electrification program where all institutions provided submissions of all national infrastructures in the country to the Rural Electrification Agency at the local level. Kenya had established presence at the local level across the country whose planning activities were fed into the national planning structures. Rural electrification in Zambia was done by several institutions compared to the case in Kenya which had achieved significant progress. Rural electrification in Zambia was vested in the Rural Electrification Authority by an Act of Parliament. REA was under the Ministry of Energy. This did not reflect what was on the ground as other entities were also implementing rural electrification by the same standard.

Kankam and Boon (2009) and Barnes and Foley (2004) assert that RE was slow in Zambia.This was confirmed by the low rate of electrification. They further assert that the government of Zambia had been promoting private sector-led development as the key to electrification in general. The legal and institutional framework was appropriately adapted to encourage and promote private sector investment by both foreign and local investors. The government encouraged both foreign and domestic investment and had steadily pursued a policy of improving the investment climate by reducing bureaucracy, streamlining the legal framework, fighting corruption, and maintaining a stable economy. However, in as much as the government made all these efforts, government funding to the rural electrification program was not sufficient to meet its own targets. Further, private sector involvement was still very low despite government policy improvements. The study concludes that RE development needed huge financial and skills investment among other things.

6.5 Summary of Findings

The reviewed and analysed mechanisms governing electrification in Zambia were frustrated by the many challenges surrounding policy, financing and management of electrification programs. In summary, policy was sufficient but was not able to achieve the intended results of increased rural electrification. This failure drove to the conclusion that it was not policy alone that was required to move the numbers The available resources for RE program were not adequate for the planned targets of RE. The study indicates that electrification targets may not be met due to limited resource envelope (2008 to 2017) compounded by the increase in population (increased demand for power) from approximately 11 million in 2008 to 18 million in 2018 unless the approach changes.

The study established a significant number of short comings of RE. It was concluded that there were many shortcomings that contributed to the low levels of electrification. However, only the four constraints, mitigated as one strategy, would aid increased access to electricity services.

6.6 Limitations of the Study

The emphasis of this research is from a financing and implementation perspective for the rural electrification program but also some issues related to the challenges on the lack of electricity, technical expertise, and sustainability of the program were reviewed. There is still much work to be done to increase the access rate to energy services in Zambia. Further research in applying a user-centric approach is vital to identify the appropriate contributions and involvement of the communities to the provision of energy services.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

7.1. Introduction

The chapter consists of conclusions and recommendations. The chapter is divided into three sections. The first section (7.1) is the introduction, section 7.2 consists of the general conclusions. While Section 7.3 is the Policy implications of the findings and 7.4 concludes with recommendations for improvement.

7.2. General Conclusions

This research analysed the rural electrification program in Zambia from a financing and implementation perspective and pointed out what is needed to be done to enhance the rural access rate to energy services.

There were many shortcomings in the process of rural electrification. However, the research concludes that the four key constraints were i) inadequate domestic funding ii). Lack of collaboration among the various stakeholders to participate, coordinate the implementation, operation, and maintenance of rural electrification projects. The private sector participation in the energy sector was very low; with no proper coordination between government and the private sector coupled with relatively low electricity tariffs which made it difficult to invest in the sector.

While literature showed the mechanism governing electrification in Zambia as, government regulation, policy and acts of parliament which were deemed sufficient to counter the challenges faced by the rural electrification program, this research noted that the actual iii) implementation of regulations and policy was limited. However, the governments' commitment was evident through deliberate policy direction and a subsidised electricity tariff scheme. The Policy Report on the Electricity Sector in Zambia reports that the country had one of the lowest electricity tariffs in Southern Africa and these tariffs were non-cost-reflective; the tariffs deterred new investments in the sector. The study concluded that even though the tariffs were subsidised, they were high in the face of the communities regarding the country's economic

status. This had not been sighted in any of the studies reviewed. The fourth key constraint was that the actual implementation of rural electrification was marred with interference from different stakeholders, starting with the proposed beneficiary communities not buying into the projects. Political interference was cited as an area where politicians and their groupings used provision of electricity as a campaign tool and thus diverted the provision from recommended guidelines.

To counter the constraints, the study suggests strategies to increase RE as follows:

i) Deployment of energy mix, using solar, wind, and biogas as alternative energy sources to hydro;
ii) Mitigating the four key constraints;
iii) Support policy and regulation to support implementing agencies including private and public institutions;
iv) promote continued use of subsidy. The research concluded that there was slow connections and uptake to electricity services even in areas where infrastructure was available.

The government had made plans to electrify rural areas to 15% by 2015 and 51% by 2013 from a rural access rate of 3% in 2006, but only 8.4% was reported in 2018. The research recommendations are that the Government of Zambia remains committed to rural development through strategies highlighted and provide sufficient funding in line with the target electrification rate. These strategies could also work to empower, ensure participation and ownership from the rural communities so that they would be able to pay for the electricity services and ultimately improve their livelihoods.

