Climate Investment Funds

April 16, 2019

SREP INVESTMENT PLAN FOR ZAMBIA
REVISED

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No.....
MOE101/9/47

Republic of Zambia
MINISTRY OF ENERGY

THE PERMANENT SECRETARY
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12th April 2019

Mafalda Duarte
Practice Manager
Climate Investment Funds Administrative Unit
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RE: RE-SUBMISSION OF SREP INVESTMENT PLAN FOR ZAMBIA

As you are aware, the Government of the Republic of Zambia (GRZ) presented its Scaling-Up Renewable Energy Programme (SREP) in Low-Income Countries Investment Plan (IP) to the SREP Sub-committee for endorsement on 1st February 2019, in Ouazazate, Morocco. However, the IP was not endorsed owing to comments raised by the sub-committee for improvement of the IP. Therefore, the sub-committee requested the GRZ to further review the Investment Plan taking into account the comments raised at the meeting of 1st February 2019 and to resubmit the updated IP for endorsement by email prior to the next sub-committee meeting, including a request for approval of Project Preparation Grants (PPGs) under the IP.

Based on the comments and recommendations of the Sub-committee, I am pleased to submit the updated SREP Investment Plan for Zambia. The updated IP maintains three (03) priority areas in line with national strategic objectives and priorities for the energy sector. These are; 1) Energy Access in Rural and Peri-Urban Areas, 2) Wind Power Promotion and 3) Investments in Geothermal Development;

However, I would like to bring to your attention that this IP will not be requesting for SREP Funds with regard to Component 3 (Geothermal Development). This is attributed to the fact GRZ could not secure a lead Multi-lateral Development Bank (MDB) for this component which is considered as only emerging and needs further exploitation. Nonetheless, this remains a national priority in light of the energy mix diversification agenda currently being pursued by the Zambian Government.

Finally, we would like to express gratitude to the Climate Investment Funds (CIF) Administrative Unit and members of the Sub-committee for giving Zambia an opportunity re-submit this Investment Plan.

Yours Sincerely,

Arnold M. Simwaba
Acting Permanent Secretary
MINISTRY OF ENERGY

THE REPUBLIC OF ZAMBIA

SCALING-UP RENEWABLE ENERGY PROGRAM
IN
LOW INCOME COUNTRIES
INVESTMENT PLAN

MINISTRY OF ENERGY

2019

ACRONYMS AND ABBREVIATIONS

AfDB	African Development Bank
BOZ	Bank of Zambia
CEC	Copperbelt Energy Corporation
CIF	Climate Investment Funds
CO_2	Carbon Dioxide
COP	Conference of the Parties
CSO	Central Statistical Office
DOE	Department of Energy
EE	Energy Efficiency
ESAP	Electricity Service Access Project
ERB	Energy Regulation Board
ESMAP	Energy Sector Management Assistance Program
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GHG	Green House Gas
GRZ	Government of the Republic of Zambia
GTF	Global Tracking Framework
ICS	Improved Cookstoves
IDC	Industrial Development Corporation
IFC	International Finance Corporation
NDC	Nationally Determined Contribution
IP	Investment Plan
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
KPI	Key Performance Indicator
LCMS	Living Conditions Monitoring Survey
LCOE	Levelized Cost Of Electricity
LPG	Liquefied Petroleum Gas
M&E	Monitoring and Evaluation
MDB	Multilateral Development Bank
MOE	Ministry of Energy
MW	Megawatt
MWh	Megawatt hour
NAMA	Nationally Appropriate Mitigation Action
NEP	National Energy Policy
OBA	Output Based Aid
OECD	Organization for Economic Cooperation and Development
OPPPI	Office for Promoting Private Power Investments
PPA	Power Purchase Agreement
PSDMP	Power Systems Development Master Plan
PV	Photovoltaic
RBF	Results Based Financing

REA	Rural Electrification Authority
REFIT	Renewable Energy Feed-In Tariff
REMP	Rural Electrification Master Plan
SADC	Southern Africa Development Community
SAPP	Southern Africa Power Pool
SE4ALL	Sustainable Energy for All Initiative
SHS	Solar Home System
SI	Statutory Instrument
7NDP	Seventh National Development Plan
SCF	Strategic Climate Fund
SIDA	Swedish International Development cooperation Agency
SREP	Scaling-Up Renewable Energy Programme in Low Income Countries
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
ZABS	Zambia Bureau of Standards
ZDA	Zambia Development Agency
ZEMA	Zambia Environmental Management Agency

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FOREWORD

Zambia has great potential for renewable energy including solar, mini-hydro, biogas, wind, geothermal and biomass. However, these resources need to be harnessed and developed at scale to support our Rural Electrification Programme and development agenda. The need to increase access to clean and modern energy cannot be over emphasised as energy will continue to be at the centre of our country's socio-economic development towards the attainment of the vision 2030 of becoming a prosperous middle-income nation. Recognising the potential contribution of renewable energy to the country's future energy mix, the Government of the Republic of Zambia has the ambition to foster the development of low-carbon energy initiatives through harnessing its renewable-energy resource base. Renewable energy, which is environmentally benign, can improve access to sustainable modern and cleaner energy services with the potential for contributing to job creation, income generation, and improved livelihoods of marginalised social groups, particularly women and children in rural areas.

As a result of climate change, Zambia like many countries in sub Saharan African region has experienced increasingly unreliable rainfall patterns and more frequent and prolonged droughts over the past two decades, which, in turn, have paralysed the country's power sector due to its heavy dependence on hydropower. This situation has induced power crises and increased dependence on expensive, fossil fuel-based generation. These experiences are a strong impetus for us to diversify our energy mix by exploring utility scale deployment of solar, wind and geothermal resources to increase and build a flexible and climate-resilient generation mix and reduce reliance on hydropower.

Zambia is facing a formidable challenge to increase electricity access from the current rate of 31 percent nationwide, and 4.4 percent in rural areas. Doing so will require a concerted effort from all key stakeholders and development partners. We particularly welcome the opportunity to tap into resources provided by Scaling-Up Renewable Energy Programme in Low Income Countries (SREP) to remove the barriers associated with the deployment of renewable energy in Zambia by contributing to the establishment of enabling regulatory framework, offsetting the high upfront costs associated with specific renewable energy technologies, improving affordability for end-user customers and promoting economic opportunities, especially in rural areas. SREP support complements Government and other key interventions that will guide Zambia's goal to attain universal access to clean and modern energy services.

The SREP Investment Plan (IP) has been developed under the leadership of the Ministry of Energy through extensive consultation with relevant Government ministries, public and private sector organisations, Cooperating Partners and civil society organizations to ensure buy-in and consensus from all stakeholders.

The IP identifies the renewable energy technologies and projects that will contribute positively to the sustainable economic development of the Zambia. The plan outlines investment areas and activities that have been prioritised by the Government of Zambia for SREP support and have the potential to leverage significant concessional and private sector financing.

The Ministry of Energy is grateful for the opportunity to develop the IP and share with you our vision for how SREP support can enable a scale-up in RE investment. We look forward to working with the Climate Investment Funds (CIF), the Multilateral Development Banks who are implementing entities of the CIF and other development partners, to successfully implement the programmes and activities with each component of the plan.

Brigadier General Emeldah Chola (Rtd)
Permanent Secretary
MINISTRY OF ENERGY, ZAMBIA

EXECUTIVE SUMMARY

Zambia is one of the pilot countries of the Scaling-Up Renewable Energy Programme (SREP) in Low-Income Countries. The SREP is a funding window of Strategic Climate Fund, which operates under the Climate Investment Funds (CIF). The SREP aims to demonstrate the economic, social, and environmental viability of a low-carbon development pathway by creating economic opportunities and increasing access to electricity through the scale-up deployment of renewable energy.

The Government of the Republic of Zambia (GRZ) recognises that access to clean and modern energy services is of paramount importance and a necessary precondition for achieving national development goals that extend far beyond the energy sector such as education, public health, access to clean water, food security, women's empowerment, climate change adaptation and mitigation. This SREP Investment Plan (IP) was prepared by the Government of the Republic of Zambia with inputs from key stakeholders in the energy sector. Details on the stakeholders' engagement and participatory process are provided in the Annex.

The aim of the SREP is to demonstrate, through pilot operations in selected countries, the economic, social and environmental viability of a low-carbon development pathway to increasing energy access using renewable energy and creating new economic opportunities.
This Investment Plan (IP), is a country-level and outcome-focused programmatic approach to scaling up renewable energy. It is prepared under the leadership of the Ministry of Energy (MoE) in line with the Zambia's Vision 2030; the Seventh National Development Plan (7NDP) 2017-2021 and the 2008 National Energy Policy. The IP brings together into a single cohesive document various power sector, renewable energy and climate change policies, programmes and initiatives.

The 7NDP seeks to increase the total electricity generation capacity by 1,000 MW and to improve electrification levels in rural areas from current 4.4% to 8% by 2021. This IP is envisaged to add at least 100 megawatts (MW) of renewable energy-based electricity generation and with a potential to increase grid connected access to electricity from the current 1.8 million connections and up to 50,000 households in off-grid localities.

Country and Sector Context

Zambia is a land locked country located in Southern Africa and covers an area of 752,614 square kilometres. It shares its borders with the eight (8) countries namely; Democratic Republic of Congo (DRC), Tanzania, Malawi, Mozambique, Namibia, Zimbabwe, Angola and Botswana. In 2015, Zambia's population was estimated at 15.5 million and is projected to reach 23.6 million by 2030 assuming a net population growth rate of 2.8% per year (CSO, 2017). The population in rural areas is expected to grow from 8.2 million in 2011 to 10.1 million in 2020 and to 14.5 million by 2035, while the population in urban areas is expected to grow from 5.6 million in 2011 to 7.8 million in 2020 and to 12.4 million by 2035 (CSO, 2017).

Zambia's economy has in the most recent past been experiencing positive growth with the country's real Gross Domestic Product (GDP) ranging from USD 12.76 billion in 2006 to USD 27.45 billion in 2013 at an average growth rate of 4.3% per annum. In 2015, the GDP was USD 16.96 billion (BOZ, 2016). In 2017, economic growth remained subdued at 3.8% due to weak

performances by the services, mining, and construction sectors and it is forecast to strengthen to 4.5% in 2018 and 4.7% in 2019. In 2017, inflation was relatively stable at about 7%.

Despite the increase in per capita economic growth, Zambia's national poverty and inequality have remained stubbornly high. Zambia faces both high levels of poverty and inequality, even when compared to other countries in the region. Impressive economic growth in the decade to 2014 brought benefits to urban areas, but poverty in rural areas remains widespread. The rapid population growth meant that the number of Zambians living in poverty increased between 2010 and 2015. Regional disparities have also not narrowed, and the sharing of prosperity in Zambia has deteriorated with inequality on the rise.

Most of the poor have continued to face extreme levels of poverty particularly in rural parts of the country. Households headed by females are more likely to be impoverished than their male counterparts. Levels of poverty are more likely to be higher among households that are headed by elderly persons. Education and wage employment reduce the risk of becoming poor. Furthermore, the Poverty Gap Ratio in rural areas, especially in remote provinces, has continued to be wide despite recording some reduction over time. The level of expenditure inequality is very high especially in urban areas.

Energy Consumption context

The country's energy consumption is mainly wood fuel (i.e., firewood and charcoal), which accounts for over 70% of total national energy consumption, putting a strong pressure on forestry resources. The electrification rate remains low with only about 31.2% of the population connected to the grid with a low energy consumption per capita of around 700 kWh/capita. With the prevailing economic growth and demography trends in the country, the access level is likely to be much less in near future if additional efforts and large investments in the infrastructure is not applied. The country has a very low resource diversification for modern energy services with almost total dependency on large hydropower power plants (nearly 84% of its installed power generation capacity in 2016) with high technical and commercial losses (a total of 18% of the production in 2015). Petroleum products are wholly imported into the country.

Renewable Energy Context

Zambia is endowed with a number of renewable energy resources including solar, hydro, geothermal, wind, small hydros (less than 200MW) and biomass. Despite the huge resource endowment, the development of renewable energy remains significantly low due to barriers that hinder the scaling up of renewable energy such as: lack of clear regulatory framework and procurement route for private sector investment especially for wind, biomass and geothermal power development; insufficient/inadequate data for planning; insufficient/inadequate standards for off-grid electrification solutions; non-cost reflective tariffs and low ability to pay especially in rural areas; limited access to finance by micro, small and medium enterprises involved in the renewable energy sector; low creditworthiness of the power off-taker (ZESCO) for on-grid projects; and limited awareness of the potential opportunities and benefits of renewable energies. The Government of the Republic of Zambia remains supportive and committed to facilitating the development of the renewable energy sub-sector. In addition, the Government continues to

enhance its efforts in creating an enabling environment through establishment of appropriate policies, regulatory and institutional framework.

Therefore, the Zambia SREP IP will play a critical role in addressing the identified barriers for increased private sector involvement in renewable energy power generation for small- and medium sized Projects. The aim of the IP is to increase and diversify the national generation output through private sector participation using appropriate business models. Additionally, the SREP IP has the potential to transform the energy sector and facilitate increase in overall renewable energy production, boost economic development and improve access to clean energy while contributing to reducing the emission of greenhouse gases and other social-economic issues i.e. energy poverty related to fossil fuel-based development. Further, this SREP IP will mobilise resources from other partners to support capacity development of the various public and private players in project preparation, feasibility studies, project development and project management.

Programme Description

The Government of the Republic of Zambia in accordance with the objectives and criteria of SREP prioritises the following three areas/components for this SREP-Zambia IP:

- ✓ Component 1: Energy Access in Rural and Peri-Urban Areas
- ✓ Component 2: Wind Power Promotion
- ✓ Component 3: Geothermal development project

The selected programs are also consistent with Zambia's Nationally Determined Contributions (NDCs) to the 2015 Paris Agreement on Climate Change in response to decisions adopted at the 19th and 20th sessions of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC).

With this intervention, the project is expected to transform and positively impact livelihoods and bring co-benefits to local communities such as reduction of indoor air pollution in homes due to the efficient biomass utilisation thereby reducing health risks to women and children. This will contribute towards Government agenda for energy mix diversification and increase the share of renewable energy.

Indicative Financing Plan

	Total	SREP[(i)]	AfDB	IFC	WB	Other donors	Private sector	GRZ[(iv)]
Component 1 – Energy Access in Rural and Peri-Urban Areas								
Investment in off-grid and mini-grid electrification solutions	161.7	10	-	-	45.9[(ii)]	55[(iii)]	50	0.8
Sub-total	161.7	10			45.9	55	50	0.8
SREP leverage					**1:16**			
Component 2 – Wind Power Promotion								
Project Preparation Grant	2.1	1.15	0.90	-	-	-	-	0.05
Wind IPP	61.0	10	18.3			14.4	18.3	
Subtotal	63.1	11.15	19.2			14.4	18.3	0.05
SREP leverage					**1:5.6**			
Component 3 - Investment in Geothermal Development								
Policy support and community development master plan	-	-	-	-	-	-	-	
Investments – Risk mitigation facility	45.5	-	-	-	-	-	45	0.5
Subtotal	45.5	-	-	-	-	-	45	0.5
Total	270.3	21.15	19.2	-	45.9	69.4	113.3	1.35
Total SREP Leverage (Component 1 and 2)					**1:11**			

Notes:

(i) All SREP funds are assumed to be grants.
(ii) Includes the on-going Electricity Service Access Project[1] (US$5.9 million) and the new electricity access project which is currently under preparation
(iii) US$55 million grants from other donors refers to the Beyond the Grid initiative and the EU programme
(iv) All GRZ contributions are derived from commitments already made under the 7NDP

[1] A complete description is available here: http://documents.worldbank.org/curated/en/556221498788150527/Zambia-Electricity-Service-Access-Project

Chapter 1 INTRODUCTION

In 2014, Zambia was selected as a pilot country of the Scaling-Up Renewable Energy Program (SREP) in Low Income Countries which operates under the Strategic Climate Fund (SCF). The SCF supports programmes with potential for scaled-up, transformational action aimed at a specific climate change challenge. The SCF is part of the Climate Investment Funds (CIF), which promote international cooperation on climate change and support developing countries as they move toward climate resilient development that minimises greenhouse gas (GHG) emissions and adapt to climate change.

The objective of the SREP in Low Income Countries is to demonstrate, through pilot operations in selected countries, the economic, social and environmental viability of a low-carbon development pathway to increasing energy access using renewable energy and creating new economic opportunities.

This Investment Plan (IP) was prepared by the Government of the Republic of Zambia, through a task-force led by the Ministry of Energy (MOE), in consultations with key institutional stakeholders in the energy sector, private sector and civil society organizations. This country-led programme is in line with the Government's vision, development plans, strategies and priority actions. Specifically, this IP supports Vision 2030 which envisions 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. This IP is consistent with the first and the third strategic areas of the Seventh National Development Plan 2017-2021 (7NDP): Economic diversification and job creation; and reducing developmental inequalities. It is expected to also strengthen the implementation of the National Electrification Strategy, currently under preparation by the GRZ, through support of the World Bank's Electricity Service Access Project (ESAP).

Chapter 2 COUNTRY CONTEXT

Zambia is a resource-rich, lower-middle-income country located in Southern Africa which covers 752,614 square kilometres. It shares its borders with the eight (8) countries namely; Democratic Republic of Congo (DRC), Tanzania, Malawi, Mozambique, Namibia, Zimbabwe, Angola and Botswana Most of the country is classified as humid subtropical or tropical wet and dry, with small stretches of semi-arid steppe climate in the southwest and along the Zambezi valley.

Figure 1: *Political Map of Zambia*

2.1. Demography

In 2015, according to Central Statistical Office (CSO) estimates, Zambia's population was estimated at 15.5 million and is projected to reach 23.6 million by 2030 assuming a net population growth rate of 2.8% per year (Figure 2) (CSO, 2017). The population in rural areas is expected to grow from 8.2 million in 2011 to 10.1 million in 2020 and to 14.5 million by 2035, while the population in urban areas is expected to grow from 5.6 million in 2011 to 7.8 million in 2020 and to 12.4 million by 2035 (CSO, 2017).

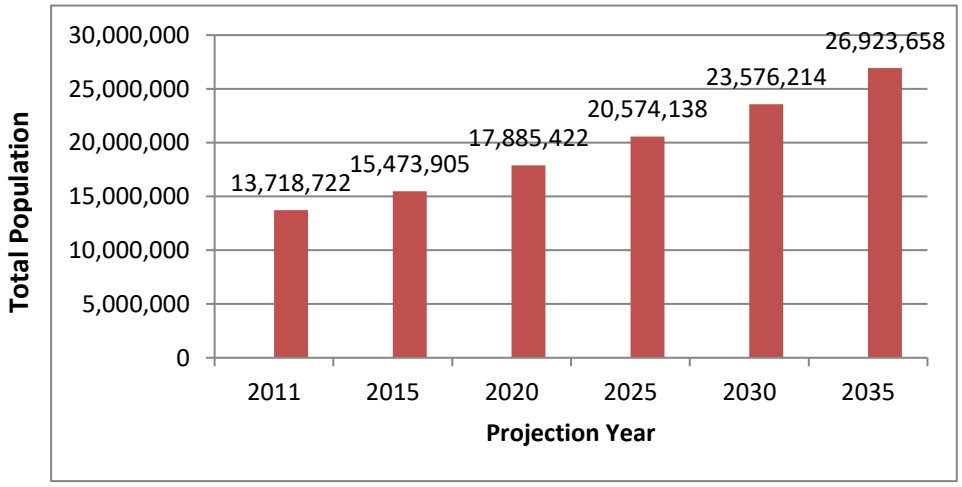


Figure 2: *Total Projected Population for Selected Years (Medium Variant), Zambia 2011-2035 (Source: CSO, 2017)*

Zambia has a youthful population as the population distribution tends to be broader at the lower levels from ages 0 to 4 and gradually thins out with higher age groups up to the peak of 80 years and above, forming a pyramid-like structure (figure 3).

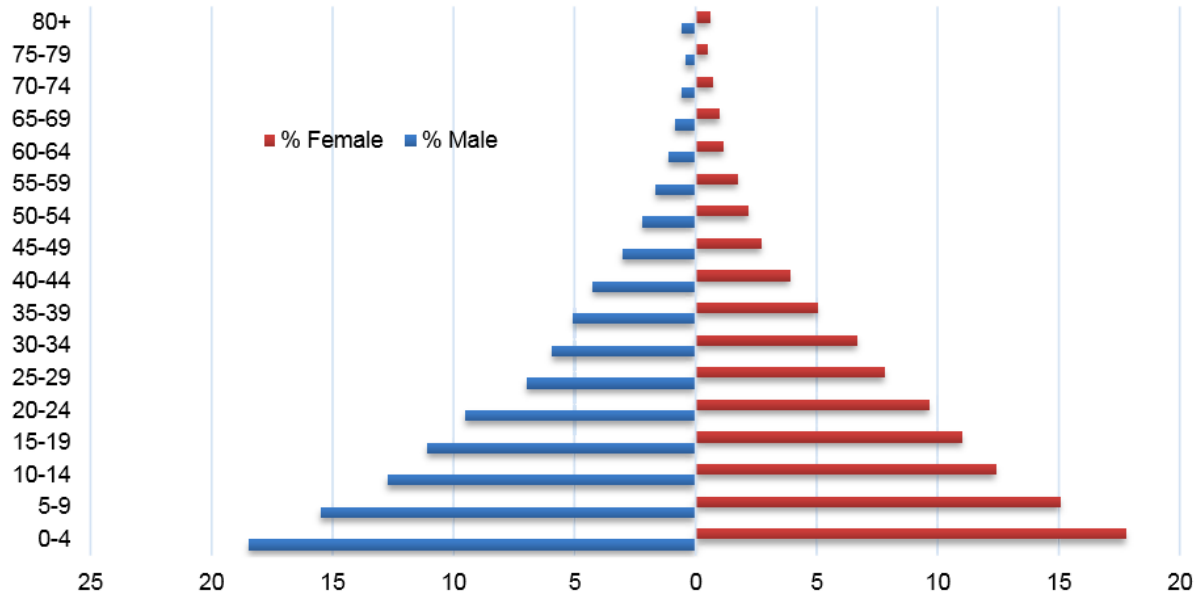


Figure 3: *Age and gender structure of the population, Zambia 2016*

As at 2016, the estimated life expectancy at birth was 53.7 years. Females had a higher life expectancy at birth of 56.1 years compared to 51.5 years for males. The projected decline in fertility and mortality is expected to lead to an increase in life expectancy at birth and at different ages as well as the proportion of the elderly, 65 years and older, in the long run.

The country's population age structure has created high child dependency with a heavy burden on the working population. Zambia's overall dependency ratio stands at 92.5 while the child dependency ratio is 87.4. This has increased pressure on the Government to provide public goods and services, such as education, health, housing, water and sanitation and employment. However, the large numbers of young people may represent great economic potential, but only if adequate investment is made in their health, entrepreneurship and education, thus continuing to stimulate new economic opportunities for them.

