



Republic of Zambia

**OFFICE OF THE
AUDITOR GENERAL**



Report of the Auditor General on the Promotion of Renewable Energy Sources in Rural Areas in Zambia

2015-2019





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Acronyms

AFROSAI-E	African Organisations of Supreme Audit Institutions in English speaking Countries
IFC	International Finance Corporation
IP	Investment Plan
MOE	Ministry of Energy
RE	Renewable Energy
REA	Rural Electrification Authority
REMP	Rural Electrification Master Plan
RES	Renewable Energy Sources
RET	Renewable Energy Technologies
SHS	Solar Home Systems
SIDA	Swedish Development Cooperation Agency
SREP	Scaling Renewable Energy Programme

Operational Definitions

Renewable Energy	Renewable energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly or indirectly from the sun, or from heat generated deep within the earth. Included in the definition is energy generated from solar, wind, biomass, geothermal, hydropower and ocean resources, and biofuels and hydrogen derived from renewable resources.
Renewable Energy Sources (RES)	For the purpose of this report, renewable energy sources include the following: solar (thermal and photovoltaic), mini/micro-hydro, biomass (agricultural wastes, forestry waste, industrial/municipal organic wastes, energy crops & products and animal waste), geothermal and wind.
Wind Energy	This is energy extracted from the wind using wind turbines to produce electrical power, windmills for mechanical power or wind pumps for water pumping. Wind power is renewable, widely distributed and produces no greenhouse gas emissions during operation.
Solar Energy	Technologies that use the sun's energy and light to provide heat, light, hot water, electricity, and even cooling, for homes, businesses and industry.
Photovoltaic or Solar Cells Systems	Producing electricity directly from sunlight.
Solar Thermal Electricity	Using the sun's heat to produce electricity.
Biomass	Any organic feedstock available on a recurring basis. Typical biomass resources include wood and wood wastes, landfill gases, agricultural and crop residues, used vegetable oil, human solid wastes and animal manures.
Geothermal Energy	The heat from the earth. It is clean and sustainable. Resources of geothermal energy range from the shallow

	ground to hot water and hot rock found a few miles beneath the earth's surface and down even deeper. The uses to which these resources are applied are also influenced by temperature.
Mini-Hydro	Sites on small rivers suitable for local small scale power generation

Foreword

In accordance with the Provision of Article 250 of the Constitution of Zambia (Amendment) Act No. 2 of 2016, Public Audit Act No. 13 of 1994 and the Public Finance Management Act No. 1 of 2018, I am mandated to carry out Performance Audits in Ministries, Government Departments and Statutory Corporations. I am pleased to present to you the Performance Audit Report on the Promotion of Renewable Energy Sources in Zambia. The audit focused on activities and programmes implemented by the Ministry of Energy (MoE) and the Rural Electrification Authority (REA) to promote renewable energy sources.

Zambia has not been spared from the effects of climate change, therefore, achieving one of the strategies of the Seventh National Development Plan (7NDP) i.e. to “Promote Renewable and Alternative Energy” will be key. This will also help Zambia work towards achieving the Agenda 2030 specifically SDG 7- Affordable and clean energy which is aimed at ensuring access to affordable, reliable, sustainable and modern energy for all and seeks to address the challenges faced in the energy sector world over.

I therefore, present to you this Performance Audit Report together with recommendations, which if implemented by the Ministry of Energy and the Rural Electrification Authority will bring about improvements in the promotion of clean energy.

I wish to take this opportunity to thank the management and staff of the Ministry of Energy and the Rural Electrification Authority for the co-operation and assistance rendered to my team during the audit.



Dr. Dick Chellah Sichembe

Auditor General

EXECUTIVE SUMMARY

The performance audit on the Promotion of Renewable Energy sources in Rural Areas sought to explore the extent to which Zambia is diversifying its energy production into other untapped renewable energy sources and examine whether the Ministry of Energy had put in place measures that are effective for facilitating increased access of Renewable Energy Sources (RES) to targeted rural beneficiaries.

Energy has been identified as an important driving force behind economic development in Zambia, and the Government has declared its commitment to developing and maintaining energy infrastructure and services.¹

Access to electricity in Zambia is estimated at 31% of the total population which was estimated at 15,473,905 in 2015, comprising approximately 67% of the urban population and 4.4% of the rural population. Approximately 500,000 urban households and 1.8 million rural households currently do not have access to electricity. Renewable Energy Sources are abundant, with the potential that Government has been keen to expand the use of Renewable Energy which is considered to be effective in addressing diversification of energy sources and increasing rural electrification rates. Renewable Energy is on-site energy source and available in rural areas and improving the living standards of residents in impoverished rural areas.

As part of the national strategy document, Vision 2030, Government has set electrification targets at 90 percent for urban and 51 percent for rural areas to be reached by 2030. However, at the current pace, these targets are not expected to be achieved. Rural electrification has long been identified as a vehicle to eradicate poverty by stimulating the rural economy in Zambia.

The audit objective was to examine whether the Ministry of Energy has put in place measures that are effective for facilitating increased access to Renewable Energy Sources to targeted rural beneficiaries. The audit focused on Renewable Energy projects carried out by the Department of Energy under the Ministry of Energy and Rural Electrification Authority to promote the use of Renewable Energy Sources in rural areas in order to facilitate increased access to targeted rural beneficiaries. The audit covered the period 2015 to 2019.

Summary of Findings

- a. The output indicators to increase contribution from renewable energy sources from solar and mini-hydro resources from 0.72% in 2013 to 2.7% in 2016 had not been achieved as the contribution of renewable energy sources to power generation stood at 1.57% as of

¹ Power Africa in Zambia – USAID Country Fact Sheet

2018 which was less than the expected target of 2.7%. In 2019, the contribution of renewable energy sources to power generation improved to 3% as of December 2019.

- b. The Ministry had concluded the resource mapping on solar and wind in December 2018 and launched in June 2019. As regards unavailability of data on other renewable energy potential such as geothermal which also needed to be quantified, the Ministry had not undertaken further studies to ascertain potential of other forms of renewable energy as a way of diversification.
- c. The Ministry had finalised the preparation of the investment plan which was completed in May 2019. The availability of the Investment Plan will enable the Ministry use new economic opportunities to increase energy access through renewable energy use.
- d. A number of projects aimed at promoting use of Renewable Energy Sources stalled due to the Ministry failing to adequately conduct monitoring and evaluation of on-going projects. In some cases, inadequate funding hampered the Ministry's efforts to complete on-going projects.
- e. There were low levels of awareness on renewable energy technologies to the beneficiaries by the Ministry as result of the poor dissemination of information largely due to inadequate communication infrastructure, low literacy levels and inadequate funding to the programme.
- f. At the time of the audit, the Ministry and REA had not adequately invested in Research & Development. Although Renewable Energy (RE) projects such as the projects visited during the audit, that had been implemented were aimed at demonstrating available energy technologies, though the Ministry faced challenges in maintaining and monitoring the projects.
- g. The audit revealed that REA was using an outdated Communication Policy and Strategy despite having planned to review the Communication Strategy for the period of 2014 – 2018, this was still not done.

Conclusion

The Ministry of Energy has in place measures to facilitate increased access to renewable energy sources to targeted rural beneficiaries. However, the audit concludes that the measures in place are not effective in ensuring increased access to renewable energy sources and there has been a delay in completion of renewable energy projects thus the intended beneficiaries not deriving the benefits.

Recommendations

- i. The Ministry should ensure that the Renewable Energy Strategy (RES) is implemented to aid in the exploitation of RES in rural areas of the country.
- ii. A resource mapping should be carried out on other sources of energy such as Geothermal so as to have readily available data on renewable energy potential thereby improving the energy mix.
- iii. The Ministry should ensure that a sustainability plan should be provided to the communities so that there is continuity of the project once it is handed over to the beneficiaries.
- iv. The Ministry should ensure that users are provided with manuals when handover of renewable energy projects is done so as to avoid them tampering with the installations when facing challenges.
- v. Sensitisation on use of installations should be carried out once the project is handed over to beneficiaries.
- vi. Regular monitoring of projects should be carried out by the Ministry to ensure that all problems encountered are rectified by trained officers.
- vii. The Ministry through REA should be carrying out applied Research & Development for it to ascertain the viability of undertaking its projects and how to profitably supply electricity to rural populations in the most effective, economical and innovative way.

Chapter One

Introduction

1.0 Overview

Zambia's electricity sector is largely dependent on hydropower. As a result of erratic rains, declining water levels in Kariba Dam and increased electricity demand, the country has experienced a severe electricity supply deficit since 2015. Output for the sector is estimated at less than one third of installed capacity. Load shedding has led to increased costs of living. This has prompted investment in renewable energy.