7.3 Policy implications of the findings

Based on the findings of the research, the policy implications of the study on the strategies for rural electrification on Zambia's electricity sector are listed below in no particular order and are general in nature: -

i The RE Act approved financing to the REF from three sources, however, the resources obtained as such are channeled to government general account. Government then provides an allocation towards rural electrification programmes at its own discretion. The research concludes that the allocation falls far below the numbers generated from electricity levy

alone. Therefore, administration of the REA Act as was intended would see an increase in rural electrification funds if the policy is implemented accordingly.

ii The research concludes that success of electrification largely depends on availability of adequate financing. Policy could be adequate but would only be effective if supported by the right funding levels and policy enforcement.

iii Migration to cost reflective tariff with support legislation for low-income households requires deliberate investment to study the impacts and outcomes of the cost-reflective tariff. Arguably, this will spur private sector participation in the energy sector.

iv Private sector participation is very limited with only five (5) private companies generating electricity, therefore investment in policy development would encourage and incentivise private sector investment in the energy sector.

v The energy generation mix options, if explored through deliberate national investment in solar, biomass and wind systems would be economical for specific use.

vi Provision of energy services could have a direct link on the national economy with respect to improved livelihoods not only in rural areas but urban areas too.

7.4. Recommendations for improvement

The major lessons learned from the study and its principal recommendations are listed below.

i There is a need for Zambia as a country to invest in alternative sources of energy. The recommended alternative sources are biomass, wind, and solar systems. These were considered to be cost-effective.

ii There is a need to review the policy framework to promote improved participation of the beneficiary communities and the private sector.

iii The government to promote governance and institutional frameworks based on partnerships between government, private sector, and communities that will help scale up rural electrification.

iv It is recommended that this current study be followed up with a design exercise to review the Rural Electrification Master Plan (REMP) to include all other technologies as the current one was drafted in 2006 with only hydro and solar sighted as the source of power.

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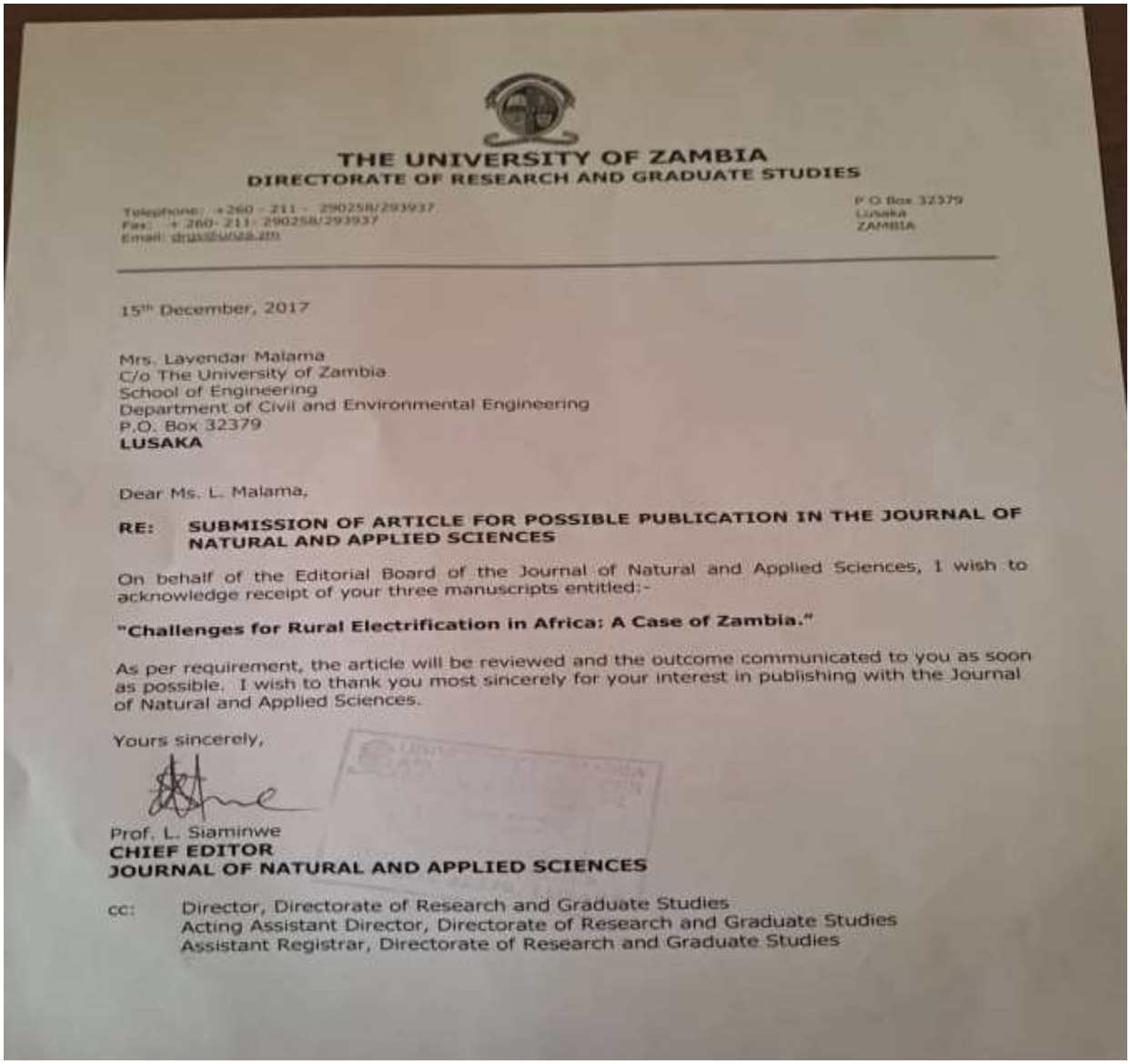
Appendix A: Proof of submission of the Journal