2.2. Socio-Economic Context and the National Development Plans

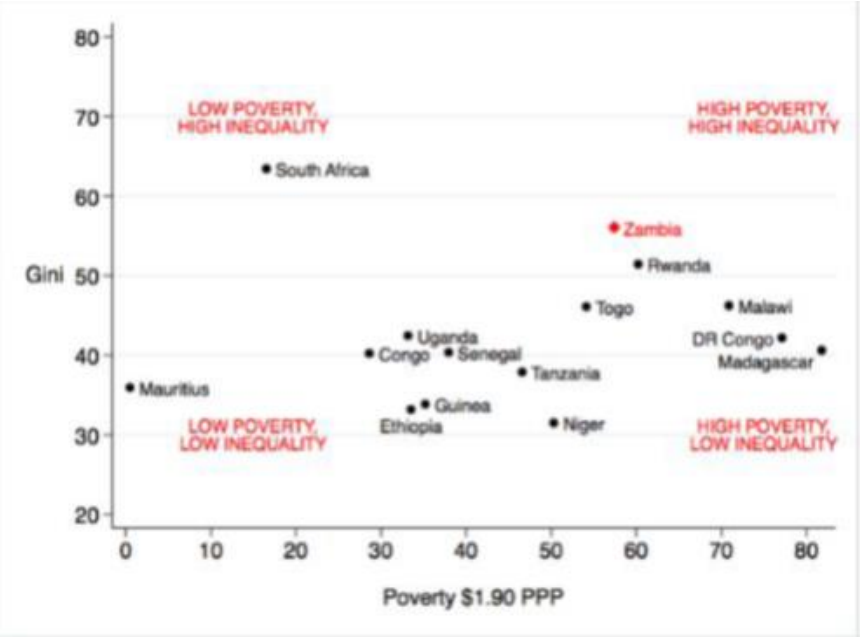
2.2.1. Economic overview

Zambia's economy is dominated by copper mining and processing, agriculture and construction. The country's high dependence on copper mining increases its vulnerability to commodity prices and foreign exchange fluctuations.

Zambia's economy has for the most recent part been experiencing a positive growth with the country's real Gross Domestic Product (GDP) ranging from USD 12.76 billion in 2006 to USD 27.45 billion in 2013 at an average growth rate of 4.3% per annum. In 2015/16 global and domestic conditions for growth deteriorated and the price of copper typically 77 % of Zambia's exports fell further from its 2011 peak. This reduced the value of exports and opened a trade deficit which, in turn, exerted a downward pressure on revenues, widening the fiscal deficit. Domestic pressures were in the form of (a) high fiscal deficits that reduced confidence in the economy and (b) low and late-onset rainfall in 2015, which undermined agricultural incomes and lowered water levels in the country's main hydro reservoirs, leading to increased power outages. Further, the strengthening of the U.S. dollar in 2015 put pressure on the Zambian Kwacha, which led to the local currency losing 41 % of its value against the U.S. dollar (World Bank, 2017). In 2017, economic growth remained subdued at 3.8% due to weak performances by the services, mining, and construction sectors and it is projected to strengthen to 4.5% in 2018 and 4.7% in 2019. In 2017, inflation was relatively stable at about 7%. Long term economic growth prospects are in the range of 5-6% per year.

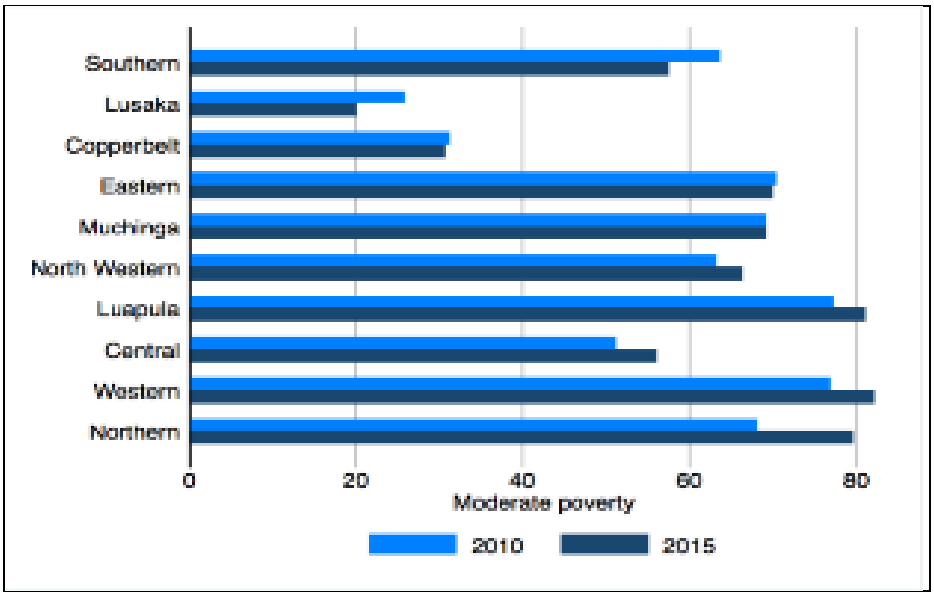
2.2.2. Poverty and inequality

Despite the increase in per capita economic growth, Zambia's national poverty and inequality have remained stubbornly high. Zambia faces both high levels of poverty and inequality, even when compared to other countries in the region. Impressive economic growth in the decade to 2014 brought benefits to urban areas, but poverty in rural areas remains widespread (the urban poverty incidence is less than half of that of rural areas) The rapid population growth meant that the number of Zambians living in poverty increased between 2010 and 2015 (figure 4). The structure of growth benefited more to the people in urban areas (both poor and non-poor), compared to those living in rural areas. Regional disparities have also not narrowed, and the sharing of prosperity in Zambia has deteriorated with increases in inequality.



Source: Living Conditions and Monitoring Survey (2015)
Figure 4: *Country comparison of poverty and inequality*

Most of the poor have continued to face extreme levels of poverty particularly in rural parts of the country. Households headed by females are more likely to be impoverished than their male counterparts. Levels of poverty are more likely to be higher among households that are headed by elderly persons. Education and wage employment reduce the risk of becoming poor. Furthermore, the Poverty Gap Ratio in rural areas, especially in remote provinces, has continued to be wide despite recording some reduction over time. The level of expenditure inequality is very high especially in urban areas (figure 5).



Source: Living Conditions, 2015

Figure 5: *Comparison of poverty index by province in Zambia for 2010 and 2015*

If Zambia is to achieve both significant poverty reduction and accelerated economic growth, there is need to (i) remove barriers hindering the development of renewable energy and diversify its reliance on extractive based growth characterised by a large copper mining sector, (ii) reduce uneven territorial development, illustrated by a large rural-urban divide and very high spatial and sectoral inequalities between Lusaka and Copperbelt and the rest of the country; and (iii) strengthen the institutional capacity, and increase public accountability to move away from policies and public resource allocations that often entrench rather than alleviate distortions, to address poverty and promote diversification.

Zambia's future economic performance is largely dependent on the evolution of external factors such as commodities prices (copper prices in particular), the pace of the economic diversification away from extractive industries, and the extent and pace of the reform and fiscal consolidation (AEO, 2017).

2.3. National development plans, policies and strategies

The two main documents presenting the national development plans are the Vision 2030 and the Seventh National Development Plan (7NDP) covering the period 2017 - 2021. The Vision 2030 lays out the goal of becoming a prosperous middle-income country by 2030. The Vision highlights three (3) possible socio-economic development scenarios: the baseline, the preferred and the optimistic. In the preferred scenario the objective is to attain and sustain an annual real economic growth of 9% between 2016 and 2020, and 10% between 2021 and 2030 (MNDP, 2017). Regarding energy, the Vision 2030 is to achieve universal access to clean, reliable and affordable energy at the lowest total economic, financial, social and environmental cost. Specific goals for the vision include;

- ensuring abundant and reliable supply of affordable energy to both urban and rural areas;
- increased renewable alternative sources of energy;
- Becoming an export led energy industry; and
- reduced share of wood fuel to 40%.

The 7NDP aims to create a diversified and resilient economy for sustained growth and socio-economic transformation through five strategic areas: (i) economic diversification and job creation; (ii) reduction of poverty and vulnerability; (iii) reduced developmental inequalities; (iv) enhanced human development; and (v) creation of conducive governance environment for a diversified and inclusive economy. This is illustrated in figure 6 below;

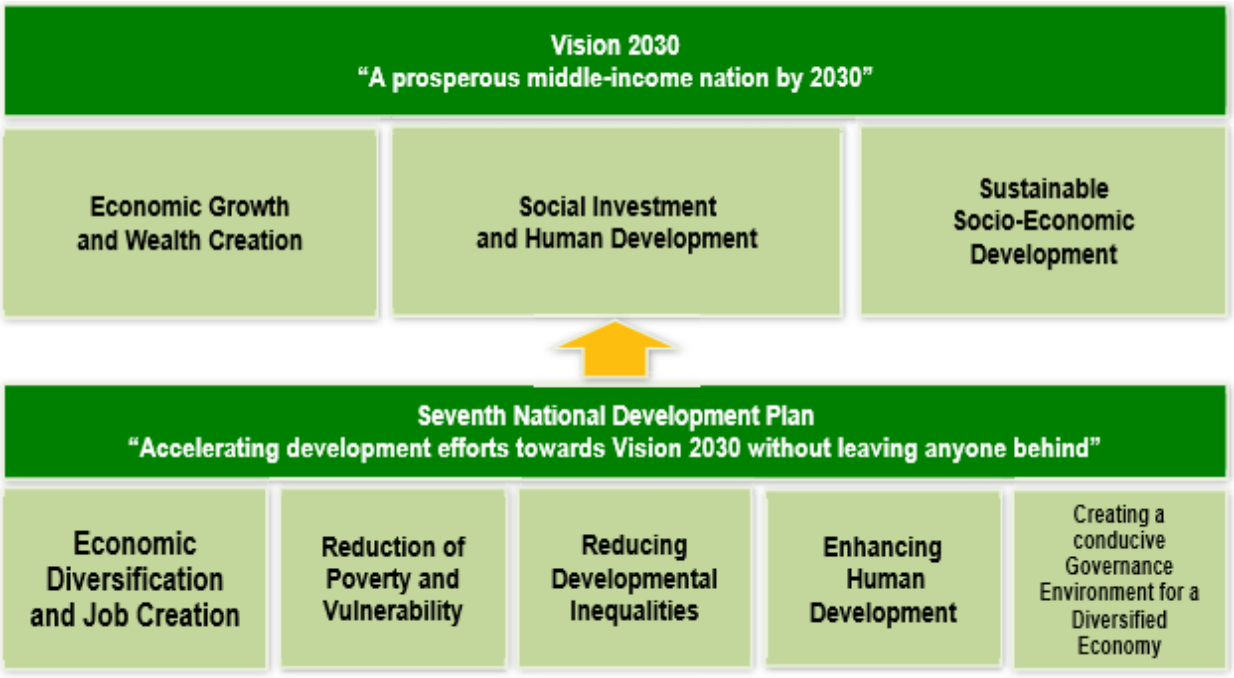


Figure 6: *Linkages between Vision 30 and the Seventh National Development Plan*

2.4. Linkages with Energy Development Agenda

The 7NDP acknowledges that energy plays a key role in facilitating activity in all sectors of the economy and further asserts that the country needs to diversify its electricity generation mix and increase its electricity supply from all sources of energy. Development outcome 4 of the 7NDP's pillar on economic diversification and job creation specifically outlines the need to improve energy production and distribution for sustainable development. With regard to poverty reduction, the Government intends to intensify rural electrification, among other measures. The strategies below specifically relate to energy access and renewable energy.

i. Enhance Generation, Transmission and Distribution of Electricity

To enhance the supply of electricity for economic development, infrastructure development will be promoted. The objective is to expand and improve electricity generation, transmission and distribution, as well as encourage the development of small and mini/micro hydro power stations. Further, the Government commits to promote the establishment of an open and non-discriminatory transmission access regime in the electricity sub-sector and implement a cost-reflective electricity tariff regime to ensure meaningful private sector participation and investments in the power sector. Currently, Statutory Instrument No. 79 of 2013 (Electricity Grid Code) sets out technical requirements for connection to, and use of, the electrical transmission system by parties other than the owning electricity utility in a manner that will ensure reliable, efficient, economic, secure and safe operation.

ii. 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 and geothermal as a way of diversifying the energy mix and improving supply. In doing so, it envisages the preparation of renewable energy resource mapping and promotion of the development and use of renewable energy technology systems, and the elaboration of a comprehensive national energy strategy including a master plan for sustainable alternatives to charcoal and other household energy needs.

iii. Improve electricity Access to Rural and Peri-Urban Areas

This strategy focuses on the promotion of rural electrification programmes to enhance rural development and increase access to rural and peri-urban consumers at an affordable cost.

iv. Reduce development inequalities

This strategic area envisages the promotion of integrated rural development through *inter alia,* rural electrification and the reduction of gender inequalities.

2.5. Climate change agenda

According to the United Nations Framework Convention on Climate Change (UNFCCC), Zambia ranked 124 (out of 179 countries) in terms of CO_2 with a small share of 0.01% of global emissions

(UNFCCC, 2012). Zambia has been experiencing the effects of climate change resulting in extreme weather conditions, such as droughts, rising temperatures and unpredictable rainfall patterns. The frequency and intensity of climate events is expected to rise in future, with negative impact on the economy and consequently people's livelihoods. It is estimated that the impact of climate change will cost Zambia approximately 0.4 % of annual economic growth. It is further estimated that without action, rainfall variability alone could lead to losses of 0.9 % of GDP growth over the next decade, thereby keeping a significant section of Zambia's population below the poverty line (MNDP, 2017).

Zambia submitted its Nationally Determined Contribution (NDC) and signed the Paris Agreement on Climate Change in 2015. Zambia's NDCs include both mitigation and adaptation components based on national circumstances. The envisaged climate mitigation measures include specific actions for renewable energy and energy efficiency highlighted in table 1 below.

Objective	**Description**	**Co-benefits**
To promote the switching from conventional and traditional energy sources to sustainable and renewable energy sources and practices, and use of off-grid renewable energy technologies for rural electrification as decentralised systems.	Programme involves implementing - Fuel switch (diesel/HFO to biodiesel) - Fuel switch (coal to biomass) - Switch from existing isolated diesel to mini-hydro - Introduce and increase blending of bio-fuels with fossil fuels and where possible substitution with bio-fuels - Off-grid RE to non-electrified rural – P.V and Wind - On-grid expansion programme to support economic growth and grid extension through inter-basin water transfer - Grid extension to non-electrified rural areas	- Improved health impacts due to child and maternal mortality and retention of medical personnel - Improved education impacts due to longer hours of study and advanced teaching methods, safety, creation of opportunity for girl child and women's education - Improved food security due to increased agriculture production resulting from use of irrigation especially for women - Increased rural development impacts due to increased economic activities through SMEs - Reduced indoor air pollution and load shedding - Reduced GHG impacts and improved air quality - Reduced energy deficits

Source: GRZ, 2015

Table 1*: Zambia's renewable energy and energy efficiency programme contribution to its NDCs.*

The implementation of the measures outlines in Zambia's NDCs will result in an estimated total emission reduction of 38,000 Gg CO_2eq by 2030, conditional and subject to international support in form of finance, technology and capacity building, compared to 20,000 Gg CO2eq under the domestic efforts with limited international support. Meeting the conditional target requires an

overall investment estimated at USD 35 billion up to the year 2030, to be mobilised through new climate finance mechanisms such as; the Green Climate Fund (GCF) and other climate related bilateral, multilateral and domestic financing including private sector (GRZ, 2015).

2.5 Energy Sector Overview

2.5.1. Primary Energy Supply

Zambia is endowed with a wide range of energy resources, particularly woodlands and forests, hydropower, coal and renewable sources of energy. Petroleum is the only energy source that is currently wholly imported. The country's energy consumption is mainly wood fuel (i.e., firewood and charcoal), which accounts for over 70% of total primary energy supply, putting strong pressure on forestry resources with a low energy consumption per capita of around 700 kWh/capita. Despite the availability of these energy resources, electrification levels still remain low with only about 31.2% of the population being connected to the grid. Figure 5 below illustrates the Country's primary energy supply;

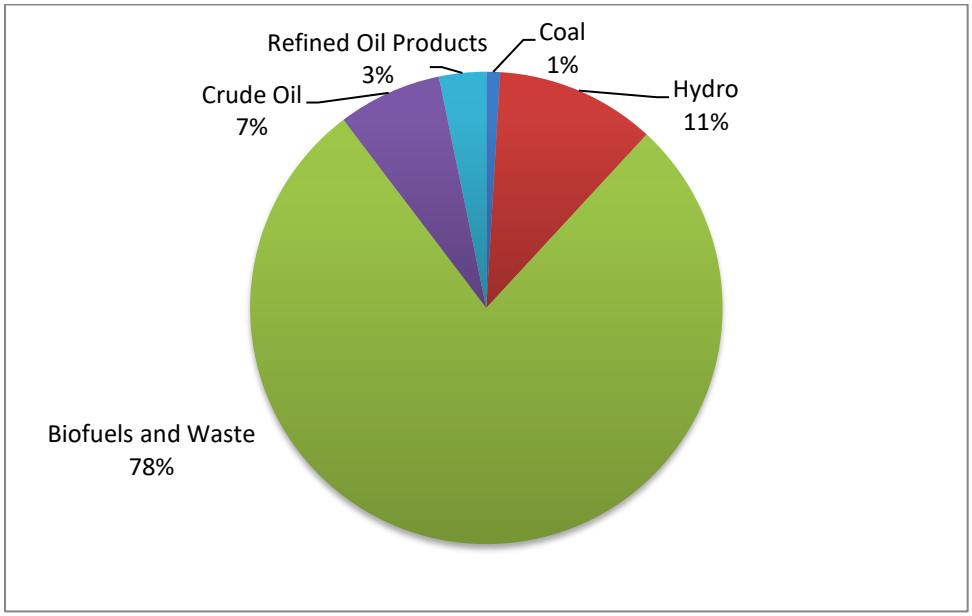


Figure 7: *Zambia's primary energy supply*

2.5.2. Electricity Supply and Consumption

Electricity is the second most dominant energy source in Zambia after wood fuel, providing about 10 % of the national energy supply. Zambia has a total installed electricity generation capacity of 2,827 MW and heavily relies on large hydro power plants for power generation (2,388 MW), the remaining balance being provided by coal (300 MW), heavy fuel oil (105 MW), diesel (89 MW) and solar (0.06 MW) power plants [ERB, 2018]. Renewable energy sources (excluding hydro) are increasingly being used but still remain insignificant in terms of contribution to the total national energy mix (figure 7).

The ramifications of the country's failure to diversify its electricity generation mix became marked in 2015 when the energy deficit resulted in unprecedented levels of electricity supply rationing to all consumers. Demand for electricity stood at 1,949 MW; however, the sector was only able to generate 1,281 MW. This situation was largely as a result of inadequate and delayed investments in generation and transmission infrastructure and the failure to diversify energy generation sources over the last 30 years.

This was further compounded by inadequate incentives to attract investment in the sector. The deficit was exacerbated by the effects of climate change, in particular low rainfall, given that Zambia has been highly dependent on hydro-power.

The current projections indicate that growth in demand will increase between 150 MW and 200 MW per annum. The peak demand for electricity in the country is likely to be 3,000 MW by 2021 and is expected to increase to over 3,525 MW in 2030.

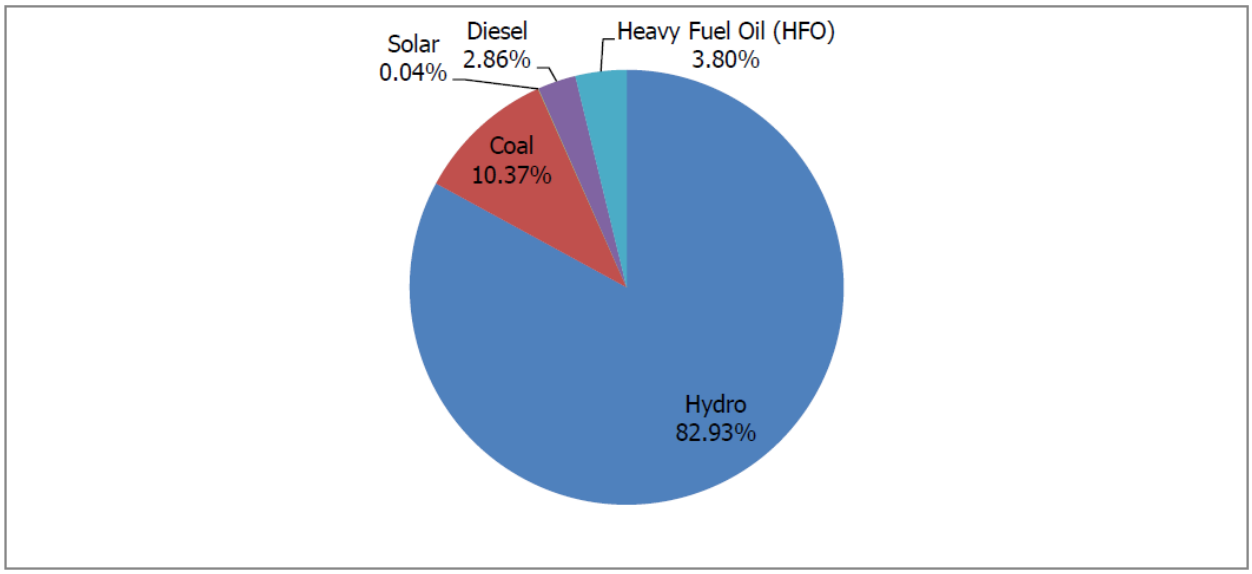


Figure 8: *Zambia installed electricity generation capacity (2018)*

Total national electricity consumption increased by 12.29% from 10,857.5 GWh in 2016 to 12,191.86 GWh in 2017. The mining industry is the largest consumer category followed by the residential sector. These sectors accounted for approximately 50% and 30% of the national electricity consumption, respectively. Figure 8 depicts the proportion of electricity consumption by economic sub-sector in 2017 compared to 2016 (ERB 2017).

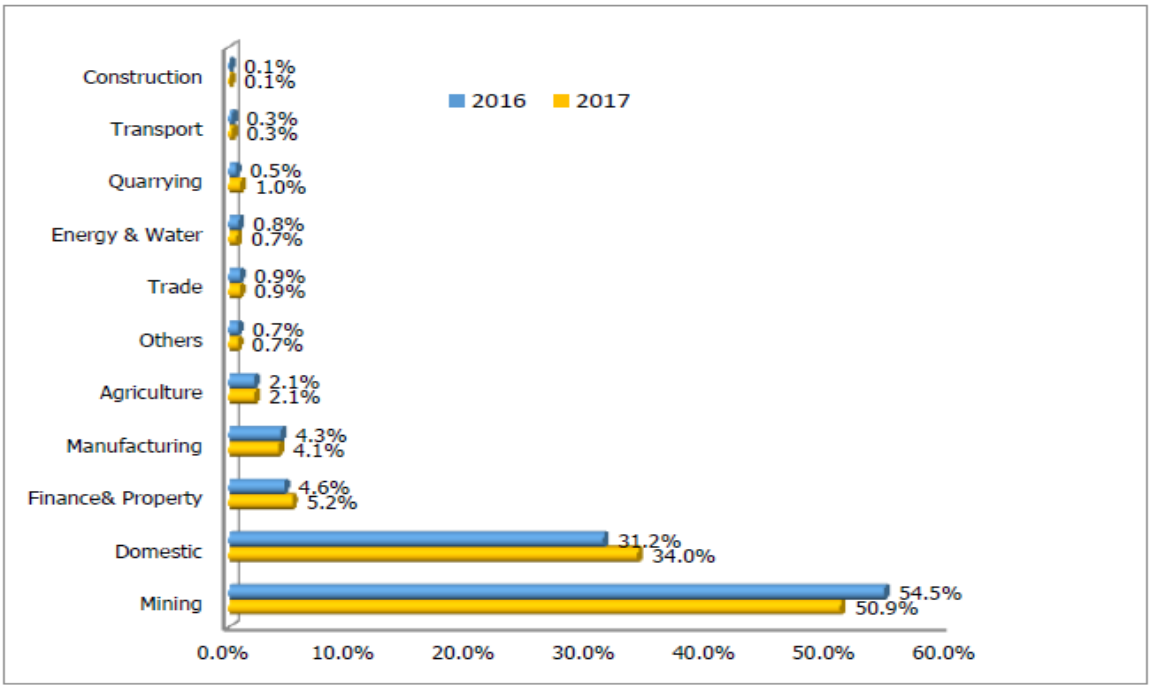


Figure 9: *Electricity consumption per key economic sectors 2016-2017*

2.6. Energy Sector Institutional Framework

The Electricity Supply Industry (ESI) in Zambia comprises generation, transmission, distribution and supply of electrical energy. ZESCO Limited is wholly state-owned power utility through the Industrial Development Corporation, the holding company for the majority of state-owned enterprises in Zambia. ZESCO owns and operates over 90 % of the generation, transmission, and distribution assets in the country and supplies electricity to all grid-connected consumers, with the exception of some of mining consumers in the Copperbelt Province, which are served by Copperbelt Energy Corporation (CEC), a private company that purchases bulk power from ZESCO for onward supply to the mines. CEC also exports power to the Democratic Republic of Congo.