The Office of the Auditor General carried out a performance audit on the Promotion of Renewable Energy Sources in rural areas of Zambia. The report sought to explore the extent to which Zambia is diversifying its energy production into other untapped renewable energy sources and examine whether the Ministry of Energy had put in place measures that are effective for facilitating increased access of Renewable Energy Sources (RES) to targeted rural beneficiaries. Renewable Energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly or indirectly from the sun, or from the heat generated deep within the Earth. Included in the definition is energy generated from solar, wind, biomass, geothermal, hydropower, ocean resources, biofuels and hydrogen derived from renewable resources.

1.1 Background

In 1996, the Government of Zambia set a goal for universal electricity access for all Zambians by 2030. Energy has been identified as an important driving force behind economic development in Zambia, and the government has declared its commitment to developing and maintaining energy infrastructure and services.² Zambia's electricity sector is largely dependent on hydropower. As a result of erratic rains, declining water levels in Kariba Dam in Southern Province and increased electricity demand, the country has experienced a severe electricity supply deficit since 2015. Zambia's demand for electricity stood at 1,949 megawatts (MW) in 2015. However, the sector was only able to produce 1,281 MW thus giving a deficit of 668 MW.³

Zambia's electricity generation mix continues to significantly rely on hydro power accounting for 82.76 percent of total installed generation capacity. The remainder of the generation mix is

² Power Africa in Zambia – USAID Country Fact Sheet

³ Seventh National Development Plan (7NDP)

made up of coal (10.35%); Heavy Fuel Oil (HFO) (3.80%); diesel (3.06%); and solar (0.04%). The hydro generation mix comprised of large, small and mini power generation stations and the installed generation capacity was about 2,898MW in 2018.⁴ In 2019, the national installed electricity generation capacity by technology as at 31st December, 2019 was made up of Hydro (80.6%), Coal (10.09%), Diesel (2.81%), HFO (3.7%) and Solar (2.8%). The national installed capacity of electricity stood at 2,981.31 MW as at 31st December 2019.⁵

Access to electricity in Zambia is estimated at 31% of the total population which was estimated at 15,473,905 in 2015, comprising approximately 67% of the urban population and 4.4% of the rural population. Approximately 500,000 urban households and 1.8 million rural households currently do not have access to electricity. The Government of Zambia maintains an official target of achieving 51% rural electricity access by 2030.

To curb this scourge, one of the strategies of the Seventh National Development Plan (7NDP) is to “Promote Renewable and Alternative Energy”. The strategy is aimed 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. This is in line with the Sustainable Development Goals (SDGs) to which Zambia is a party to - SDG 7- Affordable and clean energy is aimed at ensuring access to affordable, reliable, sustainable and modern energy for all and seeks to address the challenges faced in the energy sector the world over.

Renewable Energy Sources (RES) are abundant in Zambia. The country has potential in the said RES and the Government has been keen to expand the use of Renewable Energy which is considered to be effective in addressing diversification of energy sources, increasing rural electrification rates since RE is on-site energy source and available in rural areas and improving the living standards of residents in impoverished rural areas. The benefits to be derived from renewable energy include: Environmental benefits, Energy for future generations, Energy Security, Jobs and economic diversification. The Ministry of Energy, which houses the Department of Energy, is responsible for the development and management of energy in a sustainable manner, formulation and implementation of the national energy policy, coordination of stakeholders in the sector, development of the national energy sector strategy and plan and the monitoring and evaluation of current policies among others.

⁴ Energy Regulation Board (ERB) Energy Sector Report 2018

⁵ Energy Regulation Board (ERB) Statistical Bulletin January to December 2019

In order to enhance rural electrification, the Rural Electrification Authority (REA) was established in December 2003 and the Rural Electrification Act No.20 of 2003 was enacted to improve the management of Rural Electrification Fund. In order to enhance rural electrification efficiently, preparation of the Rural Electrification Master Plan in Zambia (REMP) was considered as an urgent issue. The REMP is a systematic implementation plan that indicates electrification targets, electrification order, electrification method, time schedule and budget required. Investment in hydro electricity generation projects and lack of research/development in alternative renewable energy initiatives were critical as Renewable Energy Sources (RES) have a significant potential role to play in expanding Zambia's future energy options especially in rural and remote areas.⁶

1.2 Motivation

Energy plays a key role in facilitating activities in all sectors of the economy. In the 7NDP, the Government of the Republic of Zambia (GRZ) in its consultations across the country noted that the energy deficit decelerated economic growth as industries could not operate at an optimum level. Although the national generation capacity outpaces the demand and hence the surplus indicated in Table 1, the challenge is that some power plants are not operating at maximum capacity because of low water levels and all hydro power plants are not producing at their installed capacity. Electricity demand in Zambia has been growing at an average rate of 4 percent per year. Generation capacity expansion has however not matched this growth in demand leading to power shortages. This was worsened when in 2015 and 2016 the country experienced lower than expected rainfall resulting in low water levels in the country's main reservoir, Lake Kariba. This situation resulted from limited investment over the years, which was also compounded by non-cost-reflective tariffs. Further, the deficit was worsened by the effects of climate change on the availability of water, considering that Zambia was highly dependent on hydro-power. The current projections indicate that growth in demand will increase by 150 MW to 200 MW per annum. The peak demand for electricity in the country is projected at 3,000 MW by 2020 and is expected to increase to over 3,525 MW in 2030⁷.

The table below shows the Generation Capacity for the period 2015 to 2019 against the Electricity Consumption for the same period.

⁶ According to the Rural Electrification Master Plan Report of 2008

⁷ Scaling-Up Renewable Energy In Low Income Countries: Investment Plan For Zambia Investment Plan For Zambia

Table 1: National Generation Capacity against Electricity Consumption					
Generation/Consumption	2015	2016	2017	2018	2019
National Generation Capacity (GWH)	13,440.00	11,696.00	14,460.00	16,189.00	15,053.38
Electricity Consumption	10,857.50	11,449.90	12,192.00	13,080.10	12,527.02
Surplus/(Deficit)	2,582.50	246.10	2,268.00	3,108.90	2,526.36

Source: Energy Sector Report 2019

As part of the national strategy document, Vision 2030, Government has set electrification targets at 90 percent for urban and 51 percent for rural areas to be reached by 2030. However, at the current pace, these targets are not expected to be achieved. Rural electrification has long been identified as a vehicle to eradicate poverty by stimulating the rural economy in Zambia. The household electrification rate, however, still remains at approximately 31% countrywide, and only 4.4% in rural area. In her ministerial statement to Parliament on the power situation in the country in February 2016, Hon Minister of Energy and Water Development informed the house on the government's commitment to escalate the deployment of renewable energy technologies in diversifying the sources of power generation through development of 300 MW solar Plants, Biofuels and Wind Resource Assessment.⁸ The above concerns provided motivation of the audit on the promotion of renewable energy sources in rural areas.

1.3 Audit Significance

The importance of this audit was to bring out the level of promotion of renewable energy sources in rural areas of Zambia. Renewable energy sources are abundant in Zambia. Small and large hydropower is the major contributor to the country's electricity supply and will be further developed over the next decades, given its high technical potential. Furthermore, high solar irradiation values promise strong potential for the development of Solar Photovoltaic-Based generation. With declining technology costs, there is potential for expansion of solar Photovoltaic, recently evidenced by the International Finance Corporation's (IFC's) Scaling Solar programme and Swedish International Development Cooperation Agency (SIDA's) Beyond the Grid Fund.

⁸ Ministerial Statement on the Power Situation in the country Feb 2016

Chapter Two

Audit Objectives and Audit Questions

2.1 Introduction

This section outlines audit objectives and audit questions. It comprises of one main objective, two specific objectives as well as two audit questions. It will further include sub audit questions within the main questions.

2.2 Main Objective

The main audit objective was to examine whether the Ministry of Energy has put in place measures that are effective for facilitating increased access to Renewable Energy Sources (RES) to targeted rural beneficiaries.

2.2.1 Specific Objectives

- a. To determine the extent to which the Ministry of Energy has implemented effective measures to promote the use of RES in rural area.
- b. To ascertain the extent to which the Ministry of Energy has facilitated increased access to electricity through Public Private Partnership (PPP) in rural electrification projects for renewable energy.