A journal of **"Challenges for Rural Electrification in Africa: A Case of Zambia"**



THE UNIVERSITY OF ZAMBIA
DIRECTORATE OF RESEARCH AND GRADUATE STUDIES

Telephone: +260 - 211 - 290258/293937
Fax: + 260- 211- 290258/293937
Email: drgs@unza.zm

P.O Box 32379
Lusaka
ZAMBIA

15th December, 2017

Mrs. Lavendar Malama
C/o The University of Zambia
School of Engineering
Department of Civil and Environmental Engineering
P.O. Box 32379
LUSAKA

Dear Ms. L. Malama,

RE: SUBMISSION OF ARTICLE FOR POSSIBLE PUBLICATION IN THE JOURNAL OF NATURAL AND APPLIED SCIENCES

On behalf of the Editorial Board of the Journal of Natural and Applied Sciences, I wish to acknowledge receipt of your three manuscripts entitled:-

"Challenges for Rural Electrification in Africa: A Case of Zambia."

As per requirement, the article will be reviewed and the outcome communicated to you as soon as possible. I wish to thank you most sincerely for your interest in publishing with the Journal of Natural and Applied Sciences.

Yours sincerely,

Prof. L. Siaminwe
CHIEF EDITOR
JOURNAL OF NATURAL AND APPLIED SCIENCES

cc: Director, Directorate of Research and Graduate Studies
Acting Assistant Director, Directorate of Research and Graduate Studies
Assistant Registrar, Directorate of Research and Graduate Studies

Appendix B: Questionnaire 1 – Hard Copy

TOPIC: **DEVELOPMENT OF A FINANCING FRAMEWORK FOR THERURAL ELECTRIFICATION PROGRAM IN ZAMBIA**

This questionnaire requests your support and participation in a research study to develop a framework on rural electrification financing strategies being undertaken in partial fulfilment of the Master of Project Management, a program under the University of Zambia.

BACKGROUND

The lack of electricity in the rural areas contributes to problems faced by individual households, global climate change, greenhouse effect and large-scale deforestation and land degradation. In Zambia, the rural electrification program was created whose aim was to deliver power to the rural parts of the country, however, access to electricity stands at 3.7% in 2015 (Central Statistics Office, 2015) from 3% in 2004 (Government of the Republic of Zambia, 2006). The low electrification rate is largely due to low levels of funding and low donor support to the rural electrification program (Rural Electrification Authority, 2015) thus the research seeks to bridge this financing gap for the Rural Electrification Program.

I anticipate drawing on your vast knowledge of rural electrification programs in order to make this undertaking a success.

In this research study I want to identify:

- What are the current financing mechanisms for rural electrification?
- How adequate are the current financing mechanisms for Africa?
- What are the limitations of current financing mechanism?
- How will the framework be adapted to the Zambian situation?

My research goals are to complete this relatively study and also use the results to design and develop a framework customised to the Zambian situation.

I hope you will agree to participate in the Study.

THE UNIVERSITY OF ZAMBIA

DIRECTORATE OF RESEARCH AND GRADUATE STUDIES (DRGS)

MASTER OF PROJECT MANAGEMENT

THE QUESTIONNAIRE

DEVELOPMENT OF A FINANCING FRAMEWORK FOR RURAL ELECTRIFICATION PROGRAM IN ZAMBIA

1. Do you think the rural electrification program has done well in Zambia?

   YES ☐ NO ☐

2. If the answer is yes, go to 3, if not, go to 4
3. What are the merits in terms of policies and guidelines?

   _____

   _____

   _____

4. What are the short falls?

   _____

   _____

   _____

   _____

5. What are the available sources of funding?

   _____

   _____

   _____

   _____

6. How accessible are these finances?

   _____

   _____

_____

_____

7. What are the financing mechanisms for rural electrification program in Zambia today?

_____

_____

_____

_____

8. What are the critical factors required for rural electrification financing?

_____

_____

_____

_____

9. In your opinion, what sustainable model of financing can we adopt?

_____

_____

_____

_____

10. What are the most desirable conditions for a successful rural electrification program?

    10.1 Universal access: YES [ ] NO [ ]

    10.2 Subsidiarity of the State in the electrification of rural areas: YES [ ] NO [ ]

    10.3 Local community participation: YES [ ] NO [ ]

    10.4 Fair prices and reasonable quality: YES [ ] NO [ ]

    10.5 Promotion of private initiative and competition: YES [ ] NO [ ]

    10.6 Cost reflective tariff for all: YES [ ] NO [ ]

_____

_____

_____

_____

11. What other factors NOT listed in 10 would be ideal to promote rural electrification in Zambia?

11.1

11.2

11.3

11.4

11.5

12. What would be required to increase participation of the private sector?

_____

_____

_____

_____

12. What would be the ideal way to raise funds for rural electrification?

_____

_____

_____

_____

13. What would be the role of subsidies and to what extent should they be applied?

_____

_____

_____

_____

14. In your opinion, what are we doing incorrectly for rural electrification in Zambia?

_____

_____

_____

_____

THANK YOU

Appendix C: Questionnaire 2 – online questionnaire

THE UNIVERSITY OF ZAMBIA

DIRECTORATE OF RESEARCH AND GRADUATE STUDIES (DRGS)