Independent Power Producers (IPPs) include:

- Lunsemfwa hydro power company (LHPC), privately owned, with 56 MW total installed capacity;
- Zengamina Power Company (ZPC), privately owned, operates a 0.75 MW isolated grid;
- North Western Energy Company (NWEC), privately owned, involved in distribution and supply of electricity;
- Ndola Energy Company (NEC), privately owned with installed HFO Thermal power plant capacity of 105MW;
- Maamba Collieries Ltd (MCL), privately owned with installed Coal thermal power plant of capacity of 300MW;
- Itezhi-Tezhi Power Corporation (ITPC), jointly owned by Tata Power and ZESCO Limited in a 50:50 share ownership; installed Hydro power capacity of 120 MW
- Kariba North Bank Extension (KNBE), special purpose vehicle (SPV) company wholly owned by ZESCO, installed hydro power capacity of 360 MW

The Ministry of Energy (MOE) is responsible for formulation and implementation of the energy policy, compiling inventories of energy resources, detailing patterns of production, distribution, consumption, and pricing of energy to maintain an energy information system used for planning, forecasting and policy analysis. It is also responsible for monitoring implementation of the rural electrification programme, promoting the development and wide utilisation of new and renewable sources of energy, promoting the efficient management of energy, monitoring and evaluating energy programmes and coordinating regional energy programmes.

The Office for Promoting Private Power Investments (OPPPI) is a unit within the Ministry responsible for Energy, set up in 1999 to mobilise private sector funds for generation (including mini-hydros) and transmission projects.

Energy Regulation Board (ERB) is responsible for regulating the electricity, petroleum and other forms of energy including renewable energy. The ERB is inter alia is responsible for ensuring a reasonable return on investment for operators/utilities, quality service at affordable prices to the consumer, licensing of operators/utilities, proposing tariffs, and monitoring competition in the market.

The Rural Electrification Authority (REA) was established by the Rural Electrification Act of 2003 to administer the Rural Electrification Fund and implement the Rural Electrification Master Plan (REMP). REA main mandate is to carry out rural electrification, develop rural electrification mechanisms through extension of the grid network and other methods, as well as by applying a subsidy for capital costs on rural electrification project. The rural electrification programme encourages the use of solar technology; however, so far only a limited number of solar projects have been implemented by REA.

The Industrial Development Corporation (IDC) is an investment company wholly owned by the Zambian Government, incorporated in early 2014. IDC mandate is to play a catalytic role in supporting Zambia's industrialization. The IDC plays its role through evaluation, pricing and lowering the investment risk profile by serving as co-investor alongside private sector investors. With regard to the energy sector, the IDC is Government's shareholder in ZESCO Limited and is currently spearheading the Scaling-up Solar Initiative with a target of installing a total 600MW grid-connected Solar PV.

The Zambia Development Agency (ZDA) is an agency responsible for fostering the country's economic growth and development by promoting trade and investment, innovations promoting high skills and productive investment. The ZDA is expected to be a one-stop-shop for all investors including those in the energy sector.

The Zambia Bureau of Standards (ZABS) the Statutory National Standards Body for Zambia established under the Standards Act, Cap 416 of 1994 for the preparation and promulgation of Zambian Standards, quality control, quality assurance, import and export quality inspections, certification and removal of technical barriers to trade.

The Zambezi River Authority (ZRA), co-owned by Zambia and Zimbabwe, is an institution that is responsible for the operation and maintenance of the Kariba Dam complex as well as the investigation and development of new hydro sites on the Zambezi River. ZRA also analyses and

disseminates hydrological and environmental information pertaining to the Zambezi River and Lake Kariba.

The Climate Change Department is domiciled in the Ministry of Lands and Natural Resources with a mandate to facilitate development and mainstreaming Zambia's integrated climate change and disaster risk reduction agenda. It has overall responsibility for project execution and reporting under the Pilot Programme for Climate Resilience (PPCR) and UNFCCC.

The 7NDP Cluster Advisory Groups (CAGS) is a coordination and M&E structure designed under the 7NDP to address each of the developmental outcomes of the Plan. This approach brings together all sectors implementing programmes under a particular development objective and outcome area with emphasis on strengthening intra- and inter-sectoral integration.

Figure 10 below depicts the relationship between the key institutional stakeholders in the energy sector.

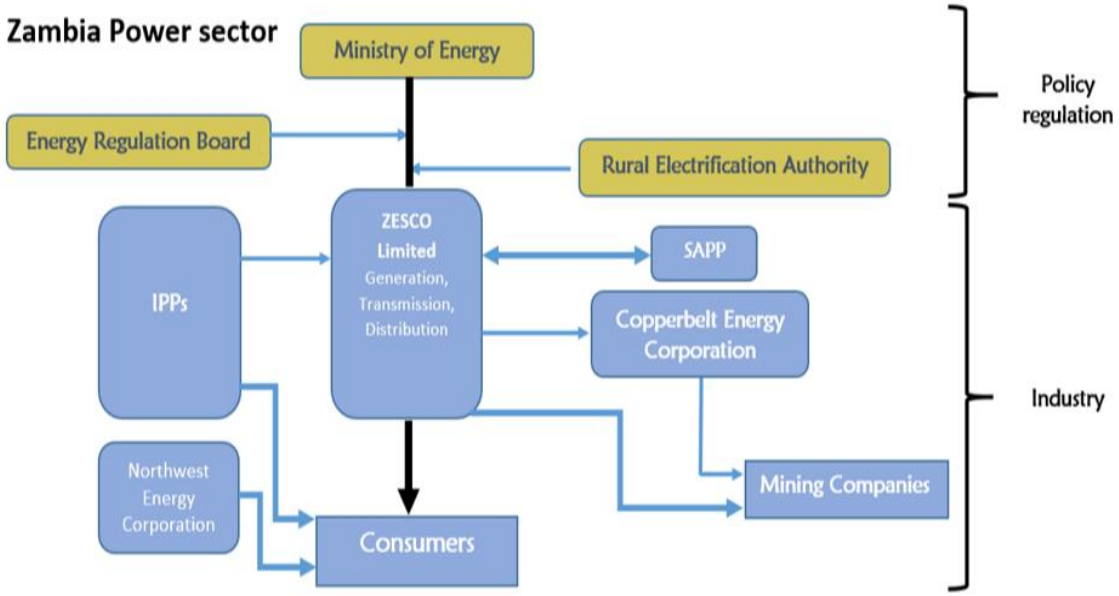


Figure 10: *Key institutional stakeholders in the Zambia energy sector*

2.7. Policy, Legal and Regulatory Framework

The National Energy Policy adopted in 2008 (NEP 2008) provides the overarching sector policy framework. Its main thrusts are: diversifying the energy mix through the use of renewable energy, private sector participation and creating conditions that ensure availability of adequate supply of energy from various sources which are dependable and at the lowest economic, financial, social and environmental costs consistent with the national development goals.

In addition to the NEP 2008, there are other strategic and legal instruments which support developments in the energy sector. Under this policy framework, the intention is to create an enabling environment for private sector participation by introducing cost-reflective electricity tariff regime, establishing an open and non-discriminatory transmission access regime in the electricity sector, and introducing an appropriate cost-effective renewable energy feed-in tariff (FiT). The following section highlights the major policy and regulatory frameworks.

The Power Systems Development Master Plan (PSDMP, 2010)
As part of the implementation of the 2008 National Energy Policy, Government developed the Power System Development Master Plan (PSDMP) whose objective is to provide a blueprint for power system development in the country up to the year 2030. The plan highlights least cost expansion options for generation, transmission and distribution in the country and has prioritized power generation projects which when developed would add a total of 4,337 megawatts to the national electricity grid by 2030.

Rural Electrification Master Plan (REMP, 2008 - 2030)
The objective of the master plan is to guide systematically the rural electrification agenda in Zambia up to the year 2030 and to bring about technology transfer.

Renewable Energy Feed in Tariff (REFIT) Strategy (2017)
The objective of the REFiT strategy is to harness the renewable energy sector's potential to drive economic growth and improve the quality of life for all Zambians. This will be achieved through the promotion of small and medium-sized renewable energy projects of up to 20 MW, quick deployment of private investment for small- and medium-sized renewable energy projects and ensuring cost-effective tariffs through transparency and competition in the sector.

Electricity Amendment Act (2003)
The Electricity Act of 1995 was formulated to regulate the generation, transmission, distribution and supply of electricity; and to provide for matters connected with or incidental to the foregoing. It liberalised the electricity sector by opening all three segments to private operators. The act was further amended in 2003 to ensure more private sector participation in line with the overall economic policy of liberalization.

Energy Regulation Act (2003)
The Energy Regulation Act of 1995 established the Energy Regulation Board and defines its functions and powers; to provide for the licensing of undertakings for the production of energy or the production or handling of certain fuels; to repeal the National Energy Council Act and the Zambia Electricity Supply Act; and to provide for matters connected with or incidental to the foregoing. The Energy Regulation Act was amended in 2003 with the main purpose to strengthen the Board in its operations.

Rural Electrification Act (2003)
This Act establishes 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.

Zambia Electricity Grid Code (ZEGC) - SI No. 79 of 2013
The Grid Code legally establishes technical requirements for the connection to, and use of the electrical transmission system by parties other than the owning electricity utility, in a manner that will ensure reliable, efficient, economic, secure and safe operation. The Grid Code seeks to ensure that investments are made within the requirements of the code and provide access, on agreed standard terms, to all parties wishing to connect to or use the transmission system and applies the principle of non-discrimination through the provision of consistent and transparent criteria and procedures.

Zambia Distribution Code (2016)
The Distribution Code is designed to provide clear procedures for both planning and operational purposes to ensure efficient development, operation and maintenance of a coordinated and economical distribution system and also to promote grid integration of renewable energy technologies. The Distribution Code seeks to avoid undue discrimination between Distribution Network Service Providers (DNSPs) and other categories of participants.

2.8. Electricity Tariffs and Pricing

Prior to 2008, Zambia enjoyed the lowest electricity tariff in Southern Africa, with an average tariff of USD 0.027 per kWh, which given the generation costs, are clearly not cost reflective. This hampered new investment in the power sector and could partly explain why very few power generation projects have been commissioned in more than 40 years. In 2009, the country decided to migrate gradually towards cost reflective tariffs in order to meet future power demand needs as well ensure quality of service. The most recent tariff adjustment came in 2017 when ERB approved a 75% increase of the tariffs for ZESCO's retail customers. The tariff increase was implemented in two phases as follows: 50% effective 15th May, 2017; and 25% from 1st September, 2017.

With the 2017 tariff adjustment, Zambia's average tariff is estimated at USDc 6.33 per kilo-Watt hour (kWh) as at 30th June 2018, for various regulated customer categories. For the mining industry tariffs stand at an average of USDc 9.30 per kWh following the upward tariff adjustment in 2017 (ERB, 2018).

Table 2 shows domestic electricity tariffs (in Kwacha) as at 30th June 2018. Prevailing exchange rate can be accessed at **www.boz.zm**

CUSTOMER CATEGORY		TARIFFS
1.METERED RESIDENTIAL(Prepaid) (capacity 15 kVA)		
R1 -Consumption up-to 200kWh in a month	Energy charge/kWh)	0.15
R2 - Consumption above 201 kWh in a month	Energy charge/kWh)	0.89
	Fixed Monthly Charge	18.23
2.COMMERCIAL TARIFFS (capacity 15kVA)		
Commercial	Energy charge/kWh)	0.54
	Fixed Monthly Charge	96.41
3.SOCIAL SERVICES		
Schools, Hospital, Orphanages, churches, water pumping & street lighting	Energy charge K/kWh	0.49
	Fixed Monthly Charge	83.84
4.MAXIMUM DEMAND TARIFFS		
MD1- Capacity between 16 - 300 kVA	MD Charge (K/kVA/Month)	24.45
	Energy Charge (K/kWh)	0.35
	Fixed Monthly Charge (K/Month)	239.44
	Off Peak MD Charge (K/KVA/Month)	12.22
	Off Peak Energy Charge (K/kWh)	0.26
	Peak MD Charge (K/KVA/Month)	30.56
	Peak Energy Charge (K/kWh)	0.44
MD2- Capacity 301 to 2,000 kVA	MD Charge (K/kVA/Month)	45.73
	Energy Charge (K/kWh)	0.30
	Fixed Monthly Charge (K/Month)	478.84
	Off Peak MD Charge (K/KVA/Month)	22.87
	Off Peak Energy Charge (K/kWh)	0.23
	Peak MD Charge (K/KVA/Month)	57.17
	Peak Energy Charge (K/kWh)	0.37
MD3- Capacity 2,001 to 7,500kVA	MD Charge (K/kVA/Month)	73.06
	Energy Charge (K/kWh)	0.25
	Fixed Monthly Charge (K/Month)	1,014.55
	Off Peak MD Charge (K/KVA/Month)	36.52
	Off Peak Energy Charge (K/kWh)	0.18
	Peak MD Charge (K/KVA/Month)	91.33
	Peak Energy Charge (K/kWh)	0.30
MD4-Capacity above 7500kVA	MD Charge (K/kVA/Month)	73.47
	Energy Charge (K/kWh)	0.21
	Fixed Monthly Charge (K/Month)	2,029.13
	Off Peak MD Charge (K/KVA/Month)	36.73
	Off Peak Energy Charge (K/kWh)	0.16
	Peak MD Charge (K/KVA/Month)	91.84
	Peak Energy Charge (K/kWh)	0.25
NOTE; The above tariffs are:- **(a) Exclusive of 3% Government excise duty** **(b) Exclusive of 16% Value Added Tax (VAT)**		

Table 2: *End-user electricity tariffs in Zambia as of June 30, 2018 in Zambian Kwacha*

Figure 11 below shows Zambia's electricity tariffs in comparison to other countries in the SADC region.

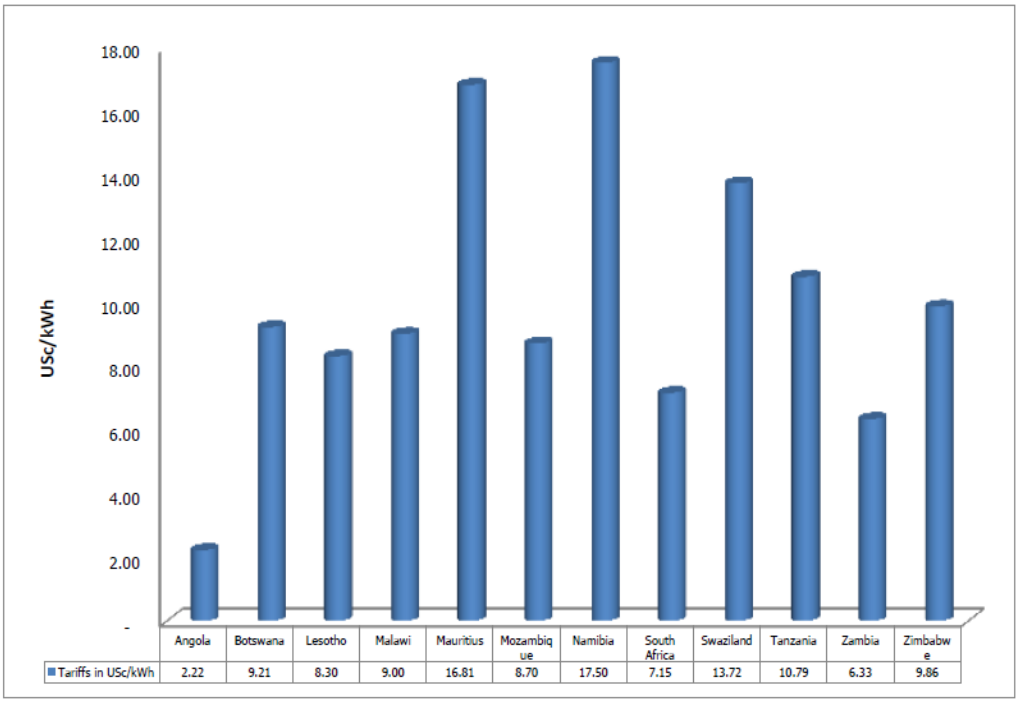


Figure 11: *Comparison of end user electricity tariffs in the Southern Africa Development Community , [ERB, 2018]*

Chapter 3 RENEWABLE ENERGY SECTOR CONTEXT

3.1 Zambia RE potential and technology options

Renewable energy sources available in Zambia include solar, mini/micro-hydro, geothermal, wind and biomass. The following is a brief description of available renewable energy resource potential and technology options in Zambia.

3.1.1 **Solar Energy**

Zambia has an average solar potential of 5.5 kWh per m^2 per day with approximately 3,000 sunshine hours annually, providing good potential for solar thermal and photovoltaic applications (Singh *et al*., 2013). Despite this huge potential, penetration of solar usage and its contribution to the national energy mix in Zambia still remains low mainly due to the high investment capital costs, which need guarantees of long- term stable income streams to ensure financial viability.

The Government has undertaken several measures to promote solar including the development of the solar resource map beginning in 2015 with support from the Word Bank Energy Sector Management Assistance Program (ESMAP). This initiative, completed in December 2017, aimed to deliver high quality solar resource mapping and measurement services for renewable energy development in Zambia. Six measuring stations were installed (figure 12). The position of solar

meteorological stations was selected to achieve a representative geographical distribution within the territory of Zambia, as well as in proximity to the population centres, where potential solar power plants will be mostly deployed. The results of the solar resource mapping programme were incorporated into the global solar atlas (https://globalsolaratlas.info/). The atlas provides quick and easy access to solar resource data globally with GIS layers and poster maps showing global, regional, and country level resource potential.

Zambia targets to develop 600MW of on-grid solar generation in the coming 2-3 years. The first two projects procured through the Scaling Solar programme are expected to create opportunities for subsequent expansion of renewable energy generating capacity in Zambia. In July 2015, Zambia was the first country to launch the IFC Scaling Solar Programme to develop two large-scale solar projects. The request for proposals (RFP) was issued in February 2016 and the winning bids were announced in June 2016. The bids were the lowest PV pricing ever seen in Africa at the time. The first bid was US$ 6.02 cent/kWh for a 45 MW project by a consortium of NEON S.A.S./First Solar, and the project is under development. The second was US$ 7.84 cent/ kWh for a 34 MW tracking project by ENEL Green Power (EGP), and is expected that EGP will commission the power plant by the end of the first quarter of 2019. The second round of auction is currently put on hold due to financial difficulties of ZESCO's which limits its capacity to meet power purchase payments. The GRZ is currently implementing a financial rehabilitation programme to help ZESCO increase its creditworthiness and continue the development of on-grid RE deployment.

The Ministry of Energy of Zambia, jointly with the German Development Bank (KfW) is implementing the Global Energy Feed-in Tariff (GETFiT) programme to fulfill the Government's Renewable Energy Feed-In Tariff (REFiT) strategy. A request for proposals was issued on 31 August 2018 by the GETFiT secretariat for the procurement of 100MW solar photovoltaic (PV) capacity with the deadline of November 29, 2018 with a maximum individual project size of 20MW. Round two (2) of the GET FiT Zambia programme is the 100 MW GETFiT Small Hydro Tender. In line with the REFiT Strategy, this tender will support the development of small hydro projects with up to 20 MW of installed capacity. The tender was officially launched on 07 January 2019 and applications were accepted until the submission deadline on 13 February 2019. The tender for 100 MW PV projects were awarded and announced on 5th April 2019 while proposals for 100 MW hydropower projects were still being evaluated by the GETFiT secretariat together with the Ministry of Energy of Zambia by April 2019.

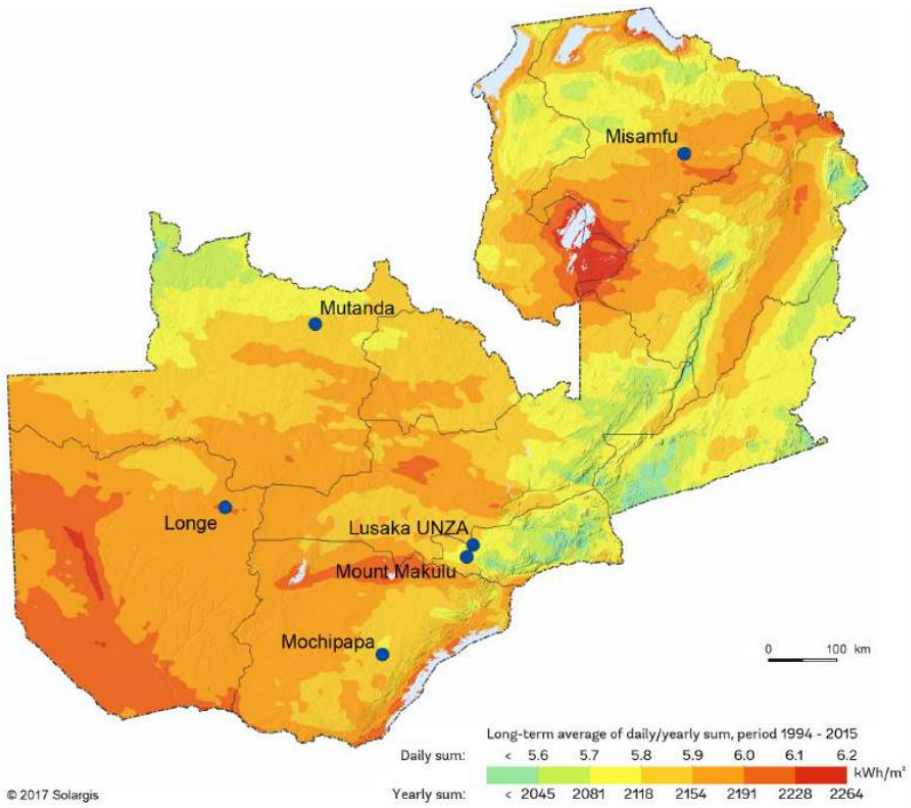


Figure 12: *Map of global horizontal irradiation showing position of solar meteorological stations.*

3.1.2 **Mini/micro hydro**

Zambia has a number of potential sites on small rivers suitable for local small-scale power generation. Suitable sites have been identified through studies on rivers with sufficient perennial flows. The Rural Electrification Master Plan (REMP) considers the development of mini/micro hydros to enhance rural electrification in some remote locations. Some mini hydro sites have already been developed with total installed capacity of 39.55 MW. The Government, through ZESCO and REA is undertaking feasibility studies to develop mini-hydro power plants.