2.3 Audit Questions

- a. To what extent has the Ministry implemented effective measures to promote the use of Renewable Energy Sources in rural areas?
 - i. Has the Ministry ensured that sufficient data and information is readily available on the Renewable Energy potential in rural areas?
 - ii. Has the Ministry ensured that significant infrastructure is available to exploit RES?
 - iii. Has the Ministry ensured that awareness campaigns are conducted so as to sensitise communities on modern energy sources?
 - iv. Has the Ministry ensured routine inspections and maintenance of RE projects to ensure increased access to electricity in rural areas?
 - v. Has the Ministry invested in Research and Development for RE programmes in rural areas?
- b. To what extent has the Ministry facilitated increased access to electricity through private public partnership participation in rural electrification projects for renewable energy?

- i. Has the Ministry of Energy put in place measures to increase and maintain the number of Financiers in Rural Electrification programmes?
- ii. Has the Ministry of Energy strengthened investment marketing campaign programmes for international resource mobilisation?
- iii. Has the Ministry of Energy ensured that the communication strategy is reviewed for increased Public Private Partnership?

2.4 Audit Scope

The audit focused on Renewable Energy projects carried out by the Department of Energy under the Ministry of Energy and Rural Electrification Authority to promote the use of RES in rural areas in order to facilitate increased access to RES to targeted rural beneficiaries. The audit covered projects in two (2) provinces namely Eastern and Luapula in Zambia and covered the periods 2015 to 2019.

Chapter Three

Methodology

3.1 Introduction

This chapter describes the methodology that was used to achieve the objectives of the audit. The methodology includes an explanation and justification of the research design. It further explains the sample population, sample size, sampling techniques, instruments for data collection and methods of data analysis.

3.2 Research Design

This was a case study design that utilized a mixed method that included qualitative and quantitative approaches. The two approaches were used because of relevance to the study as they provided a basis for data analysis by comparing interpretations in the audit. The Audit was planned and conducted in accordance with the Auditor General Performance Audit Manual, the AFROSAI-E guidelines for Performance Audit as well as standards issued by the International Organisation of Supreme Audit Institutions (INTOSAI) ISSAI 3000 and ISSAI 3100. The audit used a problem-based approach which examines, verifies and analyses the causes of particular problems or deviations from criteria. Whilst the research was designed to be qualitative and quantitative in nature, it also adopted a descriptive approach so as to simplify data interpretation.

3.3 Sample Population and Size

During the period from 2015 to 2019, the Ministry implemented a total number of thirty-seven (37) Renewable Energy projects across the country of which fifteen (15) were managed by Rural Electrification Authority and twenty-two (22) were managed by the Department of Energy. A total sample size of four (4) projects (Sustainable Solar Market Packages, Solar Photovoltaic PV Systems, and Mini-Grids) in Luapula and Eastern Provinces were selected comprising two (2) from the Ministry and two (2) from Rural Electrification Authority. While the sample size of four (4) may have been small, it was representative of the whole country as the majority of the RES projects in the country are to a large extent similar in the manner they are executed.

3.4 Sampling Technique

The projects were purposively selected based on size i.e. projects benefitting large number of beneficiaries and projects installed in government institutions, period of implementation and type of targeted rural beneficiaries. Details of the sites visited are shown in Appendix 2. The audit used purposive sampling as the requirement of the implemented RES projects rely on the same concepts and application.

3.5 Data Collection Techniques

The data collection techniques that were used in the audit included **Secondary data** through the use of document review and **Primary data** through the use of interviews and site visits. The main technique of collecting secondary data was:

i. Document Review

Documents were reviewed with the purpose of understanding the systems used in the implementation of the projects and verify whether resources had been efficiently and effectively utilised. **Appendix 1** shows the documents reviewed and the purpose for review.

Primary data was collected to supplement the secondary data and for the purpose of validating the collected secondary data. The main techniques of collecting primary data were as detailed below:

ii. Interviews

Structured interviews were conducted with key staff at the Department of Energy, Rural Electrification Authority offices and beneficiaries in order to gather evidence to support the audit findings. The list of persons interviewed is shown in the **Table 2** below.

Table 2: List of Interviewees

S/N	Interviewee	Purpose of the interview
Ministry of Energy		
1.	Director – Department of Energy, Senior Energy Officer, Energy Officer & Power Development Officer.	Understand the operations of the Ministry in promoting RE sources in Rural areas.
Rural Electrification Authority		
2.	Director – Support Services, Director – Technical Services, Chief Engineer – Renewable Energy, Director – Finance & Senior Information Communications Technology Officer	Understand the operations of the Rural Electrification Authority in promoting RE sources in Rural Areas.
Beneficiaries		
3.	Lundazi, Chipata, Chama, Samfya and Milenge districts.	Understand the actual benefits accruing to the users and the challenges they were facing with regards to the rural energy projects installed in

		their respective communities and how the projects were impacting on their livelihoods.
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iii. Physical Inspections

The team conducted field visits to inspect RE projects implemented by the Ministry and the Rural Electrification Authority to ascertain whether they were operating effectively and benefitting the targeted beneficiaries.

3.6 Data Analysis

The qualitative data collected through interviews and document review was analysed using the content analysis. Quantitative data collected was also analysed using Excel for trend analysis and descriptive statistics. In some instances, evidence collected was presented through tables. The purpose of conducting the data analysis was to put the evidence into context as regards the results from the field.

Chapter Four

Audit Criteria

4.0 Introduction

The audit criteria were drawn from the following sources:

- The Rural Electrification Act No. 20 of 2003
- National Energy Policy of 2008
- Ministry of Mines, Energy and Water Development Strategic Plan 2014-2016
- The Rural Electrification Authority Strategic Plan 2014 – 2018
- Rural Electrification Master Plan 2008 - 2030
- Rural Electrification Authority Five Year Rolling Plan 2017-2021
- REA Guidelines for Financing Rural Electrification Projects 2009

Appendix 5 shows a more detailed and specific overview of the audit criteria and its sources.

The specific criteria is also shown in the findings section.

Chapter Five

Description of the Audit Area

5.0 Introduction

This chapter explains the Ministry operations in line with providing energy sources in conjunction with its statutory body the Rural Electrification Authority.

5.1 Implementation of Sustainable Energy Projects

The Ministry of Energy is charged with the responsibility of ensuring increased access to sustainable energy. The Ministry draws its mandate from the Electricity Act No.21 of 2003 and the Energy Regulation (Amendment) Act No. 23 of 2003. The roles of the Ministry include among others; formulation of the National Energy Policies, coordinating the activities and operations of energy sector agencies and ensuring the proper management and development of the energy resources in accordance with the guiding principles, implementation of the National Energy Policy and coordination of all policy implementation functions, development of the National Energy Strategy and Plan and monitoring and evaluating the implementation of the strategies specified by the various stakeholders relating to energy. The Ministry also takes the leading role in the development of new energy related programmes, projects and activities.

The Department of Energy under the Ministry is responsible for implementation of Poverty Reduction Programmes (PRP) that are aimed at increasing access to energy services by all Zambians with continued assurance of security supply of energy to drive the country's socio-economic processes.

The Renewable Energy section which falls under the Technical Unit in the Department of Energy is mandated with the responsibility of promoting clean and renewable energy sources in the country. This is in line with the National Energy Policy of 2008 which promotes deployment of renewable energy sources and address barriers to their wider dissemination. Clean and renewable energy sources considered under the Renewable Energy section include hydro, solar, wind, and geothermal, as well as modern and sustainable use of biomass.

Apart from the Department of Energy, the Rural Electrification Authority which is a Statutory Body under the Ministry also plays an important role in the promotion of RES in rural areas. The Rural Electrification Authority was established by the Rural Electrification Act of 2003 whose mandate is to implement the rural electrification mechanisms for operating grid extension as well as applying subsidy for capital cost projects designed to supply energy in rural areas. The mandate of the Rural Electrification Authority is to increase access to electricity in rural areas by developing electricity infrastructure using appropriate technologies. The RE

sector also involves a number of stakeholders working in collaboration with the Ministry in promoting the use of RES. Other agencies that play an important role in the promotion of Renewable Energy and their roles are shown at **Appendix 7**.

5.2 Electrification of Rural Areas using Renewable Energy Sources

The Government through the Ministry of Energy has incorporated the use of Renewable Energy Sources in the rural electrification programme. Zambia has a number of potential sites on small rivers suitable for local small-scale power generation. The most promising sites for such development are in the North-Western and Northern parts of the country, because of the topography of the terrain, the geology of the ground, and high annual rainfall. Suitable sites have been identified through studies on rivers with sufficient perennial flows.⁹

5.2.1 Rural Electrification Fund

The rural electrification fund is currently administered as follows:

- i. 3% electricity levy is collected by ZESCO Limited from eligible customers which is remitted to the Zambia Revenue Authority.
- ii. Apart from the electricity levy, the capital support for various project types will be provided through the following sources of funds:
 - Appropriation by Parliament,
 - Grants,
 - Loans and donations from cooperating partners.