MASTER OF ENGINEERING IN PROJECT MANAGEMENT

I am conducting research entitled "Strategies for increasing access to electricity services for the rural electrification program in Zambia" and would be very grateful if you could respond to the questions in this questionnaire. The questionnaire is administered for the purpose of collecting data on rural electrification in Zambia for academic purpose only. Any information given shall be held in confidence and not used for any other objective contrary to the stated purpose.

1. *Age*
   - *A. 18- 25*
   - *B. 26- 36*
   - *C. 37- 44*
   - *D. 45 and above*

2. *Sex*
   - *A. Male*
   - *B. Female*

3. *Are you connected to the national electricity power grid?*
   - *A. YES*
   - *B. NO*

4. *Are you based in urban or rural area?*
   - *A. Urban*
   - *B. Rural*

5. *What is your highest level of education?*
   - *A. Post Graduate/Graduate*
   - *B. Undergraduate*
   - *C. Diploma*
   - *D. Below grade 12*

6. *Do you think the rural electrification program has done well in Zambia?*
   - *A. Yes*
   - *B. No*

7. *If the answer is yes, go to 7, What are the merits in terms of policies and guidelines? if no go to 9*

   ……

   ……

   ……

8. *What are the available sources of funding?*
   A. *Donor funding*
   B. *Government funding*
   C. *ZESCO funding*
   D. *Public private partnership*

9. *What are the most desirable conditions for a successful rural electrification program?*

	YES	*NO*
Local community participation		
Subsidiarity of the State in the electrification of rural areas		
Consistent and adequate funding to the program		
Fair prices and reasonable quality:		
Promotion of private initiative and competition		
Cost reflective tariff for all		

10. *What other factors NOT listed in above would be ideal to promote rural electrification in Zambia?*

    ……

    ……

    ……..

11. *In your opinion, what are we doing incorrectly for rural electrification in Zambia?*

……
……
……
……

12. *From my earlier survey, a number of experts agreed that there was considerable improvement to rural electrification and that more people had access to power now than 10 years ago. What would you attribute this improvement to?*
    A. *Policy development*
    B. *Improved institutional framework*
    C. *Improved financing program*

13. *There are several short comings that have been cited as critical contributors to the poor performance of rural electrification. Kindly indicate your level of agreement with the following statements, on a scale of 1-5, where 1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree.*

	1	*2*	*3*	*4*	*5*

14. *What are some of the facilities that have been established since rural electrification was rolled out to increase access to electricity?*
    A. *Hydro power station*
    B. *Wind mills*
    C. *Solar power plants*
    D. *None*

15. *What are the key beneficiary facilities to rural electrification programs?*
    A. *School*
    B. *Health post*
    C. *Chiefdom*
    D. *Private Homes*
    E. *Markets*
    F. *Businesses*

16. *Have all the targeted public facilities been electrified for 2016 and 2021?*
    A. *Yes*
    B. *No*

17. *If your answer is NO question 17 what are the challenges which were faced*

    ……

    ……

18. *Indicate your level of agreement with the following Strategies to improve management and provision of access to electricity.*

Use a scale of 1-5, where 1- strongly disagree, 2- disagree, 3- neutral, 4- agree, 5-strongly agree.

	1	*2*	*3*	*4*	*5*
Community Participation and Contribution					
There is enough awareness of other available power sources other than grid connection					
Promote systematic administration of the rural electrification activities					
Alternative sources power are more reliable as compared to the national grid.					
People generally appreciate the benefits of power and will chose the option best suited to their needs, whether connection to the grid or other sources.					
The type of power source used depends on individuals' level of income					

19. *To what extent do the alternative power sources influence electricity access?*
    A. *To a very low extent*
    B. *To a low extent*
    C. *To a moderate extent*
    D. *To a great extent*
    E. *To a very great extent*
20. *How long does it take to connect a home to electricity?*
    A. *15-30 days*
    B. *31-60 days*
    C. *61- 90 days*
    D. *Above 92 days*
21. *Do you think the use of other sources of electricity can help increase rural electrification?*
    A. *Yes*
    B. *No*
22. *If Yes to the above question what sources of electricity can be used?*

    ……

    ……

    ……
23. *Do you think reducing tariffs and removing subsidies on electricity connection rate in rural area would increase rural electrification?*
    A. *Yes*
    B. *No*