There are currently six (6) mini-hydro projects proposed under National Appropriate Mitigation Actions (NAMAs) for the energy sector , with a proposed total installed capacity of 25.59 MW (Cholwe and Kasonkomona, 2016):

- Chavuma Falls, Zambezi district, North-western Province;
- Chanda Falls, Chavuma district, North-western Province;
- Chakata Falls, Kabompo district, North-western Province;
- Mwinilunga, Mwinilunga district, North-western Province;
- Zengamina II, Mwinilunga district, North-western Province; and
- Chilinga, Eastern Province.

The GRZ intends to prepare pre-feasibility studies and preliminary environmental and social impact assessment for 16 additional sites by 2021 (table 3) for further development by the private sector.

#	Site Name	River	Location (Province)	Estimated Installed Capacity (MW)
1	Chipota Falls	Lwela River	Mansa (Luapula)	1.25
2	Changwena Site	Changwena River	Mkushi (Central)	0.54
3	Kaudinia Falls	Muswema River	Serenje (Central)	0.70
4	Mulembo River Site	Mulembo River	Mkushi (Central	1.30
5	Kampoko River Site	Kampoko River	Mkushi (Central)	0.70
6	Mumbuluma Falls Site	Lwamfumu River	Mansa (Luapula)	0.30
7	Chilindi Chipusuka Falls Upper Site 1	Musumpu River	Serenje (Central)	0.55
8	Mufwanze Falls Site	Mufwanze River	Mpika (Muchinga)	1.23
9	Kapanda Lupili Falls Site	Lukulu River	Mpika (Muchinga)	1.00
10	Chipoma Falls Site	Chinamabubwe River	Chinsali (Muchinga)	1.54
11	Chauka Mantambu Falls	West Lumwana River	Mwinilunga (North Western)	0.72
12	Yaugumwila Falls Site	Mukubwe River	Mporokoso (Northern)	1.49
13	Chinkwazi Falls Site	Kalomo River	Livingstone (Southern)	0.01
14	Luswishi Falls Site	Luswishi River	Lufwanysma (Copperbelt)	0.21
15	Nyambwezyu Falls Site	Nyambwezyu River	Solwezi (North Western)	0.58
16	Kazembe Falls Site	Mujimbezhi River	Mwinilunga (North Western)	0.89
Total				13.01

Source: 2018 Sustainable Energy for All Draft Investment Prospectus

Table 3: *List of mini-hydro projects proposed for pre-feasibility studies (2017 – 2021)*

3.1.3 **Biomass**

The Government of Zambia in collaboration with the Food and Agriculture Organization (FAO) is undertaking a project to quantify the biomass resource potential in the country. According to Salasini (2010), the overall biomass resource and economic bio-energy potential for electricity generation was estimated at about 500 MW. This includes biomass from agricultural waste (447 MW), forest waste (46 MW) and municipal/industrial waste (4 MW). The key interventions identified to fully exploit the biomass potential are as follows;

i. Raise public awareness of the benefits, availability and opportunities of biomass energy production technologies;

ii. Increase energy production from biomass by drawing lessons from various studies and replicating pilot projects which have already been undertaken;
iii. Popularise and make available affordable biomass equipment countrywide; and
iv. Electricity generation from biomass sources.

To that effect, the Government has identified specific actions to strengthen the enabling environment for biomass development. These actions include the assessment of the biomass resources and adoption of a sustainable resource management strategy, adoption of a biomass energy strategy (which includes clean and modern energy for cooking), regulatory reforms to adopt minimum energy efficiency standards for cookstoves, adoption and enforcement of minimum energy efficiency standards for charcoal production and resources harvesting, and awareness campaigns directed at urban and rural users. There are also selected capital expenditure programmes to be implemented over the period 2017-2021. These actions and their costs are summarised in Table 4.

Programmes/Projects	Description	Cost Estimate (US$ '000')
Studies and institutional strengthening programmes		
Biomass Resources Assessment	Assessment of the biomass resources, development and adoption of a comprehensive strategy for biomass resource development in Zambia; consensus building among the stakeholders on biomass development	300
Development of a Biomass Energy Strategy	Development and adoption of a comprehensive biomass strategy and an implementation roadmap including "Clean and Modern Energy for cooking" solutions; cooking technologies include improved solid biomass cookstoves, charcoal stoves, highly efficient cooking stoves (e.g., using biomass pellets, briquettes), biogas and LPG cooking stoves.	300
Feasibility study of biogas installations for the large public entities (hospitals, barracks, schools), and in the private sectors (such as farms)	Study to define the full scope of a programme of institutional digesters for the large public and private institutions of Zambia, the economics, and financial feasibility, the management, and operational arrangements and the financing modalities in particular for the private sector entities. Standard brick/concrete biogas digesters (as currently implemented in Zambia)	200
Adoption of minimum energy efficiency standards, testing labeling/certification requirements for cooking appliances, and of labeling and enforcement mechanisms for charcoal production	• Minimum energy efficiency standards for cookstoves using solid biomass (wood fuel, briquettes, pellets. etc.), charcoal, biogas, LPG, electricity etc., and consultations with the professionals involved in that activity • Minimum energy efficiency standards expected from charcoal producers • Installation of testing and labelling equipment in ZABS facilities • Information and communication campaigns	700

Awareness, information and demonstration campaigns on clean and modern cooking solutions (biogas, briquettes, pellets, and LPG) directed at residential and large biomass users	Awareness, communication, and demonstration efforts to increase the sustained use of clean and modern cooking solutions in Zambia including the monitoring and evaluation mechanisms	750
Capital expenditure programmes		
Financial support for the dissemination of improved solid biomass cookstoves to residential customers in urban, peri-urban and rural areas - Phase I	Result-Based-Financing grant provided to increase the adoption and use of improved cookstoves (target is 100% use of improved cookstoves by 2030 in urban, peri-urban and rural areas of Zambia); include resources to support the domestic producers of improved cookstoves (wood fuel, biomass pellets, briquettes, and other stoves) and strengthen the supply chain, and to monitor and evaluate progress over the implementation period	9,350
Scaling up the dissemination of domestic Biogas digesters	Dissemination of 5,000 biogas digesters for households uses as a scale-up of the SNV/MOE biogas programme under implementation in Zambia; programme will also include awareness programmes, training of masons, and monitoring and evaluation of existing facilities and of on-going programme	6,000
Introduction of institutional biogas digesters - Phase I	Dissemination of 50 biogas digesters for public institutions (hospitals, boarding schools, barracks, prisons, etc.) and commercial farms to reduce the consumption of biomass fuels; Programme to also include awareness programmes, training of masons, management and operations of the digesters and monitoring and evaluation of facilities (there is currently no institutional biogas programme in Zambia)	3,000
Increasing efficiency in resource harvesting and charcoal production - Phase I	• Promotion of alternate coupes and shelterbelt strips systems (ACOSSS) for sustainable forest wood harvesting for charcoal production • Promotion of charcoal kilns for sustainable charcoal production and associated sustainable business • Capacity building and awareness campaigns among the stakeholders participating in charcoal NAMA • Innovative financing to provide risk capital and development of business model for charcoal producers, transporter and traders	12,000

Source: 2018 Sustainable Energy for All draft Investment Prospectus

Table 4: *Studies, institutional strengthening and capital expenditure programmes to improve the use of clean and modern cooking solutions (2017-2021)*

3.1.4 **Wind Energy**

There is now an established network of state-of-the-art wind measurement masts in Zambia that can be used to support stakeholder wind analysis activities and future utility-scale wind development in-country.

The Zambian Government, with support from ESMAP, is undertaking a wind resource measurement campaign to provide Zambian policy makers, stakeholders, and Independent Power Producers (IPPs) with accurate and valuable data of the national wind resource, including complementary tools, which can be of direct practical use, both for formulating energy policy and implementing wind projects. The meteorological masts were sited in their current eight different locations primarily for the purpose of validating the national wind atlas, upon completion of 24 months of data acquisition. Several meteorological mast locations are sited in areas where wind development could be considered viable and potentially bankable with current turbine technology. The map below shows location of the masts informing the wind mapping studies.

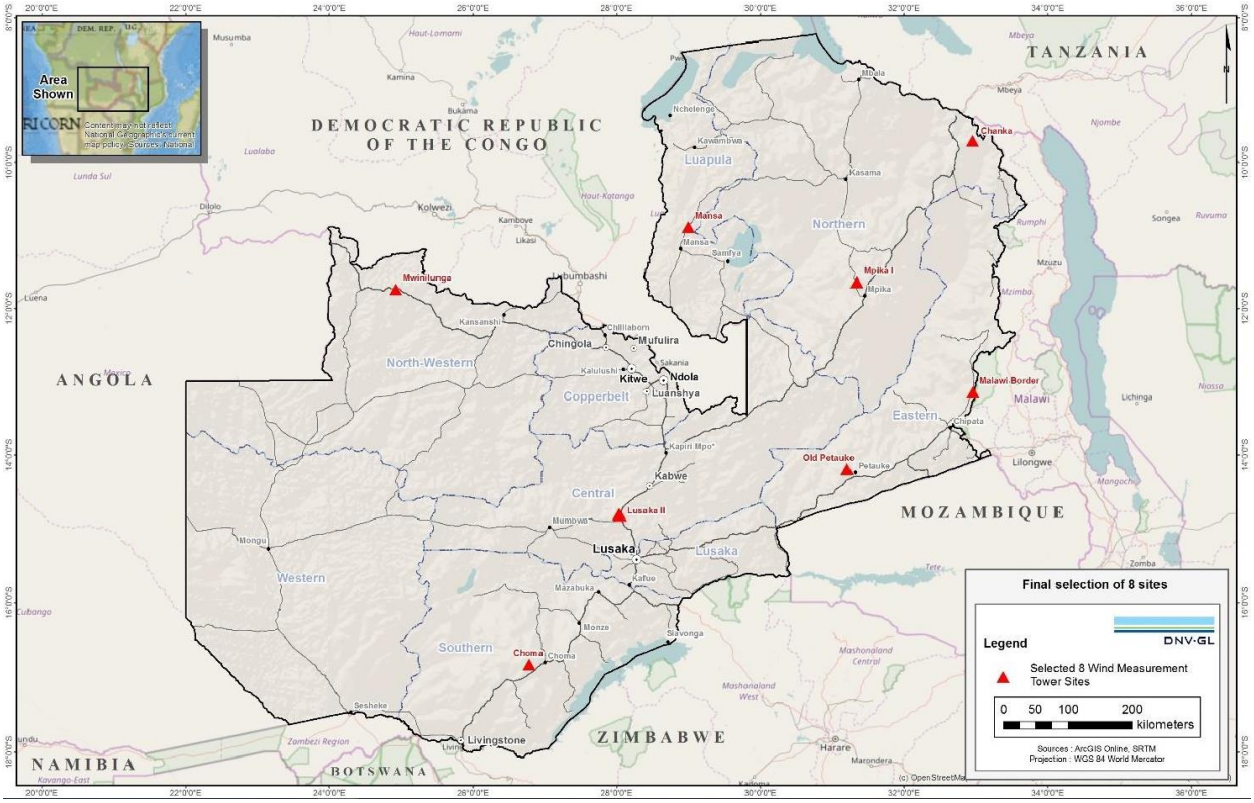


Figure 13: *Location of wind measurement tower sites*

Measurement sites	Choma	Mwinilunga	Lusaka	Mpika	Chanka	Petauke	Mansa	Lundazi
Average air density at hub elevation [kg/m3]	1.00	0.99	1.03	1.00	1.01	1.04	1.01	1.04
On-site measurement period [years]	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Long-term reference period [years]	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Long-term hub height wind speed at met mast [m/s]	7.4	7.4	7.9	7.3	7.4	6.5	6.9	6.9
Average turbine wind speed [m/s]	7.4	7.5	8.2	7.3	7.5	7.0	7.3	7.1
10-year P50 Net Energy [GWh/annum]	303.0	323.3	386.0	320.3	345.6	291.5	314.7	303.7
10-year P50 Net Capacity Factor [%]	34.6	36.9	44.0	36.5	39.4%	33.2%	35.9%	34.6%

Table 5: *Summary of 12-month wind data measurement results*

In the future, this network of masts will also provide the industry with a source of long-term reference station data which could greatly reduce uncertainties for potential developers. The data collected from the eight met masts are considered very good both in terms of data quality and data coverage. Further investment by stakeholders in well-organised measurement campaigns and in feasibility analysis that are focused on reducing uncertainties will help support future growth of the Zambian wind market.

3.1.5 **Geothermal Energy**

There are over 80 mineralised hot springs in Zambia and these have been classified into five (5) major geothermal fields. Identified geothermal systems identified in Zambia are mostly associated with Karoo (Permian) era sedimentary basins (figure 14) with crustal faults in which meteoric fluids circulate, being heated by the regional geothermal gradient and rising, to be held beneath low porosity sedimentary rocks (the Cap Rock), which can form low/medium temperature geothermal reservoirs of 130-200^{O}C. Such setting hosts binary power plants in USA (largely Nevada) and Turkey. This is a different geologic setting to that associated with magmatic, active volcanism as developed in Iceland East African Rift (Kenya) and around the Pacific Ring of Fire. These systems are high enthalpy (>200^{O}C) and geothermal steam is used directly in the power plants.

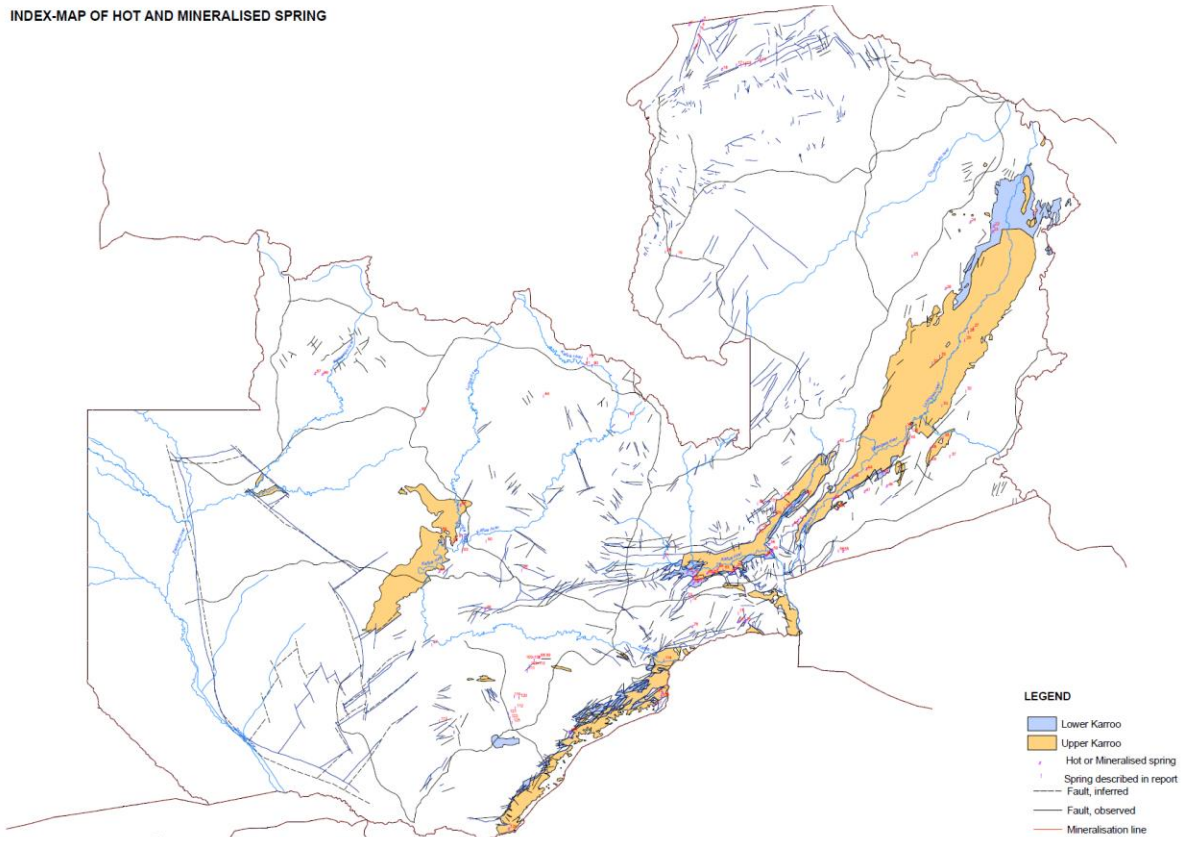


Figure 14: *Index-map of hot and mineralized springs*

Surface indications of geothermal systems (largely hot springs with surface temperatures ranging 35-93^{O}C) are concentrated a) between Lakes Mweru and Tanganyika in Northern Zambia, b) Mansa and the western Copperbelt, c) the Kafue River basin including the Kafue Trough, d) the Luangwa and Luano Valleys, and e) the middle and lower Zambezi Valley. (see map above). A commercially viable geothermal system must have three characteristics: sufficient heat (temperature), high volume of fluid to move the heat and rock porosity to allow flow of the fluid. To determine these characteristics, exploration must include both surface work and drilling.

Currently only three geothermal sites have resource calculations (table 6).

Location	**Model**	**Reservoir Temp**	**Reservoir area**	**P90 (MW)**	**P50 (MWe)**	**P10 (MWe)**	**Source**
Bweengwa River	Fault hosted	150-60^{O}C	12-14 Km^2	2	15	92	Kalahari/ Geologica USA
Kapisya	Fault Hosted	120-130^{O}C	0.5-1 Km^2	-	2	-	KenGen, Kenya
Chinyunyu	Fault Hosted	120-130^{O}C	0.5-1 Km^2	-	2	-	

Table 6: *Preliminary features of selected geothermal fields in Zambia*

Following a Country-wide reconnaissance survey of hot springs in the 1970s, the Geological Survey Department (GSD) with the support of the Italian Government in 1986 installed a 220kW pilot geothermal plant at Kapisya, Lake Tanganyika. At the time there was rather less understanding of deep circulation fault hosted geothermal systems and the production wells did not reach the reservoir; drilling was only done to a depth of about 150 metres. The power plant was also not located at the geothermal reservoir and the discharge temperatures were about 85°C insufficient to efficiently run the power plant whose design temperature was 95°C. The power plant only operated for a short time during its pre-commissioning phase. At the time, there was no motivating factor to develop non-hydro energy sources and therefore, the programme was abandoned. The project was handed over to the GSD which eventually handed over to ZESCO. ZESCO is seeking technical assistance to reassess the resource and to rehabilitate the plant.

The Government of Zambia has identified geothermal as one of the energy sources which can help the country diversify the power generation mix. In order to tap into the available opportunity arising from many geothermal potential sites with various surface and sub-surface manifestations like hot springs, ZESCO has prioritised five geothermal potential sites with the intention of subjecting them to full surface studies. The Government is also encouraging the private sector to participate in the development of geothermal resources.

In 2011, the Department of Energy granted a geothermal exploration permit to Kalahari GeoEnergy Ltd, ("Kalahari") a private Zambian company. The company initialled assessed many of the previously identified targets within Zambia establishing a data set that includes geologic setting, hydrochemistry and derived geo-thermometry; geophysics surveys were conducted at a number of targets. Subsequently Kalahari has focused its exploration on the Kafue Trough (a Karoo basin bounded by crustal faults) that contains six known geothermal systems including the Bweengwa River Geothermal Resource Area. Following an extensive and systematic exploration programme that included hydrochemistry, geophysics and the drilling of six temperature gradient holes, Kalahari is currently undertaking resource delineation work. The results from the pre-feasibility studies, which included slim hole drilling, have been yielded positive results with geo-thermometers ranging from 130°C to 180°C with very good permeability. Arising from the pre-feasibility study, an initial field power capacity was determined to be as low as 15MWe and as high as 90MWe. A full feasibility study covering both an environmental and social impact assessment is expected to be completed in 2019.

Despite the existence of adequate resources, geothermal remains unexploited as a source of energy in Zambia due to limited specialised expertise and financial resources to meet the high cost of exploration and development. There is need to develop a geothermal strategy to facilitate the transformation of the geothermal industry in Zambia. The development of this sector can easily have quick wins for women in energy as regard to gender mainstreaming activities and productive use of energy, contributing to the reduction of rural poverty.

3.2 Barriers Affecting Renewable Energy Development

There are several significant barriers affecting the exploitation of renewable energy resources in Zambia. These barriers are presented below in table 7.

Barriers/Constraints	Mitigation	Resources affected
Policy		
Lack of clear regulatory framework and procurement route for private sector investment	Strengthened policy and regulatory framework and increased institutional capacity	Wind, Geothermal, Biomass
Technical and Human Capacity		
Insufficient/inadequate data	Carry out geospatial studies for rural electrification to inform national electrification strategy Conduct resource assessments for geothermal, biomass and mini-hydros.	Small hydro, biomass, Geothermal
Insufficient/inadequate of standards on renewable energy technologies	Development of standards by the ZABS and regulations by ERB with supporting infrastructure for testing the technologies.	Off-grid electrification solutions including solar kits, lanterns
Inadequate human resource capacity in RE technologies.	Increased human resource capacity in RE through targeted capacity building programmes.	Solar, small hydro, biomass, geothermal
Economic and Financial		
Low electricity tariffs	Migration towards cost reflective electricity tariffs.	All RE technologies
High capital cost and limited availability of long-term finance, especially for small-and-medium scale enterprises	Targeted subsidies and financial support (grant, concessional loan) to improve the financial viability of RE projects Development of financing intermediaries and strengthening of their capacity to support RE projects	Wind, Solar, small hydro, geothermal
Low access to finance	Improved collaboration with development partners to provide capacity building and credit lines to commercial banks and financing intermediaries to on-lending to the private sector	All renewable energy technologies
Low creditworthiness of the off-taker (ZESCO) for on-grid projects	Develop credit risk mitigation mechanisms and undertake reforms to improve the financial viability of ZESCO	All on-grid renewable energy projects
High upfront capital cost of renewable energy projects	Implement financing support mechanisms to provide grants, subsidies and/or long-term low-cost financing to off-set upfront	All renewable energy sources

	capital cost and improve affordability of power generated	
Low capacity to pay of people living in rural areas	Implement financing support mechanisms to provide grants, subsidies for connection cost Promote productive uses of electricity to foster the development of income generating activities and contribute to poverty reduction	All off-grid renewable energy projects
Social		
Limited awareness of the potential opportunities and economic benefits	Awareness creation through sensitization and awareness campaigns	All renewable energy technologies

Table 7: *Main barriers affecting the deployment of renewable energies in Zambia*

With the support of SREP, removing these barriers, will not only help the country meet its growing demand for electricity, enhance energy security, improve access to electricity, and reduce the cost of supply, but also bring substantial economic, social, and environmental co-benefits. Most of the renewable energy resources are located in under-developed areas of the country. Through the development of these resources, the benefits to be achieved will include: additional electricity generation; reduced indoor pollution; forest conservation; opening up of the areas through infrastructure development such as roads and water; employment creation and income generation; increased security in the areas as a result of the economic activities and social amenities.