These sources of funds will have different requirements for application. The Ministry through its implementing Agencies will ensure the adherence to these requirements. In the case of co-financing through Grants, Loans and donations from cooperating partners, the specific requirements of such funds for selection of sub-projects and application of funds (such as specific Financial Internal Rate of Return (FIRR)/ Economic Internal Rate of Return (EIRR) of the proposed projects, as well as the environmental and social safeguards guidelines) of the partners shall be governed by specific agreements.

5.2.2 Rural Electrification Master Plan

Zambia developed a Rural Electrification Master Plan (REMP) in 2007. The Rural Electrification Master Plan (REMP) is the principal source of projects for financing and implementation by the Ministry up to 2030. The REMP targets 1,217 Rural Growth Centre's (RGC) currently without electricity. One hundred and eighty (180) Project Packages were

⁹ NEP 2008 pg. 2.1.5

ranked into electrification packages in order of priority according to the Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR).¹⁰ The one hundred and eighty (180) projects include Renewable Energy projects such as Mini-Hydro, Solar Home Systems (SHS) and Solar Photovoltaic (PV) systems.

The selection process for the Solar Photovoltaic (PV) systems in the Rural Growth Centre's Mini-hydro and other RE mini-grids are as shown below:

i. Mini-Hydro and other Renewable Energy Mini-Grids

Projects are selected and ranked according to the capacity of the site and the one with the highest is given priority. Preliminary studies will be done up to:

- i. Pre-feasibility study level,
- ii. Preliminary design,
- iii. Economic and financial analysis,
- iv. Preliminary environmental project brief, and
- v. Project packaging.

Bids will be invited in accordance with applicable procurement regulations, for project developers who shall not only construct but also operate and maintain the resultant power station and the associated power distribution. 100% capital support may be made available to a mini-hydro power project or a mini-grid power project using a renewable energy source, depending on the applicable requirements of the source of funds. This shall aim at buying down the proposed project tariff to promote community access to electricity and projects aimed at developing mini hydro or other renewable mini grids to electrify district centres, i.e. those created after 1990 or those supplied by diesel generators may be considered for up to 100% capital support.

ii. Solar Photovoltaic (PV) Systems in the Rural Growth Centre's

The projects identified in the Master Plan are selected in accordance with ranking in the REMP and included in the Annual Work Plan after which they are packaged and bids invited from qualified bidders for supply, installation, servicing and sale of systems to geographically identified areas. The capital support of up to 100% depending on the applicable requirements of the source of funds will be awarded on the basis of systems installed and in operation at public institutions as verified by the Ministry

¹⁰ guidelines for financing rural electrification project pg. 7-15

Chapter Six

Findings

6.0 Introduction

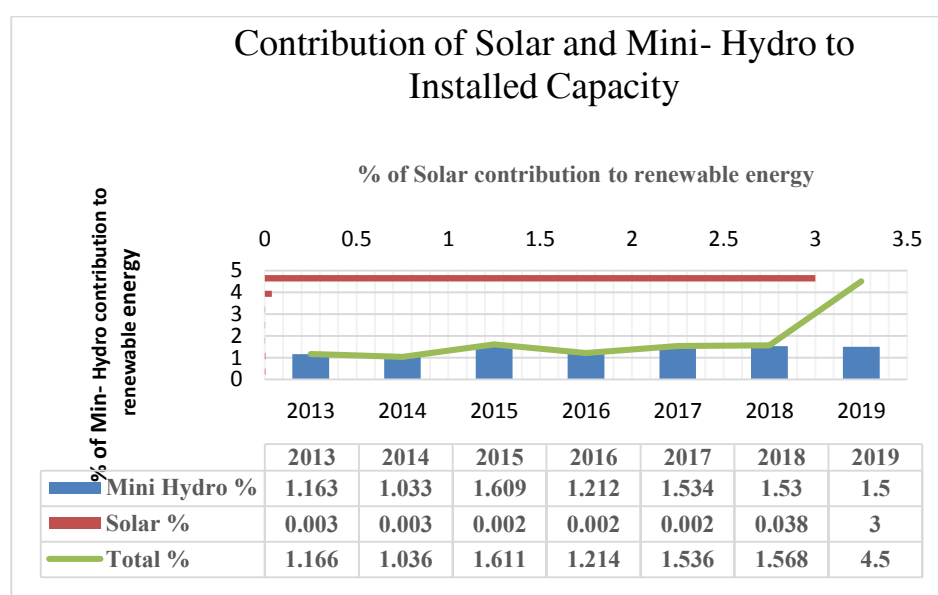
The findings and analysis of the study are presented in this chapter. The main audit objective was to examine whether the Ministry of Energy has put in place measures that are effective for facilitating increased access to Renewable Energy Sources (RES) to targeted rural beneficiaries. The audit objectives guided the audit questions and are as explained below.

6.1 To what extent has the Ministry implemented effective measures to promote the use of Renewable Energy Sources in rural areas?

6.1.1 Alternative Energy Resources to Electricity Generation

According to the Ministry of Mines, Energy and Water Development Strategic Plan 2014-2016, one of the strategies was to increase the use of renewable and alternative sources of energy. The output indicators were to increase contribution from renewable energy sources from solar and mini-hydro resources from 0.72% in 2013 to 2.7% in 2016. However, this target had not been achieved as the contribution of renewable energy sources to power generation stood at less than the targeted 2.7% as of 2018 when it stood at 1.57%. In 2019, the contribution of renewable energy sources to power generation improved to 3%. **Figure 1** below shows the contribution of Solar and Mini-Hydro to the installed capacity from 2013 to 2019.

Figure 1: Contribution of Solar and Mini-Hydro to Installed Capacity



Source: Audit Analysis 2019

The chart above illustrates the contribution of Solar and Mini-Hydro to installed capacity between the years 2013 to 2019. It can be seen that the total contribution increased from 1.166%

in 2013 to 1.568% and 3% in 2018 and 2019 respectively. The contribution of Mini-Hydro was significantly higher as it stood at 1.53% as compared to solar energy at 0.038% in 2018. The solar contribution to the national energy mix had been very negligible, estimated at less than 1% country-wide.

It was noted through interviews that the Ministry had commissioned the 54.3 MWp Scaling solar project which had improved the contribution of Solar in 2019 to 3%. Overall, there was an upward trend in the total contributions except for 2014 and 2016 when there was a reduction in the total contribution.

An analysis of the contribution of alternative energy (solar and wind) to the electricity generation mix was also carried out. The electricity generation mix stood below the targeted 18.7% as of 2019. The contributions stood at 0.042% and 1.89% in 2018 and 2019 respectively. The incremental values of the contribution of renewable energy (Solar, and wind) to the national energy mix for 2015 -2017 had been very negligible, estimated at less than 1% country-wide. An analysis of the REMP showed that the Ministry planned to electrify the provinces using three (3) electrification methods namely: Distribution Lines, Solar Home Systems and Mini-Hydro. **Table 3** below shows the details per province of the number of project packages by method of electrification.

Table 3: Number of Project Packages by Method of Electrification by Province

Province	Number of project packages	Number of Rural Grid Centres eletrified by Distribution Line	Number of Rural Grid Centres eletrified by Solar Home System	Number of Rural Grid Centres eletrified by Mini-Hydro	Total number of Rural Grid Centre
Central	19	105	19		124
Copperbelt	16	105	24		129
Eastern	25	104	18		122
Luapula	18	98	23		121
Lusaka	5	36	4		40
Northern	32	140	55		195
North-Western	18	94	24	4	122
Southern	21	140	33		173
Western	26	150	41		191
Total	180	972	241	4	1217

Source: REMP 2008

As can be seen from the table above, the REMP had a total of 180 project packages in 1,217 rural grid centres out of which 972 were to be electrified by Distribution Line, 241 by Solar Home Systems and 4 by Mini-Hydro between 2008 and 2030. The causes of the low contribution of renewable energy sources to the energy mix was due to:

i. Lack of Specific Legislation for Promotion of Renewable Energy Technology

There is no specific legal framework dealing with renewable energy in their entirety, however, these were regulated under the Energy Regulation Act and when used for electricity generation, the Electricity Act also applied.

ii. Renewable Energy Strategy not in Place

The Ministry did not have a Renewable Energy Strategy which would take into account the Renewable Energy Sources in the country and the potential of the sources for exploitation. For instance in which places solar can be best used and how much of it can be exploited. This would enable the Ministry set targets on how to exploit the energy sources.

iii. Policy Emphasises Grid-Connected Hydropower at the Expense of Other Renewable Energy Technologies

Zambia's policy direction with regard to RETs is only guided by the National Energy Policy of 2008 which was an outcome of consultative reviews of preceding policy tools. With regard to renewable energy, the policy tool seeks to address barriers to the use of RETs. However, in its present state, the policy emphasises grid-connected hydro-power at the expense of other RETs. Eleven (11) interviews conducted at the Ministry revealed that the current policy did not cover issues to deal with off-grid systems as there was potential for rural areas to benefit more from off-grid system than on-grid system which is ideal for urban areas. It was further revealed that there are no regulations covering the Mini-grids isolated from ZESCO which are not part of the national grid.