Appendix D: Electrification Rate in Africa as of 2018

SOURCE: IEA, World Energy Outlook 2015

Electricity access in Africa – 2013

Region	Population without electricity millions	National electrification rate %	Urban electrification rate %	Rural electrification rate %
Africa	**635**	**43%**	**68%**	**26%**
Sub-Saharan Africa	**634**	**32%**	**59%**	**17%**
Angola	*15*	*30%*	*46%*	*18%*
Benin	*7*	*29%*	*57%*	*9%*
Botswana	*1*	*66%*	*75%*	*54%*
Burkina Faso	*14*	*17%*	*56%*	*1%*
Burundi	*10*	*5%*	*28%*	*2%*
Cameroon	*10*	*55%*	*88%*	*17%*
Cabo Verde	*0*	*94%*	*100%*	*84%*
Central African Republic	*5*	*3%*	*5%*	*1%*
Chad	*12*	*4%*	*14%*	*1%*
Comoros	*0*	*69%*	*89%*	*62%*
Congo	*3*	*42%*	*62%*	*5%*
Côte d'Ivoire	*15*	*26%*	*42%*	*8%*
Democratic Republic of Congo	*61*	*9%*	*19%*	*2%*
Djibouti	*0*	*50%*	*61%*	*14%*
Equatorial Guinea	*0*	*66%*	*93%*	*48%*
Eritrea	*4*	*32%*	*86%*	*17%*
Ethiopia	*71*	*24%*	*85%*	*10%*
Gabon	*0*	*89%*	*97%*	*38%*
Gambia	*1*	*36%*	*60%*	*2%*
Ghana	*7*	*72%*	*92%*	*50%*
Guinea	*9*	*26%*	*53%*	*11%*
Guinea-Bissau	*1*	*21%*	*37%*	*6%*
Kenya	*35*	*20%*	*60%*	*7%*
Lesotho	*2*	*17%*	*43%*	*8%*
Liberia	*4*	*10%*	*17%*	*3%*
Madagascar	*20*	*15%*	*37%*	*4%*
Malawi	*15*	*9%*	*32%*	*4%*
Mali	*11*	*26%*	*53%*	*9%*
Mauritania	*3*	*28%*	*47%*	*2%*
Mauritius	*0*	*100%*	*100%*	*100%*
Mozambique	*16*	*39%*	*66%*	*27%*

Region	Population without electricity millions	National electrification rate %	Urban electrification rate %	Rural electrification rate %
Namibia	*2*	*32%*	*50%*	*17%*
Niger	*15*	*15%*	*62%*	*4%*
Nigeria	*96*	*45%*	*55%*	*37%*
Réunion	*0*	*99%*	*100%*	*87%*
Rwanda	*9*	*21%*	*67%*	*5%*
Sao Tome and Principe	*0*	*59%*	*70%*	*40%*
Senegal	*6*	*55%*	*90%*	*28%*
Seychelles	*0*	*97%*	*97%*	*97%*
Sierra Leone	*6*	*5%*	*11%*	*1%*
Somalia	*9*	*15%*	*33%*	*4%*
South Africa	*8*	*85%*	*90%*	*77%*
South Sudan	*11*	*1%*	*4%*	*0%*
Sudan	*25*	*35%*	*63%*	*21%*
Swaziland	*1*	*27%*	*40%*	*24%*
Tanzania	*37*	*24%*	*71%*	*4%*
Togo	*5*	*27%*	*35%*	*21%*
Uganda	*32*	*15%*	*55%*	*7%*
Zambia	*11*	*26%*	*45%*	*14%*
Zimbabwe	*9*	*40%*	*80%*	*21%*
North Africa	**1**	**99%**	**100%**	**99%**
Algeria	*0*	*99%*	*100%*	*97%*
Egypt	*0*	*100%*	*100%*	*99%*
Libya	*0*	*100%*	*100%*	*99%*
Morocco	*0*	*99%*	*100%*	*97%*
Tunisia	*0*	*100%*	*100%*	*100%*