Realising these primary and co-benefits will require immense private sector participation as per aspirations of the 2008 NEP and 7NDP which intend to create an enabling environment to encourage private sector participation. Private sector will be required to bring in the necessary financial and technical resources needed to invest and deploy renewables from current levels.

3.3 Role of Private Sector and Leverage of Resources

The 2008 NEP recognises the need to attract more investment for improved energy infrastructure development and management of the resource in order to enhance economic growth and make the resource available to all. The 7NDP further asserts the role of the private sector and the need to harness its financing potential to ensure positive contribution to national development and ease pressure on the national treasury. More specifically, the Government of Zambia aims to put an emphasis on private sector participation to improve infrastructure development in the energy sector. As part of its debt management strategy, the Government pledges to "put in place measures to reduce domestic borrowing so as not to crowd out private sector investments" (MNDP, 2017).

Private sector participation is also one of the cornerstones of the key structural reforms outlined in Zambia's Economic Stabilisation and Growth Programme (ESGP). Among other objectives, these reforms specifically aim to ensure greater economic stability, growth and job creation through policy consistency to raise confidence for sustained private sector investment.

Subsidy reform in energy

The Government will focus on adjusting electricity tariffs (while maintaining the life line tariff to protect poor households) and fuel prices in a phased manner to reach cost-reflective levels to attract private sector investment. A cost-of-service study is currently under preparation and will inform the steps towards achieving cost reflective electricity tariffs. Further the electricity sub-sector, including its legal framework, is under review to ensure consistency with current trends.

Private sector development

One of the hindrances for stimulating private sector development is the high cost of doing business. Therefore, the reform area will focus on streamlining business registration, licensing and granting of incentives. Furthermore, the Government will accelerate implementation of measures aimed at improving the general business environment and making the country a prime destination for investment and wealth creation. In addition, the Government will continue with programmes and reforms aimed at growing micro small medium enterprises. The Government will also provide the requisite incentives to the private sector for industrialisation and export diversification.

Supported by the Government's commitment to create and maintain a conducive business environment, Zambia's energy sector has seen an increase in private sector participation in renewable energy development, now seen as a major contributor to economic growth in numerous sectors. For example, a purely Solar Industry Association of Zambia (SIAZ) has recently been established which aims to become an effective, action-oriented platform for the private sector within the rapidly growing off-grid solar industry (solar home systems, mini/micro grids) to provide input and guidance towards the development of the sector strategy in Zambia.

Other activities include the increase in the number of renewable energy product/solution providers ranging from Solar Home Systems, Solar water heaters, chargers, batteries among others.

3.4 On-Going and Planned Initiatives by GRZ and Development Partners

Many multi-lateral development partners such as the World Bank Group (WB) institutions, African Development Bank (AfDB), European Union (EU), or United Nations Development Programme (UNDP) as well as bilateral partners are involved in the energy sector, and more particularly USAID, KfW, SIDA (Swedish International Development Cooperation Agency), among other partners, have been active in the renewable energy. The main objective of these interventions is to strengthen and support sectoral planning and coordination in preparing and financing energy projects.

The main programs and projects funded by various Cooperating Partners (CPs) are shown in the following table 8.

Programme / Project	Objectives	Outcomes	Amount	Donors	Start – End dates	Status
Increased Access to Electricity and Renewable Energy Production (IAEREP) Project	To increase access to clean, reliable, more equitable and affordable energy and promote renewable energy production and energy efficiency across Zambia.	• Enhancement of Policy, Legal and Regulatory Environment and Capacity Building for Renewable Energy and Energy Efficiency • Capacity Building for Renewable and Energy Efficiency – Feasibility Studies and Demonstration Projects	40 million Euro (grant)	EU	2016 - 2022	• On-going • Draft mini-grid regulation Developed • Draft EE strategy developed
Renewable Energy Resource Mapping Project	To map solar and wind resource potential in the country.	• Solar and Wind Atlas	USD 3.6 million (grant)	WB	2016 - 2018	• Solar Resource: Data collection complete. • Wind Resource: Data collection to complete in December, 2018.
China-Zambia South-South Cooperation on Renewable Energy Technology Transfer Project	To strengthen the enabling environment for the transfer and use of priority renewable technologies in Zambia	• Remove market barriers to the adoption of renewable technologies for the rural poor in Zambia, • Invigorate the Chinese capacity for South – South Cooperation on renewable	USD2.7 million (grant)	UNDP/ Denmark	2014 - 2018	• EPC contract awarded for 200Kw Chipota Hydro Project, Construction to commence in April 2019. • Centre of Excellence launched at UNZA

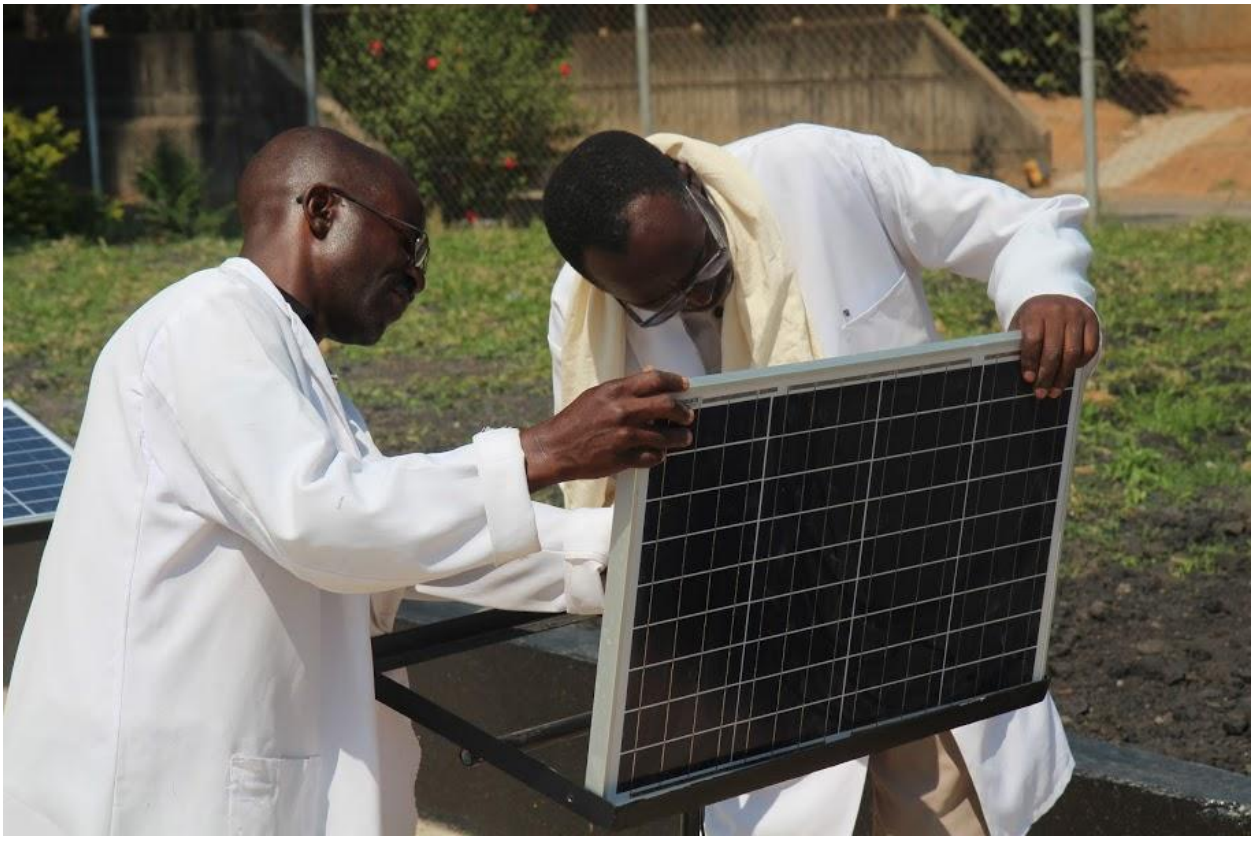
Electricity Service Access Project (ESAP)	To increase electricity access in Zambia's targeted rural areas.	• Increased on and off-grid electricity access expansion • Capacity building and project implementation support (through geospatial planning, and National Electrification Programme)	USD 26.5 million	WB	2017 - 2022	• On-going • Project Implementation Unit in place • National Electrification Programme (NEP) launched
Scaling-up Solar Program	To increase on-grid solar generation capacity	• Increase solar capacity by 600MW	-	IFC/WB	2016 - 2021	• Two solar plants are underway with capacities of 54MW and 28.2MW following first round of the bidding process • Second round on hold
Sustainable Energy for All Initiative (SE4ALL)	• Ensuring universal access to modern energy services, • Doubling the rate of improvement in energy efficiency, • Doubling the share of renewable energy in the global energy mix	• Action Agenda and Investment Prospectus	-	AfDB	2016 - 2019	• Commenced in 2016. However, contract of consultant was terminated in 2017 • Draft Action Agenda and Investment Prospectus developed • New consultant engaged in Dec 2018
Cost of Service Study	To analyse and determine costs involved in generating, transmitting, distributing and supplying electricity to various customers as well as the marginal cost of expanding the	• The goal is to migrate to cost reflective tariffs	USD 1 million	AfDB	2017 – 2019	• Commenced in 2017. • Expected to be completed at the end of 2019.

	infrastructure in order to meet the growing demand.					
REFIT/GET FIT Strategy	To remove barriers for increased private sector involvement in renewable energy power generation for small- and medium-sized (up to 20 MW)	• Add 200MW of on-grid electricity generation capacity from Solar (100MW) and Small hydro (100MW)		USAID, Germany, AfDB	2017 - 2020	• REFIT strategy adopted in 2017 • Solar Projects: RFQ stage • Small Hydro Projects: Request for Qualifications launched on November 8, 2018.
Beyond the Grid Fund	To bring affordable and high-quality renewable energy services.	• Affordable and high-quality renewable energy services to one (1) million Zambians. • Increased private- sector growth in off- grid renewable energy generation and distribution in the country.	20 million Euros	USAID, SIDA	2017 - 2021	• Implementation contracts awarded to five (5) companies.
Bioenergy and Food Security (BEFS) Project	To undertake a Bioenergy Assessment and capacity building	• Development of a Bioenergy strategy that integrates food security and agriculture needs.	USD 273,000	FAO	2018 - 2020	• Launched on October 30, 2018

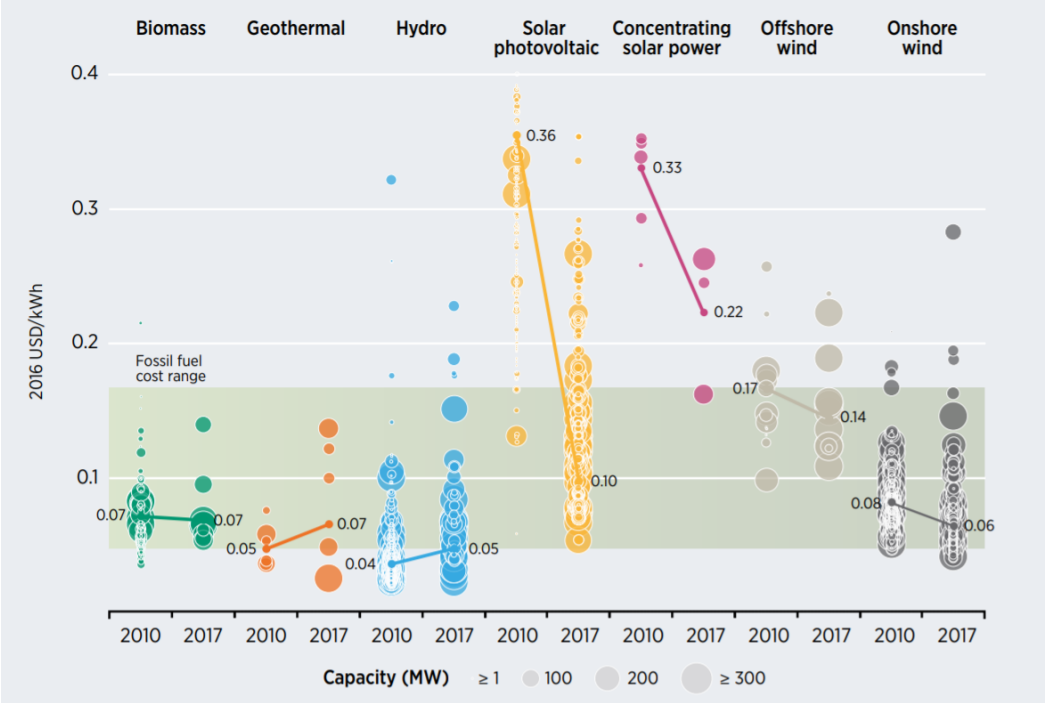
Energy for Agriculture	To develop biogas market in Zambia in order to increase access to renewable energy for Households and public services and businesses	Increased access to biogas as a clean cooking solution	USD 5,000,000	SIDA	2015 -19	• 3375 biodigesters installed in first phase
Forests Regeneratio n Project	Assisted regeneration of forests	Reducing pressure on the forest from charcoal production.	USD 300,000	UNDP	2017 - 2020	• Baseline survey done to ascertain wood fuel utilisation in Chitambo and Serenje. • Awareness / Training done in the production and use of Fixed Stoves and improved cookstoves and in Briquette Making using twigs, leaves & Maize cobs.
Zambia Renewable Energy Financing Framework	The programme targets decentralised solar energy generation and will support the implementation of Zambia's Renewable Energy Feed-in-Tariff (REFiT) Strategy.	To mobilise private investment in the renewable energy sector, aimed at diversification of Zambia's energy mix.	USD 52.5 million	GCF, AfDB	2018	Technical assistance team mobilised in 2019

***Table 8**: Main programs and projects supported by the Government of Zambia and its Cooperating Partners*

Chapter 4 ECONOMICS OF RENEWABLE ENERGY TECHNOLOGIES AND THE PRIORITIES FOR SREP IN ZAMBIA



The assessment of the economics of the different renewable energy technologies is based on the levelized cost of energy (LCOE) which is the present value of the cost to build and operate a power generating plant over its lifetime in order to evaluate the relative cost competitiveness of each renewable energy technology, considering the specifics of Zambia. The figure 15 shows the global levelized cost of energy from utility-scale renewable energy technologies.



Source: IRENA, 2018

Figure 15: *Global levelized cost of electricity from utility-scale renewable power generation technologies, 2010-2017*

Note: The diameter of the circle represents the size of the project, with its centre the value for the cost of each project on the Y axis. The thick lines are the global weighted average LCOE value for plants commissioned in each year. Real weighted average cost of capital is 7.5% for OECD countries and China and 10% for the rest of the world. The band represents the fossil fuel-fired power generation cost range.

Hydropower historically represented one of the lowest-cost electricity generation technologies and continues to do so. The increase of the global weighted average total installed cost from US$ 0.036/kWh to US$ 0.046/kWh between 2010 and 2017 was due to the fact that there is a shift to more challenging projects with higher civil engineering and project development costs. Typically, the LCOE for large-scale hydropower is rather good, getting to as low as US$ 0.02/kWh. Small-scale hydropower can also be very economic, although typically having higher cost than the large-scale, but being very suitable as an option for electrification, providing lower-cost electricity to remote communities, or for the local grid.

The table below shows the estimated LCOE for the renewable energy technologies with small capacity of 2 to 4 MW, based on the calculation done by the Ministry of Energy (MOE), considering current technology costs in Zambia.

RE Technology	**Solar PV with battery**	**Wind**	**Small Hydro Power**	**Biomass**
USD/kWh	0.148	0.103	0.10	0.09

Source: MoE 2018

Table 9: *Levelized costs of on-grid renewable energy technologies in Zambia*

Note: This considers average for 1-10 MW installed capacity for wind

As evident from the table 8 above, the LCOE for small hydropower is among the lowest. The application of the technology for many remote areas of the country where there is no power grid represents an additional cost for grid connection. The potential use of SREP funds would contribute to the improved economics of the off-grid small hydropower projects, bringing down the generation cost and presenting a clear alternative for fossil fuel-based electrification solutions. In addition, it will also allow switching to clean cooking for the vast majority of the rural households who are currently using solid biomass.

Geothermal Energy

A preliminary analysis was conducted for geothermal energy based on the assumptions presented in table 9. The base case results of the analysis show an internal rate of return varying between 5.9 and 7 % for a 20 and 25-year plant lifetime, respectively and assuming an offtake price of US$100 per MWh with no escalation.

	Value	**Unit**
Resource		
Brine temperature	145	^{o}C
Plant capacity	15	MW
Plant capacity factor	96%	
Project Costs		
Cost per Well	2,500,000	US$
Total project cost	60,000,000	US$
Annual operations and maintenance (pre-escalation)	3,800,000	US$
Annual cost escalation	3%	
Financing		
Debt equity ratio	80:20	
Repayment Term	15	Year
Term Loan Rate	6.0%	
Construction Loan Rate	6.0%	
Tariff assumption	100	$/MWh (fixed)

Table 10: *Assumptions for calculation of viability of 15 MW geothermal plant*

The analysis is highly sensitive to capital cost and cost of debt as presented in table 10, which assumes a discount rate of 11%. The net present value of the plant is negative in the base case scenario, and turns positive when the cost of debt reduces below 5%, everything else remaining equal. The negative net present value recording at varying level of capital cost (using the well cost as a proxy), show reinforce the assertion that an off-take price in excess of the assumed US$100 per MWh, low capital cost and/or concessional funding are needed to encourage private sector-led development of a geothermal plant under the current assumptions.

	Assumption	Net present value
Well Cost		
Base case	$2,500	($1,559)
	$3,500	($6,476)
	$4,000	($9,113)
	$4,500	($11,751)
	$5,000	($14,389)
Term Loan Rate		
	2.0%	$3,255
	4.0%	$872
Base case	6.0%	($1,559)
	8.0%	($4,250)

Table 11: *Sensitivity analysis for geothermal power development*

The economic co-benefits linked to the deployment of geothermal energy have not been monetised and included in the analysis. These include: higher energy security due to the diversification of energy sources, avoided greenhouse gas emissions, income generation opportunities linked to direct applications for geothermal power (figure 15). These preliminary results support the use of concessional funds to foster the development of geothermal projects in Zambia.

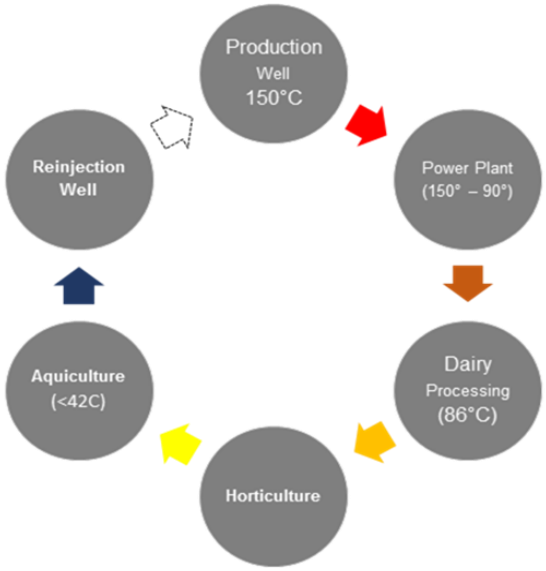


Figure 16: *Geothermal direct applications*

Prioritization of Renewable Energy Technologies for SREP Investment Plan

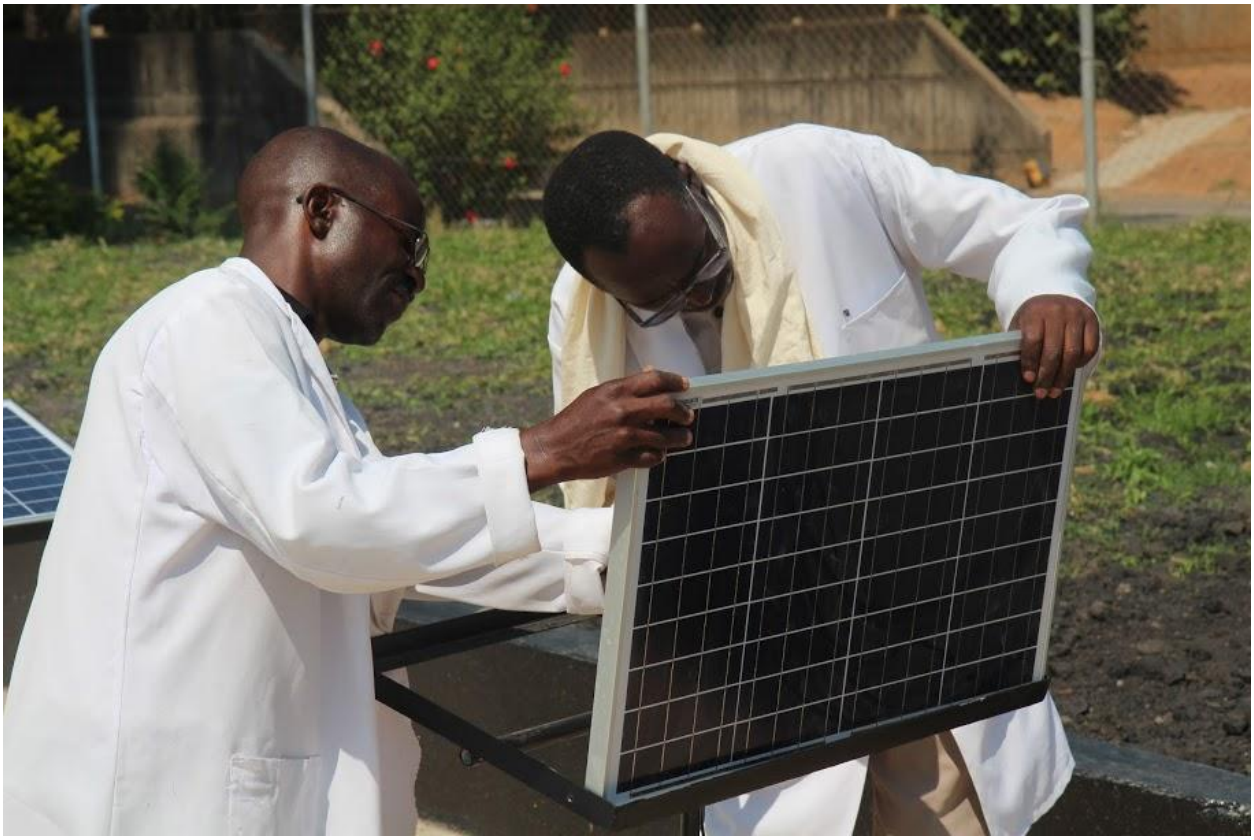
The analysis considered the use of renewable energy sources (small hydro, biomass, solar PV, geothermal, wind) for on-grid, off-grid and mini-grid deployment, taking into consideration, additionality with on-going and planned initiatives from GRZ and Cooperating Partners.

Limited additionality was found for the on-grid market segment, given the existing scaling solar programme with targets 600 MW capacity addition and the GET FIT programme that aim to

facilitate the deployment of an additional on-grid 100 MW from solar and another 100 MW from small hydro-power plants. The Zambian Government has therefore prioritised support to the Wind and Geothermal projects for this Investment Plan.

Recognizing the strong linkages between rural development, poverty reduction and electrification, the Zambian Government would need to leverage significant amount of funding from all sources, beyond what is currently available in the sector, and leverage private sector expertise to increase rural electrification beyond the current 4.4%. To that effect, the SREP investment plan adopts a technology neutral approach for the off-grid and mini-grid segments. It is expected that project support will be based on well prepared feasibility studies and business cases prepared by private developers.