6.1.2 Data on the Resource Potential or the Production and Consumption of Renewable Energy Resources

According to the Ministry of Mines, Energy and Water Development Strategic Plan 2014-2016, the Ministry planned to undertake a Renewable Energy resource mapping country-wide by

¹¹ Review of Renewable Energy Technologies in Zambian Households: Capacities and Barriers Affecting Successful Deployment Published: 30 May 2018

2016. It was aimed at developing Wind and Solar Resource Maps and assessing the potential power generating capacity from Wind Energy. The project involved installation of wind and solar measuring equipment on selected sites, collection of data for wind and Solar, and capacity building of key institutions i.e. the DOE, Zambia Meteorological Department (ZMD), University of Zambia (UNZA) and ZESCO Ltd.

The Ministry had not undertaken the renewable energy resource mapping as planned in the 2014-2016 Strategic Plan. The renewable energy resource map was earmarked for completion in 2016 resulting in a delay of two (2) years without availability of data. The cause for the delay was that the Ministry was undertaking the data collection exercise which commenced in 2015 and was concluded in December 2018 and launched in June 2019.

As regards unavailability of data on other renewable energy potential such as geothermal which also needed to be quantified, the Ministry had not undertaken further studies to ascertain potential of other forms of renewable energy as a way of diversification. According to the Ministry, the studies were costly and were being undertaken by the independent power producers at their own cost. With availability of the resource mapping on solar and wind, the Ministry would have a focussed approach in terms of how they exploit renewable energy sources as they would be aware of the potential energy sources in each area.

6.1.3 Developing the Investment Plan for Renewable Energy Projects

One of the objectives of the Scaling Renewable Energy Programme (SREP) was to develop an Investment Plan for Renewable Energy projects. The SREP aimed at assisting low income countries to use new economic opportunities to increase energy access through renewable energy use. The SREP was facilitating development of an Investment Plan (IP) for priority projects and programmes on Renewable Energy in Zambia and a grant amounting to \$300,000 had been disbursed for the preparation of the SREP IP. The Ministry conducted activities to aid the preparation of the IP which included a task force meeting and the Expression of Interest for development of an Investment Plan and pre-feasibility studies was also advertised and evaluation of the EOIs was conducted and firms were shortlisted. However, the Ministry had yet to request for proposals from the shortlisted firm, evaluate and sign contract for the consultant to prepare the IP. The Ministry was only able to finalise the IP in May 2019. The availability of the IP would enable the Ministry use new economic opportunities to increase energy access through renewable energy use.

6.1.4 Beneficiaries in Rural Areas not Accessing Energy from Renewable Energy Sources

According to the National Energy Policy of 2008, Government shall increase access to energy, particularly in rural areas, by among other options facilitating the availability of suitable forms

of energy and promote utilisation of renewable sources of energy, improve availability and use of energy in rural areas.

Although the Ministry and REA were implementing Renewable Energy projects in rural areas, it was observed that there was slow progress in implementing renewable energy projects by the Ministry. During the period under review, the Ministry had been implementing a number of projects to promote use of RES. It was observed that a number of projects aimed at promoting use of RES stalled due to the Ministry failing to adequately conduct monitoring and evaluation of on-going projects. In some cases, inadequate funding hampered the Ministry's efforts to complete on-going projects. The **Appendix 3** shows the activities planned by the Ministry but not fully implemented due to inadequate funding to carry out the activities.

It was also noted that there was under developed generation, transmission and distribution infrastructure through physical inspections. The Ministry through the Rural Electrification Authority was developing the Lunga Solar Mini Grid Project located in Lunga district of Luapula Province. It involved the construction of a 300 Kilowatt Solar Mini Grid on Kasomalunga Island at a cost of K3,350,762.95 to benefit schools, rural health centres, local court, market, shops, business (fishing), churches and associated institutional staff housing. The contract was awarded to Astor Investments Limited to carry out civil works at a contract sum of ZMW 3,350,762.95 and the contract had duration of thirty-two (32) weeks. However, a physical inspection of the project revealed that no works had commenced at the site. Although the contractor had been paid a sum of K502, 614.44 representing 15% of the contract sum as advance payment, by the time the contract was being terminated, the works had not commenced. The cause for the delays were due to the contractor not having the required equipment on site to undertake the works; and despite several reminders the Contractor failed to provide key site personnel.

To complete the outstanding work, a tender was floated to invite bid and closed on 6th October, 2017 and a successful bidder, WAH Kong Enterprises Limited was to be engaged in the first quarter of 2018 at a cost of K5, 011,756.42. The contract duration was one (1) year from 17th April, 2018 to 16th April, 2019. The new contractor had to start the works from the beginning since the previous contractor did not commence the works.

In light of the above, the site was handed over to the Contractor on 10th April 2018. The delay was attributed to the late submission of the detailed design and drawing by the Contractor as well as the delayed provision of construction equipment/materials and approved personnel on the project site. Further, it was observed that the Ministry only conducted a Market, Economic and Financial Analysis Study to establish the suitability of the project. A feasibility study should

have been the best way of executing the project considering the terrain of the island. At the time of visit in February 2019, the works at the site had not commenced as shown in **figure 2** below.

Figure 2: Incomplete Development of the Kasoma Lunga Solar Mini-Grid- Lunga District



Source: OAG-2019

6.1.5 Maintenance of Renewable Energy Projects

The terms of the contract stipulate that the contractor should provide maintenance for a period of one (1) year after which the project is handed over to the community.

However, a physical inspection of projects revealed that the Ministry did not carry out maintenance of Renewable Energy projects after they were installed. For instance, the Ministry installed five solar water pumps in Eastern Province at the following sites (Mugabe, Musipazi, Khapinde, Maguya and Chikando RHC). The terms of the contract stipulated that the contractor was to provide maintenance for a period of one year after which the project was to be handed over to the community. However, it was observed that the solar water pumps were non-functional in Musipazi.

Interviews with the rural beneficiaries at the site revealed that the solar water pumps developed a fault in 2016 and had not operated since as the warranty had expired and the beneficiaries did not have the capacity to maintain and provide security for the equipment. The other sites namely Mugabe, Khapinde, Maguya and Chikando RHC had leaking tanks. The water tanks were mounted on weak stands that were warping posing a high risk of them falling off. There was also vandalism at the site resulting in the taps not being operational. Control boxes were not switching off resulting in the pumps not being regulated thereby having wastage of water. In some instances, solar systems being stolen as well as control panels due to inadequate security at the sites.

Figure 3: Leaking Borehole Chikando RHC



Source: Chikando RHC, Chipata – 2019

The Ministry had also installed solar home systems in Milenge district. Inspections of the Solar Home Systems revealed that some of the Solar Home Systems were not operational. Interviews with the beneficiaries revealed that some of the systems had developed faults after they were installed in 2014. The Ministry had not been to inspect the sites and rectify the faults since then. The **Appendix 4** shows the SHSs inspected and the status of the systems. It was also observed that the systems had been vandalised as shown in **figure 4** below.

Figure 4: Vandalised Solar Home Systems



Source: District Administration Offices, Milenge District - 2019

The cause for poor maintenance of projects was that the Ministry did not have a sustainability plan in place to ensure that maintenance is carried out after the projects are handed over to the communities. During the installations, the beneficiaries were sensitised on the maintenance and

application of user manuals for solar home systems in the public institutions. It was noted through interviews that the only sensitisation provided was at the time the systems were installed in 2016 and in most cases, the officers available at the time of handover had been transferred to other provinces. It was also observed that the beneficiaries and the Ministry did not maintain a record of faults and repairs conducted during the one (1) year warranty or after, so as to provide details of any works conducted.

The Ministry had also failed to carryout quarterly monitoring and evaluation activities of the Renewable Energy Projects that have been implemented in various districts in the country due to insufficient funding to the M&E activities. Interviews with the Ministry of Energy established that Monitoring and Evaluation is a core function for the Ministry; therefore this activity has had a budget line since 2015, however, the released funds according to the approved budget allocation were not adequate to undertake Monitoring and Evaluation activities.