Appendix E: Regulatory Framework

Regulatory Framework for rural electrification in Zambia

Item no	Regulatory Framework	Responsibilities
1	National Energy Policy 1994 (amended 2004)	The National Energy Policy was a crucial step for the development of the energy sector in the last decade. It liberalized the electricity sector by opening all market segments to private operators and set the ground for the establishment of two new key institutions: The Energy Regulation Board, finally established under the Energy Regulation Act, was later tasked with regulating the operations and pricing of the electricity sector while the Office for Promoting Private Power Investment was later created to attract new players to the electricity market.
2	Energy Regulation Act 1995 (amended in 2003)	The act formally established the Energy Regulation Board and defined its functions and powers as regulating the energy sector in a fair, transparent, effective and efficient way to safeguard the interest of all stakeholders. The ERB is responsible for establishing fuel prices (including electricity tariffs), establishing and monitoring the application of the Zambia Grid Code and designing standards in regards to the quality, safety and reliability of supply of energy in conjunction with the Zambia Bureau of Standards.
3	Rural Electrification Act 2003	The act established the Rural Electrification Authority (REA) and equipped it with a Rural Electrification Fund. The REA is responsible for implementing the Rural Electrification Master Plan (REMP) by facilitating the creation and monitoring the operation of rural electrification organizations or companies.
4	Zambian Grid Code of 2006	The Zambia Grid Code was approved by the Energy Regulation Board in 2007, and was gazette in August 2013, with the objective of facilitating open and non-discriminatory access to the transmission system in order to contribute to the energy markets liberalization. Its aims are to enhance efficiency and more rapid electrification.
5	Seventh National Development Plan 2017-2021 (7NDP)	The Zambian Government has prepared a National Development Plan (NDP) in which each sector is represented. The development plan as at 2018 was the Seventh National Development Plan 7NDP. The goal is to ensure universal access to clean, safe, reliable and affordable energy at the lowest cost, consistent with national development aspirations with the following broad strategies:
		Strategy 1: Enhance generation, transmission and distribution of electricity
		The Government is promoting the establishment of an open and non-discriminatory transmission access regime in the electricity sub-sector, cost-reflective electricity tariff regime and adopt the electricity grid code with the following programmes:
		a) Policy and regulatory framework review and enhancement;
		b) Electricity infrastructure development promotion; and
		c) Electricity generation, transmission and distribution expansion.
		Strategy 3: Promote renewable and alternative energy
		This strategy aims at promoting the development and use of renewable and alternative energy sources, such as solar, wind, biomass, geothermal and nuclear as a way of diversifying the energy mix and improving supply. The plan is to develop a comprehensive national energy strategy including a master plan for sustainable alternatives to charcoal and other household energy needs with the following programmes:
		a) Policy and legal framework review and enhancement;
		b) Renewable and alternative energy development promotion;
		c) Wood fuel sub-sector management; and
		d) Energy efficiency and conservation promotion.
		Strategy 4: Improve electricity access to rural and peri-urban areas
		The plan is to promote rural electrification programmes to enhance rural development and increase access to rural and peri-urban consumers at an affordable cost with the following programmes:
		a) Rural electrification promotion; and
		b) Peri-urban electrification improvement promotion. [20]
6	Financial support to utility scale grid connected renewables	Rural Electrification Feed-in Tariff (REFiT): In 2014, the government commenced the process of drafting a Renewable Energy Policy Framework. The policy will focus on the specifics of expansion and diversification of renewable energy uptake, private sector involvement and the potentials of using Feed-in-Tariffs to spur investments. In addition, the ERB received technical assistance from the USAID-Trade Hub Southern Africa to develop a Renewable Energy Feed-In Tariff Regulatory Framework and a corresponding REFiT Pricing Methodology. The initiative has provided a standardized license and PPA for investment and the procurement of power from the renewable energy Independent Power Producers (IPPs).
		GET-FiT: Global Energy Transfer Feed-in-Tariff (GET FiT) Program is an initiative launched by KfW, whose purpose is to fast-track a portfolio of a number of RE generation projects (1MW-20MW) promoted by private developers. The GET FiT Program consists of three instruments: the GET FiT Premium Payment Mechanism, a Guarantee Facility to secure against off-taker and political risks and a Private Financing Mechanism that will offer debt and equity at competitive rates. The GET FiT Premium Payments are additional payments per kWh, above and beyond the regulated REFiT tariff. The program aims at supporting private sector players including SME's to participate in developing energy projects [24].
7	Rural Electrification Master Plan (REMP)	Together with the Japanese government, the Rural Electrification Authority has developed a Rural Electrification Master Plan for the term 2008 – 2030. The plan defines 1,217 Rural Growth Centers that do not have access to electricity and should be prioritized in terms of electrification. These rural growth centers will be electrified using three principle methods: (i) extension of the nation grid; (ii) construction of mini-hydro power stations where the potential exists; and (ii) installation of solar home systems at a total cost of US$1.1 billion equivalent to about K4.4 trillion during the period 2008-2030. This translates into an annual expenditure of US$50 million equivalent to about K200 billion over the same period. Once this investment is made, the rate of electrification will increase from the current 3% to 51% by the year 2030 [13].
8	Rural Electrification Fund (REF)	The Rural Electrification Fund is a crucial instrument to drive energy access in Zambia. The fund is managed by the Rural Electrification Authority. It comprises public budget, consumption tax that is collected by ZESCO and further contributions. The REA uses the fund to invest in the expansion of rural grids and projects that use renewable energy resources. [25]. Refer to information on Rural Electrification Authority.
	Vision 203o	Zambia's Vision 2030 document references the achievement of universal access to clean, reliable and affordable energy at the lowest total economic, financial, social and environmental cost consistent with national development goals by 2030.

Appendix F: Literature Reviewed

No	Author	Year	Title	Objective	Conclusions	Comments/ Critique
1	Sabah Abdullah and Anil Markandya	2007	Rural Electrification Programmes in Kenya: Policy Conclusion from a Valuation Study	To investigates one major issue impeding the rural electrification programmes in rural Kenya: high connection payments	Cost of connecting to electricity is not very affordable for rural households	Connection costs to electricity are high at individual or family level
2	Agency, International Energy	2014	A focus on the energy prospects in Sub Saharan Africa	Comprehensive and analytical study of energy in Africa	Access to energy is required to advance any economy	Africa is in poverty due to lack of access to energy
3	Rene' Masse'	2010	Financing for Rural Electrification programs in Africa		To finance national RE programs, these funds will have to find new refinancing partners. Refer to table	Governments realised that the cost of electrification at individual household was high; they created reforms to secure funds. Access rate was lowest in sub-Saharan region
4	Kenya Power and Lighting Company	2006	Kenya Power and Lighting Company, Annual report 2005-2006		Example of reforms and initiatives in energy sector	Among other stakeholders, the beneficiary community played a pivotal role towards financing for rural electrification
5	Chowdry Y	2008	Impact and sustainability of community development programs in developing countries.	To understand the policy makers' approach towards funding	Most Rural Electrification Program (REP) policy makers have limited resource mobilisation skills	RE policy makers are not enterprising but wait for handouts