Chapter 5 CONTRIBUTION TO NATIONAL ENERGY ROADMAP



4.1 Likely Development Impacts and Co-Benefits of SREP Investment

The roadmap for energy sector development for Zambia is guided by the national Vision 2030 whose overall goal for the energy sector is to attain 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. Towards this national vision, Government has set electrification targets at 90% for urban areas and 51% for rural areas and having an additional 4,333 MW of electricity generation capacity by the year 2030. In the medium term, Government intends to increase capacity by 1,000 MW and improve electrification in rural areas from the current 4.4% to 8% by 2021. The SREP is anchored in the national policy objectives and targets with a view of supporting the achievement of these aspirations.

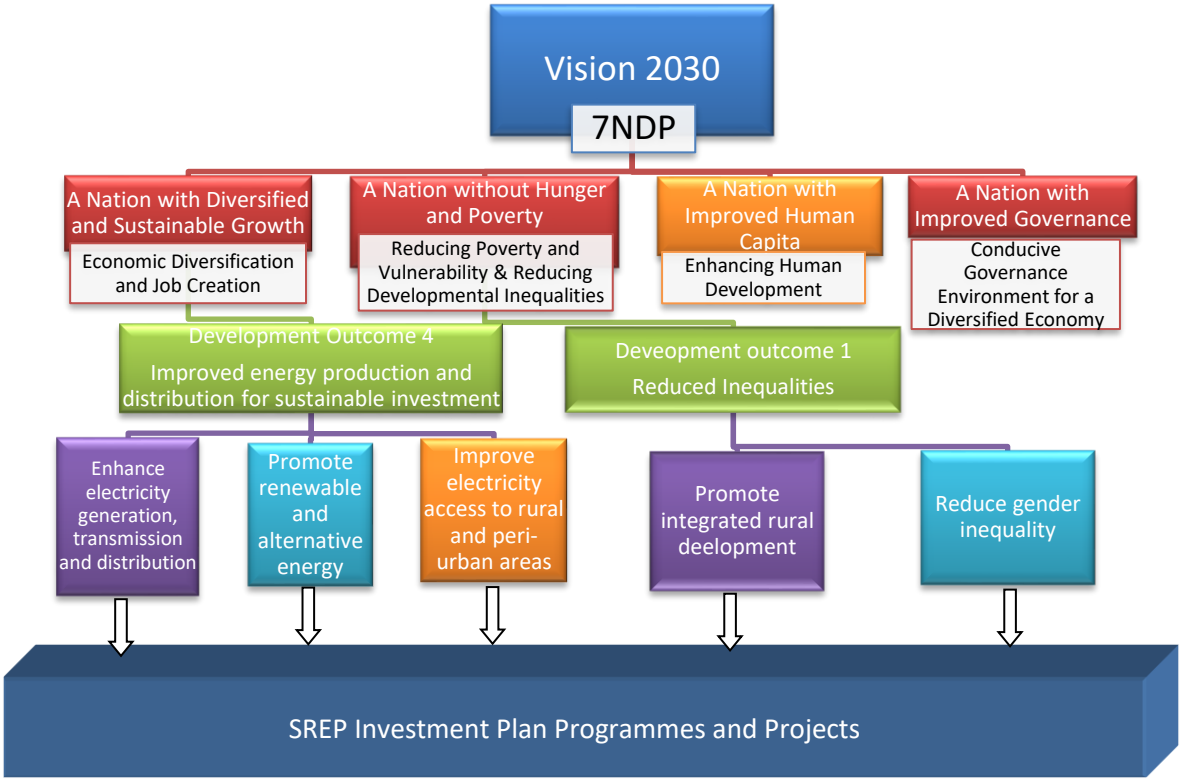


Figure 17: *Linkages Vision 30 and the Seventh National Development Plan 2017-2021 and the SREP Investment Plan*

The implementation of the SREP Investment Plan will strengthen Government's action towards the achievement of its development goals. Development impacts and co-benefits anticipated include: increased energy generation from renewable energy, improved access to electricity and other modern services, poverty reduction and community development, reduced reliance on imported fossil fuels and enhanced gender equality.

4.1.1 Increased Energy Generation from Renewable Energy

Zambia is endowed with a range of energy resources, particularly woodlands and forests, water, coal and renewable sources, such as geothermal, wind and solar energy and has the potential to generate about 6,000 megawatts (MW). The SREP investment plan will support up to 100 MW of renewable energy capacity from all sources (including wind and geothermal) and lead to approximately 500 GWh of renewable energy generation annually, thereby contributing to the attainment of universal access to clean, safe, reliable and affordable energy at low cost in line with the national development aspirations.

4.1.2 Improved access to electricity and other modern services

Access to electricity, especially in rural areas, is strikingly low. The overall national electricity access rate, defined as connection to the grid, is low at 31%. More than 67 % of the population in urban areas, while only about 4% in rural areas, have access to electricity. As part of the national strategy document, Vision 2030, the GRZ has set electrification targets at 90% for urban and 51% for rural areas to be attained by 2030. However, at the current pace of electrification, these targets are not expected to be achieved. The cost of providing on-grid access is made more prohibitive due to network expansion choices. Inadequate and unpredictable public funding for rural electrification has affected the pace of electrification. Private sector participation in the provision of access has been limited, mainly due to inadequate access to finance and a nascent enabling regulatory environment. SREP Investment Plan's activities will complement the efforts deployed by the Government of Zambia and its Cooperating Partners to pilot innovate business models to improve access to electricity and other services for approximately 4.8 million people including 850,000 households in the grid connected and off-grid areas.

4.1.3 Energy Security

Zambia's over reliance on hydropower electricity generation is threatened by effects of climate change such as drought and therefore calls for urgent diversification of the Country' energy mix. Further, Zambia imports its petroleum products to support socio-economic activities. With regard to petrol and diesel, 50% is refined locally, and 50% is imported. The domestic prices of fuel are determined by several factors, the main ones being, the international oil prices and the exchange rate of the Zambian Kwacha to the United States Dollar. This has resulted in fluctuation in prices and intermittent supply of petroleum products. To maintain a stable supply, there is need to maintain an efficient and cost-reflective mechanism of pricing petroleum products. The inefficiencies in the petroleum supply chain have negatively impacted on the cost of production, consequently reducing Zambia's competitiveness. Targeted interventions contemplated under the SREP IP, especially with regard to the wind and the geothermal sectors will help diversify the energy mix and facilitate private sector participation, thereby reducing the reliance on hydropower.

4.1.4 Poverty Reduction and Community Development

Approximately 57.9% of the Zambian population lived in rural areas in 2016. Yet, Zambia has had huge development deficits in rural areas, especially in key sectors that can help facilitate growth and development. The growth was thus exclusive (benefiting those well-off already) and not inclusive (not reaching the poorest households). Growth has been highest along the railway line from Livingstone, through Lusaka, to the Copperbelt.

Rural areas continue to have poor road networks and poor delivery of social services, limited access to electricity and low productivity, with the majority of the population working in the informal agriculture sector. There is need to provide the rural communities with energy that is adequate, available when needed, reliable, of good quality, convenient, affordable, legal, healthy and safe for all required energy services. This does not mean having an electricity connection only, it goes beyond having access to electricity under the new definition, which also takes into account other aspects, such as reliability and affordability. Energy access is measured in the tiered-spectrum, from Tier 0 (no access) to Tier 5 (the highest level of access), the highest level of access

that enables communities to engage in productive use of energy i.e. income generating activities which will alleviate poverty. The 7NDP outlines GRZ's commitment to transform underdeveloped rural settings into cohesive communities with profitable and productive opportunities where members enjoy equitable access to basic public and social services, such as rural electrification. By supporting activities that improve access to rural and pre-urban areas, the SREP Investment Plan will not only contribute to improved infrastructure services, but will also help alleviate poverty by promoting employment opportunities and productive uses of electricity.

4.1.5 Employment Opportunities and Job Creation

The deployment of renewable energy technologies will increase access to electricity and directly contribute to the creation of employment opportunities, especially in rural areas. The implementation of the investment plan's activities will create jobs during the construction of the related infrastructures and promote productive uses of energy. During implementation of the off-grid component, the significant capacity building and project opportunities will create new businesses with permanent jobs (for example SHS vendors, installers, technicians, O&M companies, etc).

The strong link between electrification projects, economic growth, and level of development is well documented. However, the micro-level-literature on productive use impacts of electrification programs is generally inconclusive. According to a comprehensive study by GIZ, access to and use of electricity by Micro, Small and Medium Enterprises (MSMEs) does not automatically lead to development outcomes such as increased productivity, profits and income. There is some evidence that electricity access can lead to the creation of informal (sometimes home-based) and formal enterprises but more research is needed to confirm these findings. However, a recent study from low-income compounds in Zambia showed that there is a significant interest from both men and women to start businesses once they get access to electricity. Regarding the link between energy and employment, there is some evidence which indicates that access to electricity (in combination with modern household appliances) leads to a substantial increase in female employment since the time spent on household chores is reduced.

The following activities emerged from an initial assessment conducted during the preparation of the investment plan:

a. Electrification of agricultural activities to unlock rural economic development such as storage and conservation of local production to secure the domestic market supply and solar-water pumping for irrigation - the fast evolution of the solar-water pumping sector enables customised solutions that match local needs and adjust to local constraints (e.g. site's topography, aquifer resources);
b. Electrification of small-scale industrial activities and businesses to boost economic growth and employment, such as lighting, electricity and water heating for hotels and other tourism facilities, refrigeration, freezing and lighting for convenience stores and use of power looms and sewing machines for clothing and outlets.

There are also other opportunities in the geothermal industry apart from electricity production. These opportunities are milk processing, fish drying, horticultural production, fruit drying and geothermal spas for tourism. Promising geothermal fields have been identified close to Lochnivar

National Park in Southern Province. Opportunities available in the region include the use of geothermal hot water for milk processing. There are over 90,000 herds of cattle in the area as the people living in this region are predominantly pastoralist. There are very few economic activities in the area apart from cattle herding while the poverty levels still remain high. Milk production is high, however there is no electrification for refrigeration for milk storage. This makes the communities unable to fully take advantage of milk production as a major economic activity. With milk processing using geothermal resources, the local communities will have an economic activity which will be able to uplift their lives from poverty as they will be able to participate in the national milk value chain with the processed milk.

Some of the geothermal sites are situated close to lakes and rivers where the main industry is fishing. An example is the geothermal fields of Kapisya on the shores of Lake Tanganyika and Mweru geothermal fields on the shores of Lake Mweru. Due to lack of electrification and thereby having no refrigeration, most of the fish caught as high as 30% goes to waste. The method mostly used for fish preservation is open sun drying and smoking using local wood resources and these methods are vulnerable to the weather. The quality of fish however, is usually low and commands a low price on the national markets.

Geothermal resources can be used to dry fish and the quality of fish is very high and commands a very high price on the market. This is a tremendous opportunity for the private sector not only to focus on geothermal resources for electricity production but also for fish drying. Most of the traders and fish mongers are women and geothermal resources can significantly help most women who trade in fish to bring high quality fish to market. Consequently, as the more fish would be able to reach market, this will create employment and livelihood for the women, thereby uplifting their standards of living. Geothermal power generation will avert the current situation where a significant amount of fish goes to waste due to lack refrigeration.

Horticulture is another important industry that the Government is trying to promote. Flowers like roses are grown on a large scale in many parts of the world using geothermal resources. This is one of the major opportunities for the private sector to venture in. The time taken to grow flowers in greenhouses using geothermal resources is much shorter compared to standard greenhouses. This creates more employment and helps in alleviating poverty.

Investment in wind and geothermal technologies will open new market segments in Zambia, and contribute to build Zambia's skills-base. The Kafue Gorge Regional Training Centre (KGRTC), a Zambia-based training institute who has been providing specialised training in energy related field, has taken steps to develop an experimental wind project for the provision of training services. Community training colleges and academic institutions as expected to introduce these new renewable energy technologies in their curriculum, further contributing to local skills development.

4.1.6 Enhanced Gender Equality

The importance of mainstreaming gender into development programmes is a known fact today. There are numerous examples of projects which have failed because women's views and needs were not included in the project design or the power relationships between men and women were

not taken into account[2]. Yet, energy sector development has largely remained gender blind in the sense that policy fails to recognise differences in the way which men and women get access to, pay for, use and benefit from electricity. A common caveat is an assumption that project benefits will automatically trickle down to women and that resource uses and needs are equal at the project site. With no prior gender assessment, policy decisions that appear to be gender neutral may have different impacts on men and women. Usually women are the group that is disadvantaged although such effect are never intended or foreseen.

In Zambia the household energy utilisation is largely dependent on wood fuel, particularly in the rural areas where only 4.4 % have access to electricity. Women play an important role in the energy sector as they are mainly responsible for supplying the households with wood fuel for cooking and heating, accounting for 70 % of the total national energy consumption. As pointed out in Zambia Gender and Energy Mainstreaming Strategy, the concentration on the provision of energy for industrial development at the expense of domestic use has disadvantaged women especially in rural areas. Women are overburdened with unreliable, unhealthy and usually cumbersome means of acquiring energy for domestic use. Below follows some of the key gender issues in relation to energy.

***Energy Poverty*:** There is evidence that indicates that female-headed households are less likely to have access to electricity than male-headed households. For example, in Lao PDR's rural electrification programme, it was found that grid connection uptake rates remained disproportionately low among female-headed households. The female-headed households made up 43% of poor households, who would not be able to afford fees for connecting to the electricity grid. In Zambia, the Multi-Tier Framework results suggest that as many as 30% of rural customers find current off-grid connections unaffordable. In addition, more than 50% of rural customers may be unwilling to pay for solar home systems even with payment plan options with female-headed households being less willing to pay than male-headed households.

***Low Productivity*:** Gender norms in society expect women to perform the majority of the domestic chores. In Zambia women in the rural areas typically spend about 2-3 hours every day collecting firewood and another 4-6 hours per day are spend on cooking. Further, according to research from Chikankata area in Southern Province, women walk more than 5 kilometers every other day in search of wood fuel which will last them a day or two.

***Health, Safety and Quality of Life*:** During firewood collection women and girls are vulnerable to sexual and gender-based violence as well as an increased risk of snake bites. The long walks and heavy loads can also lead to persistent back pains and pose a risk to pregnant women. Further women are exposed to open flames and smoke which results in respiratory problems and cataracts – the leading cause to blindness in developing countries. The World Health Organisation (2016) estimates that about 4.3 million people die prematurely every year from exposure to smoke from traditional cook stoves and open fires. Men on the other hand are more exposed to hazardous work on energy infrastructure such as electrical wiring and chemical handling with risks of injuries.

Most of the milk produced on small scale farms and households in rural areas is managed by women. Geothermal resources used for milk processing are a huge opportunity in empowering

[2] The irrigated rice project in Gambia (Carey, 1998) being one of the most well-known example of how power dynamics between men and women can affect the implementation of a project.

women with economic participation. Most of the geothermal resources are situated in rural areas where poverty rates among women are high and this can help create employment for more women and their participation in the energy sector.

The SREP Investment Plan will support the Government's commitment to promote gender equality, by including gender mainstreaming activities at project level. These activities may include:

- qualitative study to investigate differences between women and men in energy access and use, needs, affordability, coping mechanisms, to guide the design of gender-targeted interventions;
- encourage the participation of women in the manufacturing of clean cooking appliances; conduct gender -sensitive consumer awareness raising campaigns tailoring messages to the literacy level of women in rural areas;
- provide subsidies to reduce electricity connection cost for vulnerable households and support acquisition of energy efficiency appliances by women's community organisation for productive use and income generation activities;
- targeted initiatives to foster women's interest in careers in the electricity sector through, for example, internships in partnership with key educational institutions.

Monitoring and evaluation mechanism will include the collection of gender-disaggregated data to measure the impact of female and women-headed household beneficiaries. This will ensure equitable distribution of national resources between women and men, girls and boys and have meaningful impact in the medium and long-term on poverty reduction among women and girls.

Other co-benefits: Other expected co-benefits arising from the implementation of the SREP Investment Plan include improved community health by displacing the use of diesel generation and wood fuel with the use of renewable energy sources for lighting and cooking especially in rural areas, and reduced environmental risks (e.g. shortage of water, air pollution).

4.2 SREP as Initiator of Process Leading Towards Transformational Low Carbon Growth

The REMP, REFIT Strategy and the Scaling-up Solar initiative all set ambitious targets on the penetration of renewable energy for the medium and long term. From just these three strategic plans, it is foreseen that renewable energy will add at least 800MW of electricity generation by 2030.

Components identified under this SREP investment plan will contribute both towards electricity generation and increased access to electricity for rural and per-urban areas. Although, the contribution of the programme seems insignificant considering the set targets, this is seen as a first step in unlocking energy sector investments and achieving the Vision 2030. The SREP investment plan could, with its medium-term results, serve as a pilot project for the longer-term development of renewable energy in Zambia. Implementation of the selected projects components will provide useful lessons for implementation of future projects.

Technical assistance and capacity building may be carried out to help build local capacity and provide a robust technical basis for replication and scale-up of the initiatives supported.

Chapter 6 PROGRAMME DESCRIPTION

Considering the national policies and development strategies and based on the 7NDP, which outlines the development priorities of the Republic of Zambia, the following investment programme was developed within the framework of the SREP in Zambia. The investment programme components are perfectly in line with SREP investment criteria and objectives. The SREP investment plan for Zambia prioritises the following three areas/components:

- ✓ Component 1: Energy Access in Rural and Peri-Urban Areas
- ✓ Component 2: Wind Power Promotion
- ✓ Component 3: Investment in Geothermal Development

Financing Plan includes the three priority areas, detailing how the Multilateral Development Banks (MDBs), along with the funding from SREP and other partners, will support the implementation of specific investments and capacity-building programmes.

The selected investment plan's components are expected to transform and positively impact livelihoods and bring co-benefits to local communities in the project areas. In addition, the proposed programs will have a transformational effect and will scale up the overall renewable energy development agenda of Zambia. The proposed programs are also consistent with Zambia's medium- and long-term goals for the energy sector enshrined in the 7NDP (2017-2021) and national Vision 2030.

5.1 Component 1: Energy Access in Rural and Peri-Urban Areas

5.1.1 Background

The Government of the Republic of Zambia (GRZ) has set ambitious targets to increase the electrification rate to 90% in urban areas and 51% in rural areas by the year 2030. In the medium term, the target is to increase capacity by 1,000 MW and improve electrification in rural areas to 8% by 2021. However, electricity access in Zambia is currently estimated at 31.2% with 67.3% in urban areas and 4.4% (on-grid) in rural areas. This lag in electrification has been attributed to several factors but mainly due to inadequate policy and regulatory frameworks, low population density in rural areas and lack suitable financing mechanisms and consequently inadequate funding. Additionally, current generation of electrical power is highly concentrated in the southern part of the country while the major load centres are in the central and north-western part of the country.

In terms of Zambia's cooking profile, the recently completed Multi-Tier Framework survey has shown that the vast majority of Zambian households (over 80%) cook with either a three-stone fire or a traditional *mbaula* (charcoal bucket) burning wood in rural areas (84% of rural households) and charcoal in urban areas (61% of urban households). This heavy reliance on forest-derived biomass as a fuel has contributed to Zambia having one of the highest deforestation rates in Africa. Between 250 and 300 thousand ha of land were estimated to have lost their forest cover in Zambia during 2018 alone. Zambia has adopted an NDC to reduce forest degradation by promoting more efficient and cleaner cooking devices.

5.1.2 Objectives

The objectives of the component include:

- Increase access to electricity and clean cooking solutions for rural, peri-urban and urban households;
- Enhance quality of power supply to support community productive uses; and
- Increased private sector participation in off-grid, mini-grid, and clean cooking sectors.

5.1.3 Scope

The objectives under this component will be achieved by providing partial grants and subsidies to support private sector-led electrification of rural and peri-urban communities through renewable energy mini-grids and standalone solar systems. The application of funds will be technology neutral, supporting micro, small and medium enterprises (MSMEs) offering a variety of off-grid solutions including solar PV kits/home system, micro-grids, hybrids, small hydropower plants and biomass clean cooking solutions. These beneficiaries are expected to be selected through a competitive bidding process. The proposed support would be complemented by subsidies to offset the high electricity connection cost for poor and vulnerable people living within the areas served by the off-grid facilities. The subsidy would cover the difference between the cost of providing the mini-grid connections and what consumers are able to pay for it. End-user beneficiaries include households, community service facilities and small businesses.

Regarding the clean cooking, the proposed component will build both a public sector framework amenable to transforming the country to a reliance on cleaner and more efficient cookstoves and fuels as well as investing through Result-Based-Financing (RBF) in strengthening the supply chain for the supply of more efficient stoves and clean stoves and fuels\ through the following activities:

- ✓ Creation of Favorable Enabling Environment for Clean Cooking: Under this component, the GRZ will use consultants to assess the current status of the market for cookstoves and cooking fuels to identify particular shortcomings or disincentives to the adoption of cleaner cooking practices.

- ✓ Stimulation of Urban and Peri-Urban Market using Results-Based-Financing: Given that urban and peri-urban consumers in Zambia rely heavily on charcoal produced and imported from the rural areas, the persistence of the charcoal market presents an opportunity to create market incentives to the adoption of more efficient charcoal stoves and even super-efficient stoves using clean biomass fuels, LPG and possibly even electricity. Result-Based-Financing, when the payments to the providers of services are based on the quality of the output, will provide support to distributors of the high-quality efficient charcoal stoves for inventory management, sales incentives, and distribution channel strengthening.

- ✓ Formulation and Implementation of Rural Stove Programme: Because most rural dwellers in Zambia cook with gathered firewood over a three-stone hearth, market-incentives will not be the clear drivers toward efficiency and cleanliness that they are in the urban and peri-urban areas. This programme will make use of RBF as well as support to micro-financing institutions to deal with affordability challenges on the part of rural consumers, but the goal remains the longer-term adoption of cleaner and more efficient cooking fuels and technologies across rural Zambia.

5.1.4 Parallel activities to be funded by GRZ and/or other development partners

This component complements, and in some cases scales up already existing and planned programs in the energy access space, led by the GRZ and supported by development partners, particularly the World Bank-funded Electricity Service Access Project. SREP's efforts in conjunction with the ongoing efforts will be able to crowd in private/donor finance for bankable packaged projects and address some of the barriers listed earlier, affecting exploitation of renewable energy resources in Zambia, particularly low access to finance, low creditworthiness of the off-taker (ZESCO) for on-grid projects and insufficient/inadequate data, among others. In addition, the ESAP project will also contribute to cross-cutting issues, such as gender and climate change, by supporting low-emission, renewable energy mini-grids, solar home systems (SHSs), and solar lanterns in remote areas, reducing women's exposure to indoor air pollution. Attention will be paid to the ability of female-headed households and enterprises to access on- and off-grid electricity connections. More details on the ESAP projects are provided in Annex 4.

Additionally, the Ministry with the support of the European Union (EU) is implementing the Increased Access to Electricity and Renewable Energy Production (IAEREP). The overall objective of the project is to increase access to clean, reliable, more equitable and affordable energy and promote renewable energy production and energy efficiency across Zambia. The project comprises two service contracts namely;

- Technical Assistance One (TA1) Enhancement of Policy, Legal and Regulatory Environment and Capacity Building for Renewable Energy and Energy Efficiency and

- Technical Assistance Two (TA2) Capacity Building for Renewable and Energy Efficiency – Feasibility Studies and Demonstration Projects

So far under TA1 of the IAEREP Project, a newly developed mini-grid regulatory framework for off-grid systems was approved by the ERB on 30th October 2018. Under TA2, the IAEREP Project will also be launching a EUR25 million facility that would provide up to 50% grant to eligible off-grid private investors.