Furthermore, it was also observed that REA had not conducted monitoring and evaluation of donated SHS. According to the mandate, REA was to promote utilisation of available electrification technological options to enhance the contribution of energy to the development of energy and to the development of economic and social activities in rural areas. The proposed modes of deployment of sustainable solar market packages (SSMP) kits included the following options which were approved by the board:

- i. Distribution to public institutions,
- ii. Selling to a private company,
- iii. Engaging a company/organisation to sell on behalf of REA,
- iv. Distribution through Members of Parliament; and
- v. Distribution to a selected rural area.

However, it was observed that during the period from April, 2017 to January, 2018, the Authority distributed a total of 888 Solar Kits valued at K1, 629,320 to forty-four (44) Members of Parliament for distribution to their Constituencies. There were no details on how the kits were distributed to the beneficiaries and the Authority had not conducted any verification to ascertain whether the kits were operational and were benefiting the intended beneficiaries. As a result, the Ministry and REA were not able to establish whether RE projects implemented were still operational and the targeted beneficiaries were benefiting from the projects.

6.1.6 Levels of Awareness on Renewable Energy Technologies

According to the National Energy Policy of 2008, Government shall increase information available to consumers and potential energy service providers, and provide education and technical advice in the efficient use and conservation of energy.

There were low levels of awareness on renewable energy technologies to the beneficiaries by the Ministry. Further, there has been poor dissemination of information largely due to inadequate communication infrastructure, low literacy levels and inadequate funding to the programme. According to a review of Renewable Energy Technologies in Zambian Households: Capacities and Barriers Affecting Successful Deployment Published on 30th May, 2018, one of the major factors which was preventing successful adoption of RETs in Zambia was a low level of awareness on the benefits, functional characteristics and efficiency of renewable energy technologies available for use by households. Policies, incentives and benefits associated with RETs in Zambia had not been effectively communicated to energy users to the extent that they would make informed and deliberate decisions to transition to the use of renewable energy. Usage of ever improving renewable energy technology will depend on how well-informed a potential household decision-maker is on the sources of energy for domestic use resulting in increased use of clean energy sources over time.

6.1.7 Investment in Research and Development

According to the National Energy Policy of 2008, Government will increase supply of energy and access for rural income generation activities and households through supporting applied research and development of modern energy services¹² to strengthen the Institutional Framework for Research and Development, and promotion of RETs by: Strengthening the capacity of the Rural Electrification Authority (REA) in the application of RETs.¹³

At the time of the audit in 2019, the Ministry and REA had not effectively invested in Research & Development. Although RE projects such as the projects visited during the audit implemented were aimed at demonstrating available energy technologies, the Ministry faced challenges in maintaining and monitoring the projects. This was because the R&D activity was very costly and there was no subsequent budget allocated for this specific activity. Consequently, it was not clear on how REA would increase the supply of energy to rural households without R&D framework that would ascertain the cost benefit analysis and viability of the project.

¹² National Energy Policy of 2005

¹³ National Energy Policy of 2005

An analysis of the funding arrangements and budgets showed that the Department of Energy had a budget of K10, 861,943 for the period 2015 and 2019 allocated towards Renewable and Alternative Energy Development and Promotion. In addition, a total of K1, 130,596,377 was allocated for renewable energy projects under the Rural Electrification projects. **Table 4** below shows the detailed budget for renewable energy for the Department of Energy and Rural Electrification Authority respectively.

Table 4: Renewable Energy Budget Details						
Institution	Budgets					
	2015	2016	2017	2018	2019	Total
	K	K	K	K	K	K
Department of Energy - Renewable Energy Unit	8,762,914	450,337	146,000	294,000	1,208,692	10,861,943
Rural Electrification Authority	213,662,996	136,665,876	154,716,305	459,227,200	166,324,000	1,130,596,377
Total	222,425,910	137,116,213	154,862,305	459,521,200	167,532,692	1,141,458,320

Source: Ministry of Energy and Rural Electrification Authority, 2015 -2019

As can be seen from the table above, the budget for promotion of renewable energy sources in the Department of Energy decreased from K8, 762,914 in 2015 to K294, 000 in 2018 representing a percentage decrease of 96.6%. However, in 2019, there was an upward increase of 75.7% from K294, 000 to K1, 208,692.

REA had a budget of K459, 521,200 allocated for electrification programmes in 2018. There was a reduction of 63.8%% in 2019 with the budgeted amounting to K166, 324,000.

6.2 To what extent has the Ministry facilitated increased access to electricity through private public partnership participation in rural electrification projects for renewable energy?

6.2.1 Private Sector Participation in Rural Electrification using RES

According to the National Energy Policy of 2008, in order to promote private sector participation in rural electrification, government shall develop an investment marketing campaign programme for local and international resource mobilization.¹⁴ In order to promote private sector participation in rural electrification, the REA will establish or identify institutions for the generation, distribution and supply of electricity to rural areas and undertake appropriate road shows to attract investors and participants in Small Power Projects (SPP).

However, through a review of documents and interviews held with key personnel at REA, it was revealed that REA did not develop an investment marketing campaign framework necessary for attracting local and international resource mobilization. This was because the

¹⁴ According to the National Energy Policy of 2008

annual budgets during this period could not accommodate this activity. In addition, there was inadequate incentives i.e. private sector participation in the renewable energy sub-sector. Fiscal incentives and some form of smart subsidies had yet to be implemented to enable the development of renewable energy projects and make them financially attractive for private participation. Although import duties had been waived for importation of solar and energy efficient products through Statutory Instrument (SI) 32 and 33 of 2008 and the REA had provided smart subsidies through the Rural Electrification Fund (REF) to private players in the sector, it was indicated that with the available tax incentives in the sector, the number of private players still remained low due to high cost of renewable energy technologies and the absence of the regulatory framework for the off-grid sector.

Without an investment marketing campaign, it was very difficult for REA to develop a framework on how to implement and manage capital subsidies for generation and distribution of projects, develop a comprehensive framework for Small Power Projects (SPP) that includes technology specific tariff structure and tariff review methodologies in conjunction with the Energy Regulation Board (ERB). Consequently, this meant that REA did not have an effective tool necessary to attract investment and how the investors will return their investment based on prevailing market and investment conditions.

6.2.2 Communication Policy and Strategy

In order to promote stakeholder awareness and participation in rural electrification, REA planned to review the communication policy and strategy to guide information sharing with various stakeholders in its Strategic Plan for the period 2014-2018. An effective communication strategy forges and maintains connections, allowing the business of the organization to work efficiently toward its goals and strengthening strategic partnerships.¹⁵

The audit revealed that REA was using an outdated Communication Policy and Strategy. Despite having planned to review the Communication Strategy for the period of 2014 – 2018, this was not done. The Authority developed its first Communication Strategy in 2009 which was designed on the objectives of the 2009 – 2013 Strategic Plan based on the functions of REA as defined in the Act, vision, mission and strategic objectives. The Communication Strategy could not be developed in the subsequent years i.e. 2015 to 2019 because the annual budgets during this period could not accommodate this activity. In addition, the department of Energy submitted that this assignment could not be undertaken because it included a huge component of performance evaluation and review of the previous strategy hence the plan to engage a

¹⁵ Strategic Plan 2014 – 2018

consultant. Consequently, this meant that REA did not have an updated communication plan that would develop a profile for Public Private Partnerships for both local and international firms. This also created a gap in informing stakeholders on the existence and possible applications of PPPs that would explain the potential advantages and disadvantages of PPPs to promote best practice in the development and application of the PPP approach; and provide a resource for the general public, potential participants and interested parties to obtain information/clarify issues.

Chapter Seven

Conclusion

The overall aim of the study was to audit the promotion of renewable energy sources in rural areas of Zambia from the period 2015 – 2019. The Ministry of Energy has put in place measures to facilitate increased access to renewable energy sources to targeted rural beneficiaries. The conclusions of the audit areas are as set below.

- i. The audit concludes that the measures in place are not effective in ensuring increased access to renewable energy sources. The contribution of alternative energy sources to the national electricity mix still remains low. Further, access to electricity in rural areas also remains low. The Ministry is diversifying the country's energy mix by promoting renewable energy, however, the progress is hindered due to a number of factors identified during the audit. For instance, the current legal and regulatory framework has not adequately addressed the exploitation of RES.
- ii. Access to RES is also dependant on development and maintenance of renewable energy projects in order to enhance generation, transmission and distribution of electricity using RES. The delays by the Ministry in completing renewable energy projects has resulted in targeted beneficiaries not deriving benefits from the projects. Although inadequate and erratic funding is identified as one of the causes for the delays, failure to conduct feasibility studies before commencement of projects is also a contributing factor to the delays. Maintenance of the implemented projects has also been poor and in some cases non-existent. This is due to the fact that the Ministry does not have a sustainability plan in place for communities so that there is continuity of the project once it is handed over to the beneficiaries. The monitoring and evaluation system for the projects is very weak as evidenced by the poor state of infrastructure.
- iii. Further, the Ministry has not adequately invested in Research & Development as the projects inspected aimed at demonstrating available energy technologies are not adequately monitored and maintained. In an effort to promote and attract private sector participation in rural electrification, an Investment Marketing Campaign programme is required, however, this is not in place resulting in limited investment in renewable energy sources in rural areas.
- iv. In order to supply timely and quality information needed to increase Public-Private Partnership in rural electrification, it is imperative to have an up to date communication strategy which has not been reviewed as planned by REA. In the absence of a Communication Strategy, PPP in rural electrification was limited.