6	Kankam and Boon	2009	Energy delivery and utilisation for rural development: lessons from Northern Ghana	To compare the rural and urban electrification	There is a difference between urban and rural area markets. The rural market is thin.	The financial risks are high for private enterprise to pull renewable energy services into remote rural area.
7	Barnes and Foley	2006	Rural energy in developing countries: A challenge for economic development	Rural or urban electrification	There was a lower specific energy consumption for rural communities thus rural distribution systems realise far lower revenue per kilometer of rural distribution line than their urban counterparts	Rural electrification by small enterprises alone may not be as profitable as the electrification of the urban location
	Ohiare, Subhes C Bhattacharyya and Sanusi	2012	The Chinese Electricity Access Model for Rural Electrification	To understand how China had achieved near 100% electrification	Role model to electricity strategy for others	China was way ahead in electrification dating back in the early 1800sthu having a well-developed economy
8	World Bank,	1993	Power Supply in Developing Countries: Will Reform Work? Proceedings of a Roundtable Co-sponsored by the World Bank and Electricite de France	To qualify financing for Rural electrification	Financing institutions required an improved technical and financial performance of the power sector	The need for financing became apparent. Countries reformed their power sectors to access financing
9	Rene' Masse'	2010	Financing for Rural Electrification programs in Africa	To understand rural electrification financing	Governments not only showed very strong political will: They were also able to secure, from their assets, the larger part of necessary financing and sustained this effort for decades. cooperation entities have conditioned their financial contribution upon the opening of rural electrification to the private sector	Success stories of rural electrification in Africa needs political will as well as sustained effort in mobilising resources internally to the country Governments adhered to reforms to access the funding

10	Word Bank	2010	Addressing Electricity Access Gap	Discusses the challenge of scaling up electricity access in developing countries, efforts involved and obstacles therein	Funding plays a great role in the formulation of Renewable Energy Technologies (RETs) policies	Most of the population in Africa is poor and hence cannot afford modern energy services
11	Dumisani Chirambo	2016	"Addressing the renewable energy financing gap in Africa to promote universal energy access:Intergrated renewable energy financing in Malawi," *Renewable and Sustainable Energy Reviews*, vol. 62, p. 794,			The article acknowledges that financing is a major hindrance to increased electrification
12	United Nations Development Program	2014	Finance Structure and its Management for a Rural Electrification NAMA	To understand financing for rural electrification and its impacts	Definition of rural electrification	Access to energy is vital for economic development and improvement of rural livelihood
13	Charles Haanyika,	2005	Rural Electrification Policy and Institutions in a Reforming Power Sector,	T understand the rate of electrification	Electrification of rural areas has progressed at low rates mainly due to high costs associated with extending electricity grids and developing decentralised systems	Electrification rates were low primarily due to high cost of electrification
14	Charles Haanyika	2007	Rural Electrification in Zambia. A Policy and Institutions	To understand impact of reforms of rural electrification	Reforms did not achieve the intended results as planned	Some countries benefited from reforms while others suffered from their impacts
15	World Bank	2007	Increased Access to Energy and Information and Communication Technology Services Project: resettlement policy framework	To understand the institutions in the power sector in Zambia	In Zambia, many reforms were adopted as can be seen by the number of institutions charged with the responsibility of the rural electrification program	There are a number of institutions and guidelines, policies and regulations governing operations in the power sector

16	Government of Zambia	2009	Rural Electrification Master Plan for Zambia 2008-2030	To understand the Governments plan, budget and source of funds for rural electrification	The REMP is governments' blue print guideline for rural electrification program, it provides for the locations, scopes and cost at given time	Rural electrification was mapped out in the REMP with the help of funding agencies.
17	Government of the Republic of Zambia	2007	Resettlement Policy Framework: Increased Access to Energy and Information and Communication Technology Services	To provide guidelines on resettlement of affected peoples during increased Access to Energy service activities	Consideration for human safety and protection during infrastructure was a requirement	Guidelines well structure and in use
18	World Bank	2016	Regulatory Framework on Off-Grid Electrification	To justify governments' role in energy services provision	Renewable Energy must be integrated into national rural electrification strategies	To achieve the goal of universal energy access, governments must be fully engaged in provision of energy strategies
19	Md. Mizanur Rahman, Maria Elojärvi, Aditya Poudyal, and Jukka V. Paatero	2012	Review on Rural Energy Policy: Nepal, Ghana, Bangladesh, and Zambia	To review policy measures on rural electrification	Policy measures of Rural Electrification in Zambia	Policies at the time of investigation were sufficient, what worked and building on what did not work
20	Kristin Dietrich, Álvaro López-Peña and Pedro Linares*	2010	A New Framework for Rural Electrification Programs	To propose Guidelines for rural electrification general and customised to Guatemala	A new regulatory framework for Guatemala by which governments would only provide the funds needed to make electrification projects profitable for private investors,	A case of Guatemala