Further, the Ministry of Energy has been promoting off-grid systems and one typical example under development is the 200kW off-grid small Hydro plant at Chipota Falls in Serenje district. The project will provide access to 15,000 households in Chief Kabamba's Chiefdom. It is envisaged that the project can be up-scaled using SREP Funds, provide connection subsidy and mitigate the high tariff rate that the households would pay.

Beyond the Grid fund was established by the Swedish International Development Association, Government of Sweden, Power Africa, and Renewable Energy and Efficiency Partnership (REEEP). The Fund is managed by REEEP on behalf of the Swedish Embassy in Zambia and in cooperation with Zambian partners. The project aims at providing access to energy to 1 million end users within four years; this will translate to electrifying approximately 167,000 households (assuming 6 people per average rural Zambian household); the project will achieve the following:

- Reduce dependence on fossil fuels through a shift toward sustainable and renewable energy generation;
- Increase confidence and capacity of banks to extend credits to off-grid business ventures;
- Support the transfer of technology and knowledge that accelerate Zambian energy sector growth.

To date, Beyond the Grid estimates that 55,000 off-grid connections have been made across the country.

5.1.5 Expected Outcomes

Development of the off-grid/mini-grid systems is expected to realise 70 MW of renewable energy based electricity expected to increase access to financing for at least 300,000 people, i.e. 50,000 households. Additionally, the programme will contribute to the improved quality of electricity supply and will foster economic activity in the region as a result of new connections in the rural areas, which is critical, considering the low rate of electrification. Further, this action will contribute also to the clean cooking agenda, providing an opportunity for cleaner and more efficient cooking solutions, thereby reducing the health risk for households from indoor pollution and reducing the time rural women spend collecting firewood as well as the time urban women spend waiting for their *mbaulas* to become warm enough to cook on.

This programme also seeks to demonstrate the application of hybrid systems that will allow easier management of power generation from the variable renewable energy sources. The deployment of solar home systems is targeted to provide basic services such as lighting, appliances and phone chargers.

5.2. Component 2: Wind Power Promotion

5.2.1. Background

In 2015, Ministry of Energy embarked on a wind resource assessment with the objective of diversifying the current energy mix. It was envisioned that this would help overcome barriers facing wind power project developers, namely the acquisition of two years of high quality measurement data proving the real wind potential of a selected area. The existence of such a database would be used both to encourage private investors/developers to come and operate in the region, and to initiate a national wind mapping programme. Though private wind developers are actively conducting investigations in Zambia, the absence of a clear pathway for private sector investment in the wind sector represents an impediment for the deployment of actual projects.

5.2.2. Objectives

The component has three key objectives:

- To develop a policy and regulatory framework to encourage private sector participation in wind power development;
- Develop a full project documentation package and potentially auction one wind power project; and
- Build a wind IPP project with an installed capacity of up to 40 MW.

5.2.3. Scope

Preliminary data from the wind resource assessments, measured at 80m height at eight (8) locations throughout Zambia, has so far shown wind speeds suitable for power generation, which has sparked interest among private developers in wind generation. However, despite the availability of this data, development of wind energy is impeded by a lack of policy and regulatory framework to leverage the much-needed private investment that could make up for scarce available public funding to harness the identified wind energy potential. Therefore, main activities under this component will be to develop a policy and regulatory framework that will establish an enabling environment for on-grid wind power development.

5.2.4. Parallel activities to be funded by GRZ and/or other development partners

The Government of Zambia, with the support of the World Bank, is in the final stages of concluding a wind resource mapping exercise. Several other wind assessments have been undertaken by both quasi-Government organisations and the private sector. These include;

i. the wind resource assessment in Lunga district by the Rural Electrification Authority (REA) with the objective of developing a 1MW off-grid wind generation plant;

ii. the wind resource assessment in Kafue district by Kafue Gorge and Regional Training Centre (KGRTC) with the objective of developing a 7.5MW wind power plant for training purposes as well as to be injected in the grid; and
iii. Wind assessments by Access Infra Africa, a private firm, operating in Serenje district, Central Province with the objective of developing the Pensulo wind power Project.

5.2.5. Expected Outcomes

Utility-scale wind power projects have not yet been implemented in Zambia. SREP is expected to facilitate the deployment first-of-a-kind private sector-led competitively-procured wind power project of at least 40 MW. This pilot project will lay strong foundations supporting the development of wind power and could assist Zambia in diversifying its sources of energy away from hydropower. SREP's support towards the development of a wind power project is timely following the growing interest from private developers and completion of the wind resource assessment. Current wind assessments indicate that there is significant potential for wind power generation in Zambia.

Further, SREP financing will be instrumental in supporting the development of a wind project and designing of regulatory framework and investment guidelines. It is also expected that wind power development will serve as a demonstration of the economic viability of wind project not just in Zambia but also in the region in addition to limiting global carbon footprint as opposed to investments in coal fired power plants which has been a more attractive option for private sector players. In addition, this priority area is expected to improve the quality and reliability of electricity provision for on-grid customers.

5.3. Component 3: Investment in Geothermal Development

5.3.1. Background

There is currently no geothermal electricity generation in Zambia. The only development in this energy resource was through an initiative with the Italian Government in the mid 1980's. This saw the development of the Kapisya Hot Springs Geothermal Plant in Northern Province to the extent that 2 x 120kW turbines were installed in 1987 to be operated by ZESCO Limited. However, the Kapisya Plant has not been operational since it was built and efforts to revive the plant have not yielded positive results. ZESCO together with the Geological Survey Department (GSD) has conducted reconnaissance studies on five sites. Therefore, the geological surface studies undertaken by GSD forms an integral part of the inception report.

Additionally, there has been interest from private sector to explore the geothermal resource. More notably has been the exploration works being undertaken by Kalahari Geo-energy Company who have been carrying out exploration drilling in the southern part of the country with positive indications so far. Private investors have also expressed interest in developing direct uses of geothermal energy. In countries such as Kenya, Indonesia, New Zealand and Iceland geothermal energy is used in such areas as agriculture(greenhouses), dairy industry (milk pasteurisation), aquaculture (fish breeding and drying), district heating and cooling, industrial heat exchangers (heat to chilling) and in the promotion of tourism (hot spars and in the visits to the power generation plants).

5.3.2. Objectives

The objectives of this component are to:

- Promote use of geothermal resource for electricity generation and agro-industrial activities;
- Improve affordability of geothermal electricity generation by mitigating investment risk.

5.3.3. Scope

The use concessional funds for policy support of regulatory institutions that will facilitate promotion and oversight of geothermal activities for electricity production and agro-industrial uses. This would include the development of the enabling framework and a comprehensive master plan providing a framework for using geothermal energy for community development and promotion of productive uses of energy. Regulatory support could include the elaboration of clear mechanisms for procurement of geothermal power including tariff mechanism. Additionally, concessional funding would be required to provide a risk mitigation facility to offset exploration cost incurred by the private sector and buy-down the tariff to increase affordability. Possible support could take the form of long term loans to private sector, higher risk financing instruments (e.g. convertible debt, equity) and/or the provision of off-taker credit enhancement instruments to enhance the bankability of Power Purchase Agreements. The scope will be further refined during project preparation activities.

5.3.4. Parallel activities to be funded by GRZ and/or other Development Partners

On the 22nd of February 2017, the Government of Morocco and the Government of Zambia brought together MASEN (a power utility of Morocco) and ZESCO Limited to collaborate in the area of renewable energy development. To this effect, a Memorandum of Understanding (MOU) was signed to facilitate the exploitation and development of renewable energies including 50MW of Geothermal Power.

Earlier, in 2010, GRZ signed an MOU with Kalahari Geo-energy Limited, a private firm, in respect of research and exploration activities in the Zambia in order to determine and if appropriate develop, inter alia, the geothermal energy resources that may be available within Zambia. So far, the company has conducted a country wide reconnaissance of known surface expressions of geothermal systems (2011-2013) and is currently undertaking resource delineation work in the Bweengwa River Geothermal resource area (south of Lochinvar Park) where its exploration programme, which included geophysics and drilling, established an initial indicative resource of ~15MWe. In 2019, the Company will drill further wells to delineate the resource and will then conduct a feasibility study. GRZ is also actively seeking donor funding to support the development of the geothermal sector.

5.3.5. Expected outcomes

Concessional funds are expected to facilitate the development of at least 15 MW of utility scale-geothermal power and improve access to electricity to all grid connected customers. Furthermore, geothermal is a dispatchable source of energy, that can provide stable and reliable base-load power to the national grid, allowing for more integration of variable renewable energy power (solar and wind).

5.4.Environmental and Social Aspects

Environmental impacts associated with the implementation of the investment plan activities are related to construction, operation, and decommissioning of the infrastructure facilities. The construction of access roads in remote locations may result in additional risks, including adverse impacts on biodiversity and induced access to relatively inaccessible areas. Since specific locations of investments will be determined during project design, an Environmental and Social Management Framework will be prepared that defines the environmental and social planning, review and clearing processes that follow national and MDB guidelines. This notwithstanding, key environmental and social impacts are provided below.

5.4.1. Noise pollution

Construction activities typically include land clearing for site preparation and access routes, transportation of supply materials and fuels, construction of foundations involving excavations and placement of concrete. Noise-producing activities include blasting, piling, construction of roads and foundations, operating cranes for unloading and installation of equipment.

Noise sources in geothermal facilities are mainly related to well drilling, steam flashing and venting. Other sources include equipment related to pumping facilities, turbines, and temporary pipe flushing activities. Noise abatement technology includes the use of rock mufflers, sound insulation, and barriers during drilling, in addition to silencers on equipment in the steam processing facility.

5.4.2. Air Pollution

Geothermal power plant emissions are negligible compared to those of fossil fuel combustion-based power plants. Hydrogen sulfide and mercury are the main potential air pollutants associated with geothermal power generation employing flash or dry steam technologies. Carbon dioxide is present in the steam although its emission is also considered negligible compared to fossil fuel combustion sources. The presence and concentration of potential air pollutants may vary depending on the characteristics of the geothermal resource.

5.4.3. Occupational Health

Occupational health and safety hazards are generally similar to those of most infrastructure projects. They may include physical hazards, such as working at heights, working in confined spaces, working with rotating machinery and falling objects. Prevention and control of these and other physical, chemical, biological, and radiological hazards will be determined during site-specific environmental and social impact assessments.

Construction activities may involve influx of workers from other localities. Interaction of external labor with local communities may increase the risk of occurrence of community diseases, including HIV/AIDS, and gender-based violence. Specific awareness raising and outreach campaigns will be implemented.

Occupational exposure to geothermal gases, mainly hydrogen sulfide gas, may occur during non-routine release of geothermal fluids (for example, pipeline failures) and maintenance work in confined spaces such as pipelines, turbines, and condensers. The significance of the hydrogen sulfide hazard may vary depending on the location and geological formation particular to the facility.

5.4.4. Land Use and Biodiversity Conservation

The identification and release of the necessary land area for project development is generally critical for all development sub-projects in Zambia. Adverse impacts may include loss of economic income, encroachment on or destruction of a tribal, cultural, ethnic, historical or religious area, encroachment on a conservation area (protected area, etc.). The site selection for the off-grid projects will be chosen to limit the need for involuntary displacement and provide adequately compensation mechanism to restore the economic livelihood of affected people. Care will be taken to avoid critical or cultural sites and protected areas.

The Environmental Management Act (EMA), 2011 established the Zambia Environmental Management Agency (ZEMA) which is responsible regulator for all environmental issues in Zambia. The EMA Act, demands that any person shall not undertake any project that may have an effect on the environment without the written approval of the Agency, through undertaking an Environmental Impact Assessment (EIA). Therefore, for each SREP priority area/component to be undertaken, separate, comprehensive Environmental and Social Impact assessments must be conducted. Additionally, adequate stakeholder consultations must be undertaken to effectively guide the development of such studies. Additional specialised Environmental and Social (E&S) management plans and/or initiatives may be required to better address the impacts associated with a given sub-project. In all cases, preparation of detailed E&S studies must adhere to Zambian laws and regulations, as well as the E&S policies, guidelines, and standards of the MDBs.

Chapter 7 FINANCING PLAN

This section presents the financing plan for the implementation of the components of the SREP IP, including costs and sources of funding. At this stage, SREP co-financing is not sought for the implementation of Component 3 (Investment in Geothermal Development) due to the priorities of the SREP's implementing MDBs. However, geothermal development is an important part of GRZ's long-term development strategy and will require concessional funding for market initiation and scaled-up development. GRZ will continue to engage with cooperating partners to address the existing barriers.

	Total	SREP[(i)]	AfDB	IFC	WB	Other donors	Private sector	GRZ[(iv)]
Component 1 – Energy Access in Rural and Peri-Urban Areas								
Investment in off-grid and mini-grid electrification solutions	161.7	10	-	-	45.9[(ii)]	55[(iii)]	50	0.8
Sub-total	161.7	10			45.9	55	50	0.8
SREP leverage	**1:16**							
Component 2 – Wind Power Promotion								
Project Preparation Grant	2.1	1.15	0.90	-	-	-	-	0.05
Wind IPP	61.0	10	18.3			14.4	18.3	
Subtotal	63.1	11.15	19.2			14.4	18.3	0.05
SREP leverage	**1:6**							
Component 3 - Investment in Geothermal Development								
Policy support and community development master plan	-		-	-	-	-	-	
Investments – Risk mitigation facility	45.5	-	-	-	-	-	45	0.5
Sub-total	45.5	-	-	-	-	-	45	0.5
Total	270.3	21.15	19.2	-	45.9	69.4	113.3	1.35
Total SREP Leverage (Component 1 and 2)	**1:11**							

Table 12*: *Indicative sources and uses of funds

Notes:

[(i)] All SREP funds are assumed to be grants.

[(ii)] Includes the ongoing Electricity Service Access Project[3] (US$5.9 million) and the new electricity access project which is currently under preparation.

[(iii)] US$55 million grants from other donors refers to the Beyond the Grid initiative and the EU programme

[(iv)] All GRZ contribution are derived from commitments already made under the 7NDP

[3] A complete description is available here: http://documents.worldbank.org/curated/en/556221498788150527/Zambia-Electricity-Service-Access-Project

Chapter 8 RESPONSIVENESS TO SREP INVESTMENT CRITERIA

Zambia has experienced effects of climate change, and therefore its government is committed to taking responsible mitigating actions to reduce the impacts. The SREP offers a unique opportunity to begin the process of transforming the country's energy sector, and the government accepts the responsibility and associated challenges. The three priorities proposed under the SREP-Zambia are in national interest and are aligned to the country's priority goals. Given the sparsely distributed nature of many rural communities, renewable energy–based off-grid systems have great potential to deliver clean energy services and solutions. The SREP projects are responsive to the SREP criteria and table 13 below provides this description.

Criteria	Energy access in rural and peri-urban areas	Wind power promotion	Geothermal development project
Increased capacity from renewable energy sources as a result of SREP intervention	70 MW (300 MWh)	40 MW (140 GWh)	15 MW (126 GWh)
Increased access to energy through renewable energy source as a result of SREP intervention	50,000 households (~300,000 people)	All grid-connected customers (31% population). Estimated 4.5 million people and 800,000 households	
Low Emission Development	Expected avoided GHG emissions from diesel powered mini-grids is estimated at 70.81 Gg of CO2 per year	Expected avoided emission from coal plants is estimated at 56.94 Gg of CO2 per year	Expected avoided emission from coal plants is estimated at 56.94 Gg of CO2 per year
Affordability and competitiveness of renewable sources	The economic cost of supply for mini-grids and solar home systems is significantly competitive vis-à-vis diesel generation electrification solutions. However, consumers have lower ability to pay especially in rural and remote areas; subsidies are needed to improve access. An affordability study will be conducted during the implementation of the investment plan	Utility-scale wind resources are competitive with imports under private financing; other sites require subsidies.	Supply curve analysis shows that, once the resource is confirmed, geothermal power generation is competitive with, large hydro, and coal on an economic basis.
Productive use of energy	Renewable-based off-grid solutions directly support electricity supply to local community business and small-and-medium commercial enterprises by enabling them to increase their productivity and indirectly from the benefits that accrue	Apart from electricity production from wind, this resource can also be used for water pumping in agriculture for irrigation and household use.	Geothermal provides base-load power supply and enhances supply reliability and availability and thus meet crucial requirements of the

	from children's improved education due to better lighting and access to communication, improved health, and enhanced security.		economy's industrial and productive sectors
Economic, social and environmental development impact	Greater economic opportunity results from electricity access and improved hours of electricity services. These translate into creation of income-generation activities, especially in rural areas other co-benefits including higher productivity, improved health outcomes due to indoor reduced air pollution.	Implementation of the wind programme may have result in noise pollution, and disturbance for birds and fauna habitats. However, implementation will adhere to national and global environmental regulations to mitigate negative impacts.	Access to electricity generally brings socioeconomic development to a community; geothermal power does so with positive environmental impacts. It allows the offset fossil fuels (e.g. HFO and coal).
Economic and financial viability	Renewable energy is least cost compared to fossil-fuel alternatives, and projects have high and robust economic rates of return. Financial rates of return are satisfactory, though some grant support for initial investment is needed due to rural residents' lower ability to pay, especially since 50 % access must be reached	Utility-scale Wind is economically viable, but will only be financially viable with subsidies.	Geothermal power is economically competitive with other base-load sources (once the resource is confirmed). Financial viability depends on how well commercial and development risks are managed. Also geothermal can be a financially attractive power source, not subject to fuel-price increases
Leveraging of additional resources	Infrastructure is needed to rapidly scale up investments to achieve the national electrification goal. SREP resources also leverage investment financing from other sources		
Gender	Women and children are direct and significant beneficiaries as they will gain access to cleaner energy services in homes that offer far superior services, improved access to essential health and educational services, greater economic opportunities, and lower costs of accessing better energy	The utility-scale RE project has the potential to create jobs and/or increase economic activity, thereby improving the lives of women.	Women will share equally in the benefits that access to electricity brings. In addition, there are opportunities for utilisation of by-product heat and condensate that

	services. Tools based on the national gender policy/7NDP will be used for integrating gender considerations into project preparation, implementation, and monitoring and evaluation.		will support industrial and agricultural activities (e.g. horticulture, diary produce, fisheries) that can be developed and run by women.
Co-benefits of renewable energy scale-up	- Improved health impacts due to child and maternal mortality and retention of medical personnel - Improved education impacts due to longer hours of study and advanced teaching methods, safety, creation of opportunity for girl child and women's education - Improved food security due to increased agriculture production resulting from use of irrigation especially for women - Increased rural development impacts due to increased economic activities through SMEs - Reduced indoor air pollution, reduced GHG impacts and improved air quality - Reduced energy deficits		

Table 13: *Responsiveness to SREP Criteria*

Chapter 9 IMPLEMENTATION POTENTIAL WITH RISK ASSESSMENT

9.1 Country/regional risk analysis

The overall implementation risk of the SREP-Zambia Investment Plan (IP) is assessed as Moderate. Table 13 below, presents the main identified risks and mitigation measures used to ensure successful implementation of the programme. Guidance from members of the SREP Steering Committee will be actively and regularly sought to ensure that good practices are always adopted.

Risk type	Description	Mitigation measure	Residual risk
Institutional	Implementation and funds flow arrangements require that there is close coordination between REA and ZESCO, otherwise this would cause delay	REA / ZESCO coordination is expected to be partially mitigated by having MOE play a coordinating role and equipping staff with required skills	Low

	institutional capacity for implementation and sustainability especially in the off-grid space	Build local capacity to support project management, including carrying out supervision of contracts.	Low
	Clearance and approval are delayed.	• OPPPI/ZESCO/REA and ZEMA will work closely to remove bottlenecks. • Development of IPP Project Investment Framework/Guidelines for licensing of projects. This is currently under preparation by MOE	Moderate
Climate and disaster risks	Increased frequency of extreme weather events, notably droughts and floods (affecting hydro), high temperatures (affect the output of the solar PV panels) etc.	Through proper design, operation, and maintenance	Medium
Technical	Grid absorptive capacity and connection risk	• Undertake Grid integration studies for variable RE technologies • Undertake Grid rehabilitation and expansion projects such as the ongoing Lusaka Transmission and Distribution Rehabilitation Project (LTDRP) • Development of Grid and Distribution Codes. These exist already but may require some revision	Low
Financial	Mini-grid and solar off-grid customers have limited ability to pay or will not pay.	• Willingness-to-pay and market studies are undertaken as part of the feasibility assessment phase to evaluate ability to pay. • Performance-based grants are provided to increase affordability. • Pay-as-you-go metering or microfinance is used to increase affordability.	Moderate
	ZESCO's creditworthiness; inability to pay for power supplied and service loans	• GRZ being aware of this temporary difficulty has embarked of a reform programme for ZESCO in order to overcome its current financial and operational challenges through improving its liquidity position, pre-	High

		conditioned on performance improvements. • Migration to Cost reflective tariffs based on results of Cost of Service Study to be completed at the end of 2019. This is expected to increase ZESCO's Revenue base • Introduction of a credit-worthy intermediary off-takers and enabling regulatory framework to facilitate the effective regulation of intermediary off-takers. This is currently under consideration by GRZ.	
Economic	Exchange rate and inflation fluctuations	Use grants to partially mitigate this risk	Moderate

Table 14: *Risk analysis*

With respect to risks identified above, GRZ is undertaking various reforms for the energy to thrive. For example, Non-cost reflective tariffs – has been a major barrier to power project development in Zambia the region at large. During the 34th Meeting of SADC Ministers responsible for Energy held in South Africa on July 24, 2015, it was resolved that all SADC countries should have cost reflective electricity tariffs by 31st December, 2019. In light of this decision, GRZ adopted a recommendation for moving to cost reflective tariffs as the country awaits the completion for a Cost Service Study. Therefore, GRZ adopted an upward tariff adjustment in two phases of 50% effective May 15, 2017 and 25% effected on 1st September, 2017.

With respect to ZESCO's financial position, GRZ constituted a Task Force that would critically analyse the financial, organizational and operational structure of ZESCO Limited given its current challenges. The Task Force was mandated to explore measures to enhance corporate governance and recommend the reforms required for the company to run efficiently and profitably. Arising from the work of the Task Force and its recommendations, Cabinet in July 2018, resolved a series of measures to be undertaken in a phased and systematic manner in order to align the utility to industry best practice and ensure its commercial viability. This work is on-going.

9.2 Absorptive capacity for SREP implementation

Zambia's absorptive capacity to implement the projects to be supported under SREP is detailed in Annex 1 based on macroeconomic, institutional and technical, and managerial dimensions.

Chapter 10 MONITORING AND EVALUATION

The Monitoring and Evaluation Framework defined under the 7NDP will be employed premised on the principles of results-based management. As such, the Plan will draw its results/outcomes from the National Performance Framework (NPF), which articulates a series of results to be achieved towards attainment of the 7NDP. This will be undertaken in cooperation with MDBs and other donor partners to track and report the Programme's progress towards achieving its objectives, as well as to assess the transformative impact of the SREP.