- v. On a positive note, the Ministry has in place a renewable energy resource mapping for the country for wind and solar. The purpose of the mapping is to take stock of the RES in the country and the potential of the sources for exploitation. With this focussed approach, the Ministry is able to identify potential or the production and consumption of RE resources in the country which is key in identifying areas with the most potential. However, much needs to be done to ensure that mapping for other sources such as geothermal is done to diversify the energy mix. The Ministry also has in place an Investment Plan which was finalised in May 2019. This ensures that the Ministry has a structured approach to exploit opportunities to increase energy access through renewable energy use.

Chapter Eight

Recommendations

This chapter presents the recommendations of the study. The intention of the audit is to help the Government through the Ministry of Energy, and other stakeholders on the promotion of renewable energy sources in rural areas of Zambia. The recommendations of the audit are follows.

- i. The Ministry should ensure that the Renewable Energy Strategy is implemented to aid in the exploitation of RES in rural areas of the country.
- ii. A resource mapping should be carried out on other sources of energy such as Geothermal so as to have readily available data on renewable energy potential thereby improving the energy mix.
- iii. The Ministry should ensure that a sustainability plan should be provided to the communities so that there is continuity of projects once handed over to the beneficiaries.
- iv. The Ministry should ensure that users are provided with manuals when handover of renewable energy projects is done so as to avoid them tampering with the installations when faced with challenges.
- v. Sensitisation on use of installations should be carried out once projects are handed over to beneficiaries.
- vi. Funding towards RE projects should be improved. The Ministry should also prioritise available funding to ensure that Renewable Energy projects are effectively implemented.
- vii. Regular monitoring of projects should be carried out by the Ministry to ensure that all problems encountered are rectified by trained officers.
- viii. The Ministry through REA should be carrying out applied Research & Development to ascertain and know the cost benefit analysis and viability of undertaking its projects and how to profitably supply electricity to rural populations in the most effective, economical and innovative way.
- ix. The Ministry through REA has to design and develop an Investment Marketing Campaign Strategy that will identify and attract private sector investors for the generation, distribution and supply of electricity to rural areas.
- x. The Ministry through REA should review and update its communication strategy which will enable it to identify critical issues and prepare effective strategies. In particular, it can frame discussions with beneficiaries, clarify project impacts and objectives, and ultimately increase public support for a given project.

Appendices

Appendix 1: Documents reviewed at the Ministry of Energy and the Rural Electrification Authority

Documents Reviewed	Purpose for Review
Rural Electrification Master Plan 2008 – 2030	To gain an in depth understanding of; (a) Development of selection criteria for rural electrification projects (b) Selection of candidate site for rural electrification considering socio-economic and technical aspects (c) Selection of electrification methods, Extension of existing grid, Isolated mini-grid with renewable energy, such as mini- and micro-hydro power generation and Solar home system (SHS) Mini-grid with diesel power generation.
National Energy Policy of 2008	To gain an understanding on how the Ministry of Energy and various stakeholders involved in the promotion of Renewable Energy Source is creating conditions that will ensure the availability of adequate supply of energy from various renewable sources at the lowest economic, financial, social and environmental cost consistent with national development goals.
Rural Electrification Act of 2003	To understand the mandate of various key stakeholders involved in the promotion of renewable energy sources and also to be used as a source of criteria.
Operations Manual for Financing Guidelines	To understand the criteria the key stakeholders use in the identification, selection and implementation of the various renewable energy projects.
The five year Rolling Plan/Annual Work Plan 2015 -2019	To identify Renewable Energy related activities that were planned for execution during the period under review.

Annual Reports for 2015, 2016, 2017 and quarterly reports for 2018	To assess the extent to which renewable energy targeted activities were implemented and challenges that were being faced during the implementation.
Organisation Structure and Establishment indicating both filled and unfilled positions	Assess whether the approved establishment has been filled up. The information was also helpful in identifying the roles and responsibilities of the key personnel in the promotion of Renewable Energy in rural areas.
Databases of all Renewable Energy Projects.	To understand the type of project, location, cost, when they were started, when they were supposed to be completed and when they were actually completed.
Internal Audit Reports for the period 2015, 2016, 2017 and 2018.	Internal Audit reports were reviewed to provide information on the implementation of renewable energy programmes. Internal audit reports provided information on the weaknesses identified and whether recommendations provided had been implemented.

Appendix 2: Renewable Energy Projects Visited

Town	Sites/Project
Milenge	<u>Solar Home Systems</u> Lunga Primary School East 7 Rural Health Centre Milenge District Office Kapalala Primary School
Lundazi	<u>Sustainable Solar Market Packages</u> Chikomene Chief Palace Chikomene Local Court Semphe Primary School Lumimba Day Secondary School Chitungulu Rural Health Center Chitungulu Primary School
Chama	Viombo Basic School
Chipata	<u>Solar Water Pumping Systems</u> Mugabe Community Muzipasi Trading Area (Market) Khapinde Basic School Maguya Basic School Chiponde Rural Health Center
Samfya	Lunga Mini-Grid Mpata Home Solar Systems

Appendix 3: Activities not Implemented by the Ministry 2015-2018

Year	Activity not Implemented	Reasons for not Implementing
2015	1. Installation of Wind Energy Systems - Two boreholes drilled in Northern Province and Two boreholes drilled in Luapula Provinces	Funding not received from Ministry of Finance
2016	1. 4 potential sites for Windmill installation identified by June 2016. Only site identification done but no installation	The activity was budgeted for. The Ministry received K50,000 which is not adequate
	2. 30 Bio digester systems installed by October, 2016	The activity was budgeted for. However only K30,000 was budgeted and received and this was not adequate
	Promotion of Solar Water Heaters	Not conducted. Funding of K14,074 was total budget and this was not adequate
2017	Solar Street Lights 1. Milenge District 2. Nalolo District 3. Mungwi District	Not done
	Solar Water pumps 1. Mungwi 2. Chipata	Not done A tender of 15 solar water pumping systems to be installed in Mungwi (10) and Chipata districts (5) and solar street lights in Mungwi and Milenge was awarded to Zamgreat Ltd but has not taken off due to funding. Approved budget was K30,000 against a contract sum of K1,600,000
	Solar-Wind Hybrid Systems 1. Southern and Western Provinces. 2. Not done Only site identification was done.	Not done. Approved budget was K66,000

	<p>Solar water pumping system</p> <p>The Systems are to be installed in the following institutions;</p> <ol style="list-style-type: none"> 1. Musokotwane basic school. 2. Kaumba Basic School. 3. Simungoma Basic School 4. Moboola R.H.C 5. Kalomo High School 	<p>Yes, approved budget was K30,000 against contract price of K360,000</p>
2018	<p>Projects under the Rural Electrification Master Plan not fully implemented due to inadequate funding in the year</p>	<p>Not implemented. Approved budget for the Rural Electrification Master Plan was K160,400. However, the funds were not recieved.</p>
	<p>Infrastructure Maintenance and Development</p>	<p>Not implemented. Approved budget for infrastructure maintenance and development was K50,000, however, the funds were not recieved.</p>
	<p>Renewable and Alternative Energy Development</p>	<p>Not implemented. Approved budget for renewable and alternative energy development K294,000, however, the funds were not recieved.</p>
	<p>Energy Efficiency and Conservation</p>	<p>Not implemented because funds not received by user dept. The Ministry had budgeted K442,720.00 for the activity out of which K50,000 was released. The expenditure incurred was K49,908.20. however, it was not received by the user department.</p>

Appendix 4: SHSs inspected in Milenge District and status of the installations

Place Visited	No. of Installations	Status of Installations
Kapalala Primary School	<ul style="list-style-type: none"> The panels were installed at four (4) staff houses and two (2) classroom blocks to benefit 651 pupils and twenty (20) teachers The installations comprised of one (1) panel, two (2) batteries and one (1) inventor 	<ul style="list-style-type: none"> All the batteries and inventors were not working. The charge controllers were attached but there was need to have them tested to verify if all were working
District Administration Offices		<ul style="list-style-type: none"> District Commissioners' (DC) House: the system was not operational as the inventor blew up during the rainy season DC's office: not operational Forest Department- Operational DC Administration Office: not operational due to vandalism. The batteries were not available National Registration Office: the system was not working as the battery had been removed in July 2018 Ministry of Health: the system was working although they faced challenges with the batteries which were worn out. Zambia Police: the system was vandalized Council Chambers and Council Secretary's office: Operational ZANIS: the system was not working since October 2017 as it had been vandalized Director of Works: the system was not working and the connections had been removed
East 7 Rural Health Centre	Three (3) SHS were installed in at the facility	<ul style="list-style-type: none"> All the inventors had not been operational since 2017 at the RHC. The panels were available at the facility but the inventor and batteries were missing. Two (2) staff houses were also inspected. Although the panels were still installed, the inventors and batteries were missing
Lunga Primary School	Two (2) systems were installed at the school blocks in 2014	<ul style="list-style-type: none"> The systems were not operational at the time of visit in 2019. Users of the system at the school indicated that the system had not been functional for some time when it began failing to operate a few years after it was installed in 2014.