Appendix G: Ethical Clearance

THE UNIVERSITY OF ZAMBIA
DIRECTORATE OF RESEARCH AND GRADUATE STUDIES

Great East Road Campus | P.O. Box 32379 | Lusaka10101 | Tel: +260-211-290 258/291 777 **Fax**: (+260)-211-290 258/253 952 | E-**mail**: director.drgs@unza.zm | Website: www.unza.zm

APPROVAL OF STUDY

IORG No. 0005376
HSSREC IRB No. 00006464

19th April, 2023,

REF NO. HSSREC:-2023- APR - 025

MS. Lavender Malama, IDE,
P.O.BOX, 32379, LUSAKA.

Dear, Ms. Malama,

RE: **STRATEGIES FOR INCREASING ACCESS TO ELECTRICITY SERVICES FOR RURAL ELECTRIFICATION IN ZAMBIA**

Reference is made to your submission of the protocol captioned above. The HSSREC resolved to approve this study and your participation as Principal Investigator for a period of one year.

REVIEW TYPE	**ORDINARY REVIEW**	**APPROVAL NO. HSSREC:-2022- APR -025**
Approval and Expiry Date	Approval Date: 19th April, 2023	Expiry Date: 18th April, 2024
Protocol Version and Date	Version - Nil.	18^{8h} April, 2024
Recruitment Materials	Nil	Nil

Information Sheet, Consent Forms and Dates	□ English.	To be provided
Consent form ID and Date	Version - Nil	To be provided
Other Study Documents	Questionnaire.	
Number of Participants Approved for Study		

Specific conditions will apply to this approval. As Principal Investigator it is your responsibility to ensure that the contents of this letter are adhered to. If these are not adhered to, the approval may be suspended. Should the study be suspended, study sponsors and other regulatory authorities will be informed.

CONDITIONS OF APPROVAL

- No participant may be involved in any study procedure prior to the study approval or after the expiration date.

- All unanticipated or Serious Adverse Events (SAEs) must be reported to HSSREC within 5 days.

- All protocol modifications must be approved by HSSREC prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address.

- All protocol deviations must be reported to HSSREC within 5 working days.

- All recruitment materials must be approved by HSSREC prior to being used.

- Principal investigators are responsible for initiating Continuing Review proceedings. HSSREC will only approve a study for a period of 12 months.

- It is the responsibility of the PI to renew his/her ethics approval through a renewal application to HSSREC.

- Where the PI desires to extend the study after expiry of the study period, documents for study extension must be received by HSSREC at least 30 days before the expiry date. This is for the purpose of facilitating the review process. Documents received

within 30 days after expiry will be labelled "late submissions" and will incur a penalty fee of K500.00. No study shall be renewed whose documents are submitted for renewal 30 days after expiry of the certificate.

- Every 6 (six) months a progress report form supplied by The University of Zambia Humanities and Social Sciences Research Ethics Committee as an IRB must be filled in and submitted to us. There is a penalty of K500.00 for failure to submit the report.

- When closing a project, the PI is responsible for notifying, in writing or using the Research Ethics and Management Online (REMO), both HSSREC and the National Health Research Authority (NHRA) when ethics certification is no longer required for a project.

- In order to close an approved study, a Closing Report must be submitted in writing or through the REMO system. A Closing Report should be filed when data collection has ended and the study team will no longer be using human participants or animals or secondary data or have any direct or indirect contact with the research participants or animals for the study.

- Filing a closing report (rather than just letting your approval lapse) is important as it assists HSSREC in efficiently tracking and reporting on projects. Note that some funding agencies and sponsors require a notice of closure from the IRB which had approved the study and can only be generated after the Closing Report has been filed.

- A reprint of this letter shall be done at a fee.

- All protocol modifications must be approved by HSSREC by way of an application for an amendment prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address or methodology and methods. Many modifications entail minimal risk adjustments to a protocol and/or consent form and can be made on an Expedited basis (via the IRB Chair). Some examples are: format changes, correcting spelling errors, adding key personnel, minor changes to questionnaires, recruiting and changes, and so forth. Other, more substantive changes, especially those that may alter the risk-benefit ratio, may require Full Board review. In all cases, except where noted above regarding subject safety, any changes to any protocol document or procedure must first be approved by HSSREC before they can be implemented.

Should you have any questions regarding anything indicated in this letter, please do not hesitate to get in touch with us at the above indicated address.

On behalf of HSSREC, we would like to wish you all the success as you carry out your study.

Yours faithfully,

Dr. J.I. Ziwa

DR. J. I. Ziwa

ACTING CHAIRPERSON
THE UNIVERSITY OF ZAMBIA HUMANITIES AND
SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE - IRB

CC: Director, Directorate of Research and Graduate Studies
Assistant Director (Research), Directorate of Research and Graduate Studies
Assistant Registrar (Research), Directorate of Research and Graduate Studies