		<ul style="list-style-type: none"> • The inventor box for one of the installations was stolen. The cables and panels had also been removed to safeguard them against theft
Milenge Primary School	The SHS were installed in five (5) houses and three (3) offices	<ul style="list-style-type: none"> • All the systems were available. However, they were not operating as they should. The batteries for all the systems were drained and therefore they had to connect directly to the batteries.

Appendix 5: Audit Criteria

AUDIT QUESTIONS & CRITERIA

a. To what extent has the Ministry implemented effective measures to promote the use of Renewable Energy Sources in rural areas?

According to the National Energy Policy of 2008, Government shall increase access to energy, particularly in rural areas, by among other options facilitating the availability of suitable forms of energy and promote utilisation of renewable sources of energy, improve availability and use of energy in rural areas.

Government shall increase supply of and access to modern, affordable, reliable and sustainable energy services to promote economic growth and reduce poverty. In addition, ensure sustainable management of existing resources and promote access to these resources by continuing the acceleration of rural energy supply and access.

i. Has the Ministry ensured that sufficient data and information is readily available on the Renewable Energy potential in rural areas?

According to the National Energy Policy of 2008, Government shall ensure availability of data and information on market demand, resource assessment and applicability of Renewable Energy Technologies (RETs) by undertaking studies on needs/demand, resource and technology assessments of RETs.

Renewable Energy resource mapping undertaken country-wide by 2016.

- The strategic objective of the Ministry is to provide adequate and reliable supply of energy in order to increase access to use of renewable and alternative sources of energy by setting the following indicators:

<ul style="list-style-type: none"> • Electricity access in rural areas increased from 3% to 8% by 2016 • Contribution of power from solar and mini-hydro resources to electricity generation mix increased from 0.72% to 2.7% • Contribution of alternative energy (solar and wind) to the electricity generation mix increased from 0% to 18.6%¹⁶ • The Authority will monitor a set of operational progress indicators to determine institutional effectiveness in project implementation and stimulating the market for renewable energy services. 	<p>ii. Has the Ministry ensured that significant infrastructure is available to exploit RES?</p> <p>According to the National Energy Policy of 2008, Government shall increase access to energy, particularly in rural areas, by among other options facilitating the availability of suitable forms of energy and promote utilisation of renewable sources of energy, improve availability and use of energy in rural areas.</p>
<p>iii. Has the Ministry ensured that awareness campaigns are conducted so as to sensitise communities on modern energy sources?</p> <p>According to the National Energy Policy of 2008, Government shall increase information available to consumers and potential energy service providers, and provide education and technical advice in the efficient use and conservation of energy.</p>	

¹⁶ MMEWD Strategic Plan 2014-2016

iv. Has the Ministry ensured routine inspections and maintenance of RE projects to ensure increased access to electricity in rural areas?

The terms of the contract stipulate that the contractor should provide maintenance for a period of one year after which the project is handed over to the community.

v. Has the Ministry invested in Research and Development for RE programmes in rural areas?

According to the National Energy Policy of 2008, Government will increase supply of energy and access for rural income generation activities and households through supporting applied research and development of modern energy services.¹⁷

Further, to strengthen the Institutional Framework for Research and Development, and promotion of RETs by:

- establishing a co-ordinating agency for RETs;
- development of a mechanism for integration of RETs with institutions involved in developmental activities;
- Integrating RETs policy in poverty reduction programs; and
- Strengthening the capacity of the Rural Electrification Authority (REA) in the application of RETs.¹⁸

¹⁷ National Energy Policy of 2005

¹⁸ National Energy Policy of 2005

<p>b. To what extent has the Ministry facilitated increased access to electricity through private public partnership participation in rural electrification projects for renewable energy?</p> <p>i. Has the Ministry of Energy put in place measures to increase and maintain the number of Financiers in Rural Electrification programmes?</p> <p>According to the National Energy Policy of 2008, to increase supply of energy and access for rural income generation activities and households through:</p> <ul style="list-style-type: none"> • creating awareness among investors of Government programs to promote rural energy supply; • creating innovative microcredit financial instruments; • developing smart subsidies for energy in rural areas; <p>ii. Has the Ministry of Energy strengthened investment marketing campaign programmes for international resource mobilisation?</p> <p>In order to promote private sector participation in rural electrification, government shall develop an investment marketing campaign programme for local and international resource mobilisation</p> <p>One of the policy objectives for the RE sector is to promote development and use of modern energy in rural areas establishing an institutional framework for resource mobilisation, system planning and expansion</p>

<p>iii. Has the Ministry of Energy ensured that the communication strategy is reviewed for increased Public Private Partnership?</p> <p>In order to promote stakeholder awareness and participation in rural electrification, REA planned to review the communication policy and strategy to guide information sharing with various stakeholders in its Strategic Plan for the period 2014-2018.</p>

Appendix 6: Availability and Utilisation of Renewable Sources in Zambia

Renewable Energy Source	Opportunities/Use	Resource Availability	Potential Energy Output
Solar	Thermal (water heating), Electricity (water pumping, lighting, refrigeration)	6-8 sunshine hours per day	5.5 kWh/m ² /day (modest potential especially for limited irrigation)
Wind	Electricity, Mechanical (water pumping)	Average 2.5m/s	Good potential especially for irrigation.
Micro-hydro	Small grids for electricity supply	Reasonably extensive	Requires elaboration and quantification
Biomass (Combustion and gasification)	Electricity generation	Agro wastes Forest wastes Sawmill wastes	Requires elaboration and quantification
Biomass (biomethanation)	Electricity generation Heating and cooking	Animal waste Municipal and Industrial waste Waste water	Potential requires elaboration
Biomass (extraction, processing for transport)	Ethanol for blending with gasoline to replace lead as octane enhancer Biodiesels as a blend or in stationary engines	Sugarcane Sweet sorghum Jatropha	Requires elaboration and quantification
Biomass (for household energy)	Improved charcoal production Improved biomass stove	Sawmill wastes and indigenous trees from sustainable forest management	Reasonably Extensive
Geothermal	Electricity generation	Hot springs	Requires elaboration and quantification

Source: National Energy Policy 2008

Appendix 7: Key Stakeholders in the Promotion of Renewable Energy Sources

Stakeholder	Roles
Energy Regulation Board (ERB)	This is an independent energy sector regulator for electricity, petroleum and other forms of energy including Renewable Energy. It is responsible for ensuring reasonable return on investment for operators/utilities, quality service at affordable prices to customers, licensing of operators/utilities, setting markets and monitoring competition in the market. (RRA 2013)
Office for Promoting Private Power Investment (OPPPPI)	This is a unit within the Ministry of Energy that was set up in 1999 to attract private sector funds for generation (including hydro) and transmission systems. (RRA 2013)
ZESCO	ZESCO was established in 1970 and is fully owned by the Industrial Development Corporation, a fully state-owned investment holding company, owning all state-owned enterprises. The company operates the electricity grid and is responsible for much of the country's power generation.
Zambia Environmental Management Agency (ZEMA)	The Zambia Environmental Management Agency advises on environmental policy formulation, makes recommendations for the sustainable management of the environment, ensures the integration of environmental concerns in overall national planning, reviews environmental impact assessment (EIA) and strategic environmental assessment (SEA) reports, and facilitates public access to environmental information in the Country.

Source: Africa–EU Renewable Energy Cooperation Programme¹⁹

¹⁹ Long-term programme for cooperation between Africa and Europe on Renewable Energy Launched in 2010