As this Plan has identified three priority areas, underpinning each level of results of the Plan are key performance indicators that will track progress towards attainment of outcomes. Sector Performance Frameworks (SPFs), a measurement tool to track progress at sector level, will be developed and will guide strategies for implementation of SREP programmes.

Monitoring arrangements will be such that the implementing institutions (MOE, ERB, REA, ZESCO) performing their functions in an interrelated and integrated manner towards attainment of the Plan outcomes, will generate, collect and document performance data that will be useful for measuring progress and reporting. Monitoring activities will include period reports, regular MDB supervision missions, at midterm, and at project closing.

The M&E framework will be coordinated by the designated office of the Ministry of Energy. MDBs and other development partners who will provide the Ministry and PMT staff with the necessary support and training to facilitate data collection, analysis, and reporting for SREP IP

M&E framework. Data and information from the relevant institutions will be basic source of information. For off-grid component specific methodology for data collection will be elaborated. Other relevant information and demographic data will be collected by the Central Statistical Office (CSO) through the bi-annual Living Conditions and Monitoring Surveys (LCMS) based on national administrative data sources. The LCMS captures relevant data on the living conditions of the population covering among others household demographic characteristics, education, health, economic activities of household members, household access to amenities and housing conditions, and poverty.

Table 14 below shows Zambia's Investment Plan Results framework

Result	**Indicators**	**Baseline (2017)**	**Targets (2021)**	**Means of verification**
Transformative Impact Indicators				
Support low-carbon development pathways by reducing energy poverty and/or increasing energy security	Percentage of total urban households with access to electricity	67	80	Sector Performance Framework of 7NDP
	Percentage of rural households with access to electricity	4.4	8	Living Conditions Report
	Annual electricity output from RE	9020	TBA	
	Avoided GHG emissions (tons/year)	TBA	TBA	National communication
SREP Indicators				
Increased supply of renewable energy	Increased annual electricity output (GWh) as a result of SREP interventions	0	165.3	
Increased access to modern energy services	Number of women and men, businesses and community services benefiting from improved access to electricity as a result of SREP interventions	TBA	TBA	
Increased economic participation of women in the energy sector	Number of women employed in the energy sector	TBA	TBA	
New and additional resources for renewable energy projects	Leverage factor: USD financing from other sources compared to SREP funding	TBA	TBA	

Table 15: *Results framework*

Annex 1: ASSESSMENT OF COUNTRY'S ABSORPTIVE CAPACITY

Zambia's absorptive capacity to implement the projects to be supported under SREP, is best described through the macroeconomic, institutional and technical, and managerial dimensions of the Country's absorptive capacity.

Macroeconomic Aspects

The Zambian economy in 2018 was projected to grow at around 4 % from 3.4 % in 2017. This was due to improved performance in sectors such as mining, construction, manufacturing, wholesale and retail trade as well as stable and reliable energy supply supporting growth. However, expenditures are projected to be higher on account of higher interest payments and project loan disbursements. Government's external debt stock as at end-June 2018 was US$9.4 billion, representing 34.7 % of GDP from US$8.7 billion as at end-December 2017. The increase was due to disbursements on existing loans. The total stock of Government guaranteed debt stood at US$1.2 billion as at end-June 2018.

According to the International Monetary Fund (IMF) Debt Sustainability Report (2017) for Zambia, it was revealed that the Country faces a high risk of external debt distress, and heightened vulnerabilities on total public debt. Under current policies, the Present Value (PV) of the external debt-to-GDP ratio breaches the 40 % threshold during 2019-23, while the debt-service-to-revenue ratio temporarily breaches its threshold in 2022 and 2024 when Eurobonds mature. All indicators breach their thresholds for extensive periods under a variety of shocks, underscoring the sensitivity of the external debt burden to fiscal performance and developments in exports, growth and the exchange rate. The ratio of total public debt to GDP breaches the benchmark level associated with heightened vulnerabilities. However, IMF reports that debt dynamics improve substantially under the adjustment policies scenario. Therefore, Fiscal consolidation, restraint on non-concessional borrowing, and strengthened debt and public investment management capacities are needed to put debt on a sustainable path

Institutional Aspects

ZESCO Limited and REA have some experience implementing the off-grid projects both having implemented the IDA Increased Access to Electricity Services (IAES) Project and now both also implementing the same components under the recently launched World Bank Supported ESAP project. Additionally, REA with support from the EU is being given technical assistance to undertake feasibility studies and off-grid demonstration projects under the Increased Access to Electricity and Renewable Energy Production (IAEREP) supervised by the Ministry of Energy.

However, ZESCO and REA do not have experience in implementation of the wind and geothermal components and therefore these two components will be implemented by the private sector who have shown interest and are undertaking various activities in the country in this respect.

In the case of Ministry of Energy (MoE) and also even other statutory bodies, it is evident that there are overlaps in mandates. For instance, the mandates of the Department of Energy (DOE) and Department of Planning and Information (DPI) mention similar functions that include policy

formulation, planning, M&E and Information Management System. Statutory bodies also have certain RE/EE project promotion activities that could be better rationalised for instance the Office for Promoting Private Power Investments (OPPPI), ZESCO and REA. The proposed action then is to take a holistic approach to address this issue across the relevant Departments and Statutory Bodies (SBs) in form by streamlining and clearly defining their mandates for better efficiency.

The absorption capacity of budgets and cooperating partner funds by public institutions particularly Government ministries has been low and several reasons are provided ranging from late disbursements, misallocation of budgets and slow to meet partner requirements. Ministry of Finance and the Finance Department in the MoE have cited that part of cause of low absorption is due to delays in procurements and eventually in project and contract management and failure to effectively apply the existing financial management procedures and procurement standards. This points to the need for on-going capacity strengthening in public financial management and procurement procedures.

Technical and Managerial Aspects

A project management Team (PMT) will be created led by the MOE with overall role for coordination and supervising of the implementation of the SREP activities. The Project Management Team (PMT) will comprise Ministry of Energy, ERB, ZESCO, and REA and the lead MDB. The PMT will report to the already established SREP Task force which will play the role of Project Steering Committee (PSC). The DoE, within the MoE, will serve as the Secretariat of the PSC and will be staffed with an SREP coordinator reporting to the director of the DoE and funded from the project.

The SREP Funds will be administered by the Ministry of Energy (MoE) through a dedicated Fund Manager. As leader of the PMT, MOE will manage the project on behalf of the GRZ and, in this regard, will be responsible for project fiduciary responsibilities. The Fund Manager will account for the deposits and withdrawals and perform the audits and provide financial reports in accordance with SREP rules and guidelines. MOE will monitor the utilisation of the project resources by each beneficiary and provide expenditure reports. The PMT will be responsible for tracking the project's Results Framework, providing regular progress reports, as well as the mid-term Review Report and the Implementation Completion and Results Report.

PMT will coordinate overall procurement under the project, prepare and revise Procurement Plans as needed. Implementation of specific activities under the project components will need close involvement of ZESCO and the REA and, therefore, these institutions will be co-executing agencies for specific component activities and correspondingly assign dedicated project coordinators and project implementation units (PIUs) to implement respective on-grid and off-grid component activities.

Annex 2: STAKEHOLDER CONSULTATIONS

The Zambia SREP Investment Plan was prepared in consultation with various stakeholders including: (i) relevant government ministries, civil society organizations, the private sector and development partners during the SREP scoping mission; (ii) consultation workshops and meetings with development partners; and (iii) technical consultation workshop. Public comments were also received on the draft Investment Plan.

Task force

The SREP Task force was established as the project Steering Committee to guide the process and ensure consistency with national policy. The task force was consulted with regard to TORs for developing the SREP IP as well as endorsement of the final draft IP.

Scoping Mission (8-10 April 2015)

A joint World Bank Group (WBG), including the International Finance Corporation (IFC), and African Development Bank (AfDB) Mission Team met with officials of the Department of Energy (DoE) of the Ministry of Energy, ZESCO, the Energy Regulation Board (ERB), and the Rural Electrification Authority (REA), as well as various stakeholders from private sector, academia and Non-Governmental Organizations (NGOs).

The mission introduced the objectives, scope, and type of investments which could be supported under the SREP, as well as the activities involved in the country-led SREP process. The Mission also clarified key features of the SREP, including: (i) transformational impact, (ii) barrier reduction, (iii) leveraging investments, including private participation, (iv) scaling-up renewable energy capacity and access to energy. The mission informed the discussions that the SREP financing can be provided to all renewable energy technologies including solar, geothermal, wind, hydropower (below 10MW per facility), and bio-energy.

The meetings with the various stakeholders highlighted the non-cost-reflective tariff as a major constraint to private sector participation in the power sector. In addition, it was noted that the absence of a transparent and competitive procurement framework, standardised Power Purchase Agreements, indicative term sheets to raise debt, among other factors, negatively affect the level of private investment in Zambia's power sector. Further, the Lack of clarity on the future of mini-grids when national grid reaches the mini-grid areas puts the mini-grid developers at risk and reduces attractiveness for new investments. Noteworthy too; d. Absence of a least-cost expansion plan does not allow ZESCO to efficiently expand the power sector;

The GRZ and the mission agreed on the need to align the investment plan with the priorities identified in the National Energy Policy of 2008 (NEP 2008), the Sixth National Development Plan (SNDP 2011-2016), and the Vision 2030, which aims to transform Zambia into a prosperous middle-income country with universal access to clean, reliable, and affordable energy by 2030. In addition, it was noted that the prioritization of investments proposed in the investment plan would consider alignment with both SREP objectives and GRZ priorities as outlined in the NEP 2008 and the Rural Electrification Master Plan (REMP).

Potential areas of engagement under the SREP were identified as renewable energy technologies such as small-hydro, solar, geothermal, and wind. It was indicated that the GRZ would identify and review all types of renewable energy applications (including cookstoves) and business models that have potential for replication in Zambia during the preparation of the investment plan through consultations with relevant stakeholders. The investment plan would be developed to include a broader set of renewable energy priorities to help GRZ access not only SREP resources but also other climate finance resources such as the GCF.

Technical Discussions (December 19-21, 2018)

Several meetings were arranged with key stakeholders in the sector during a technical mission in December, 2018. The meetings were held with the national utility, ZESCO, the Energy Regulation board (ERB), the Rural Electrification Authority (REA) and the EU delegation. The key discussion points are summarised hereafter;

Meeting with REA

On December 21, 2018, a meeting was held with the REA were ongoing renewable energy projects were discussed. The REA informed the meeting of a 60KWp solar mini-grid that is installed in Mpanta, Samfya district in Luapula province. It was indicated that REA has further commenced the development of two more solar mini-grids Chunga and Lunga in Central province and Luapula province respectively. Further, it was noted that the REA is undertaking a wind resource assessment with a view to setting up a hybrid (solar and Wind) project in order to reduce on the high costs incurred on batteries. It was pointed out that the main challenge the REA is facing is the lack of finance to undertake projects in their plans.

The meeting discussed the challenges related to rural electrification namely, high capital cost and low population income levels in some areas which limit the ability to leverage cost-recovery user fee for operations and equipment replacement. The need for low cost financing and grants to scale up the current efforts and improve living conditions of the poor was also discussed.

Meeting with ZESCO Limited

ZESCO welcomed the opportunity to reflect in the SREP IP, the need to diversify the energy mix and respond to the government's directive of connecting new districts. To that effect, the utility is investigating wind prospects. The meeting was informed that ZESCO is also considering geothermal resources as a stable source of base load power to reduce the reliance on climate-sensitive large hydropower plants. Potential support for exploration and other technical studies, was discussed.

Meeting with ERB

The meeting with Energy Regulation Board (ERB was held as part of the technical consultations in the SREP-IP development process. In this regard, the ERB acknowledged the weakness in the regulatory framework especially with regard to off-grid systems and other RE technologies.

However, it was reported that a draft regulation was recently approved by the ERB Board supported by European Union delegation in Zambia. ERB acknowledged the need to develop frameworks for the RE sector in general to cater for the Wind and Geothermal projects proposed.

European Union delegation

The EU welcomed the SREP programme and discussed synergies with ongoing EU-funded projects: The Increased Access to Electricity and Renewable Energy Production (IAEREP) Project and the Electrifi Initiative. IAEREP will provide 25 million (Euros) to provide up to 50% grant for off-grid projects in rural areas of Zambia. The project also includes a large capacity building component for the development of RE policies and regulatory frameworks. The Electri-fi initiative is expected to provide a 40 million (Euros) loan facility to support private sector developers in bridging the gaps in financing small and medium scale clean energy initiatives.

Further meetings focused on the World Bank-supported Renewable Energy Resource Mapping Project and Electricity Service Access Programme (ESAP) and potential opportunities to use the SREP funding to scale-up the current efforts.

Stakeholders' Consultation Workshop (January 4, 2019)

The Ministry of Energy organised a Stakeholders' Consultation Workshop on 4th January, 2019. The workshop was attended by representatives of relevant ministries and government agencies, national institutions development partners, civil society organizations, and cooperating partners. It was officiated by the Permanent secretary of the Ministry of Energy, who is also the chairperson of the National SREP taskforce.

Four groups were arranged to discuss the three proposed programmes in the draft SREP IP and the financing needs. The discussion was articulated around the following questions: (i) Do the proposed SREP components support GRZ investment priorities? (ii) Do they have a transformative impact? iii) What is the role of the private sector? (iv) What partnerships and synergies are leveraged? (v) What additional sources of funds are leveraged?

1. **Group on Financing Arrangements**

The discussion first focused on financing for mini hydro projects and whether it makes economic sense to develop these projects especially considering that Zambia already has most of its generation capacity from hydro and that it is susceptible to effects of climate change.

It was pointed out that mini hydro power projects are site-specific and that their economic viability is dependent on the proximity of consumption centres with sufficient load and/or the ability to connect to the national grid.

It was indicated that the SREP should help to secure grant funding towards mini-grids so as to make the projects viable and thereby encourage private sector participation. Further, the group felt that the SREP should build on the work that the Off-Grid taskforce which is working on particularly regarding unlocking challenges to electricity services affordability issues. It was

recommended that players be identified to spearhead the boosting of economic activities in targeted areas.

The group also discussed possible areas partnerships and synergies particularly off-grid and grid related energy projects. Several initiatives were discussed including technical assistance project by the EU which includes the formulation of regulatory framework for mini-grids, updating the NEP 2008 and developing the National Energy Efficiency Strategy. The EU also informed the group about the electrify project meant primarily as grant, loan, or equity finance for the private sector as.

JICA and the AfDB informed the group that they would submit at areas of co-financing by January 8, 2019. It was also pointed out that the SREP should bring out the Swedish Embassy's role in the off-grid sector.

Further, it was pointed out that there would be no need to carry out pre-feasibility studies on these sites as big companies are already willing to undertake this on their own. Instead, it was felt that the IP should focus on creating favourable market conditions that would provide comfort to the investor of recouping their investment.

Cooperating partners gathered noted that GRZ has not requested support for geothermal development in the country.

The group made the following recommendations:

- SREP IP should highlight the initiatives supported by the Swedish cooperation in the off-grid sector;
- Structured project pipelines to procure electricity from RE sources of energy should be considered;
- Cooperating partners should identify areas of support that would leverage or complement what is proposed in the SREP IP.

2. Group on Investments in Geothermal Resources

The group unanimously agreed that the geothermal component supports GRZ investment priorities such as diversification of the energy mix through various renewable energy technologies including Geothermal. It was also indicated that GRZ acknowledges that geothermal is a clean energy source capable of reliably producing baseload power as it is not affected by climate change.

The group felt strongly that the component has a transformative impact on the socio-economic and environmental activities. It was noted that companies investing in geothermal energy can participate in community development activities such as infrastructure development to improve the community's standards of living. Further, the group pointed out that geothermal would increase rural access to electricity for the local communities and thereby increase economic activities in the area.

It was further highlighted that geothermal development would help to create job opportunities for the local people especially when it is used for direct utilisation such as flower farming, pasteurizing

milk, fish drying etc., which ultimately have a high gender aspect as women find employment in most of these activities. Further, it was noted that geothermal development helps in improving the country's tourism especially with recreational facilities such as the geothermal spa. Bwangwe geothermal resource located in one of the national parks in Zambia was highlighted as having huge potential for tourism.

The group pointed out that the role of the Private sector would be to invest in demonstrative projects for electricity that will unlock potential for other investments either in the generation of electricity or direct utilisation. It was indicated that once feasibility studies are conducted, potential investment are unlocked for geothermal development.

3. Group on Electricity Access in Rural and Peri-urban Areas

The group proposed to expand the focus of the component by referring to "energy access" as opposed to electricity access." It was agreed that the component supports GRZ investment priorities highlighted in the national strategy documents which identify energy as a key enabler for all the economic drivers. It was indicated that the component is relevant to the theme of the 7NDP of "not leaving anyone behind" and supports GRZ's ambitions regarding clean energy development.

The group also agreed that the component has a transformative impact including the reduction of smoke borne diseases as well as increased income generating activities leading to improved lives. Further, it was noted that the component addressed environmental safeguards (reduced indiscriminate cutting of trees and less greenhouse gas emissions) and job creation and knowledge transfer. The programme would cater to the majority of the population as over 60% of Zambians live in rural and peri-urban areas.

It was noted however, that for the benefits to be realised, there is need for complementary activities that will improve ability and willingness to pay. Further, it was pointed out that there is need to have linkages between Energy access and Agriculture and other sectors.

The group indicated that private sector will have a major role to play in the Clean Energy Access space. They will be Project developers, service providers, funders, investors, skills developers and business model innovators. However, in order to encourage private sector participation in this space, it was noted that there is need to provide subsidies as well as improve on the ability of consumers to pay for cost reflective tariffs.

The group felt that the component would complement already existing and planned programs in the clean energy access space as well as crowd in private/donor finance for bankable packaged projects. Further, it was noted that there would be skills transfer and partnership with training institutions. It was indicated that for proper and accelerated uptake of clean energy, there is need to put in place payment modalities such as the pay as you go solutions and leverage grant funding that will make tariffs affordable.

4. Group on Wind Power Development

The group unanimously agreed that wind development would support GRZ investment priorities in line with the Vision 2030 and the Seventh National Development Plan (7NDP).

It was also greed that transformative Impact would be achieved once the strategy and regulatory framework on wind energy are developed and a wind farm is set-up for demonstration purposes. It was noted that setting up wind plants would lead to economic activities for the local communities and improve revenue generation as opposed to depending on income from seasonal farming

The group indicated that the role of the private sector can only be clearly spelled out once the wind strategy and regulatory framework have been developed. Furthermore, the private sector is not keen to invest in wind power due to ZESCO's financial situation which has caused a lot of uncertainty. It was indicated that the private sector would only be willing to invest once the aforementioned matters cleared.

With regard to partnerships and synergies, it was noted that there are possible partnerships between the private sector and Government in developing wind projects (through PPPs). It was also noted that financiers would only be willing to invest when appropriate strategies and regulatory framework on wind energy are developed and ZESCO's financial viability improves.

Other Public Comments

Private sector representatives highlighted the fact that they do not require support to prepare feasibility studies for projects. Rather, they stressed the need for a clear regulatory pathway for project development, procurement and tariff setting mechanism.

Other key comments related to the need for a creditworthy off-taker or appropriate credit-enhancement mechanism for the development of on-grid projects. Affordability issues and promotion of productive uses of energy and economic activities were also debated.

COMPOSITION OF THE SCALING-UP RENEWABLE ENERGY PROGRAM IN LOW INCOME COUNTRIES (SREP) JOINT MDB SCOPING MISSION TEAM TO ZAMBIA APRIL 8-10, 2015

No.	Name	Organisation	Position
1.	Raihan Elahi	World Bank	Senior Energy Specialist
2.	Joseph Kapika	World Bank)	Senior Energy Specialist
3.	Federico Qüerio	Energy Specialist	World Bank)
4.	Dan Croft	IFC	Senior Investment
5.	Brunno Maradei	IFC	Investment Officer, Blended Climate Finance
6.	Elizabeth Muguti	AfDB	Senior Power Engineer

List of Stakeholders Consulted During Preparation of the Zambia SREP - IP

No.	Name	Organisation	Type of Organisation
1.	Tigran Parvanyan	World Bank	Multilateral Development Bank
2.	Monyl Toga	World Bank	Multilateral Development Bank
3.	Wedex Ilunga	World Bank	Multilateral Development Bank
4.	Hawa Sekela Msham	Africa Development Bank (AfDB)	Multilateral Development Bank
5.	Misheck Mubuyaeta	Office for Promoting Private Power Investments (OPPPI)	Government
6.	Shuko Zyambo	Office for Promoting Private Power Investments (OPPPI)	Government
7.	Brig. Gen. Emeldah Chola	Ministry of Energy (MoE)	Government
8.	Arnold Simwaba	Ministry of Energy (MoE)	Government
9.	Harriet Zulu	Ministry of Energy (MoE)	Government
10.	Agnelli Kafuwe	Ministry of Energy (MoE)	Government
11.	Masialeti Nakamboa	Ministry of Energy (MoE)	Government
12.	Elijah Chibwe	Ministry of Energy (MoE)	Government
13.	Mundia Sitali	Ministry of Energy (MoE)	Government
14.	Chivunda K Allan	Ministry of Energy (MoE)	Government

15.	Faith Nakawala	Ministry of Energy (MoE)	Government
16.	Brian S. Mainza	Ministry of Energy (MoE)	Government
17.	Chilombo chila	Ministry of Energy (MoE)	Government
18.	Chola Chipampa	Ministry of Energy (MoE)	Government
19.	Lloyd Ngo	Ministry of Energy (MoE)	Government
20.	Agness Mtambo	Ministry of Energy (MoE)	Government
21.	David M. Wamulume	Ministry of Energy (MoE)	Government
22.	Lufunda Muzeya	Ministry of Energy (MoE)	Government
23.	Mafayo Ziba	Ministry of Energy (MoE)	Government
24.	Brian Siakweenda	Ministry of Energy (MoE)	Government
25.	Rozipher M. Siya	Ministry of Energy (MoE)	Government
26.	Sikabela Chikuba	Ministry of National Development Planning (MNDP)	Government
27.	Mukuka Chibale	Ministry of Local Government and Housing (MLGH)	Government
28.	Musama Obbie	Ministry of Community Development and Social Services (MCDSS)	Government
29.	Nelson Banda	Energy Regulation Board (ERB)	Government/Regulator
30.	Elizabeth B. Phiri	Zambia Environmental Management Agency (ZEMA)	Government/Regulator
31.	Banji Muleya Mayiya	Zambia Development Agency (ZDA)	Government
32.	Jones Zulu	Zambia Development Agency (ZDA)	Government
33.	Maxwel Z. Phiri	Rural Electrification Authority	Government
34.	Patrick Mubanga	Rural Electrification Authority	Government
35.	Wazingwa Mugala	Rural Electrification Authority	Government
36.	Mr. Fidelis Mubiana	ZESCO Limited	Power Utility
37.	Mr. Kangwa Bweembya	ZESCO Limited	Power Utility
38.	Mr. Joel M. Mwale	ZESCO Limited	Power Utility

39.	Philippa Viljoen	Eleqtra	Private Sector
40.	Emmanuel Chilufya	Jothanuel (Z) ltd	Private Sector
41.	Joki Frick	Globaleq	Private Sector
42.	Mukabanji Mutanuka	Power Corner Engie	Private Sector
43.	Daniel Rea	Zengamina	Private Sector
44.	Thandiwe Tembo	Zengamina	Private Sector
45.	Geoffrey Kaila	Muhanya Solar	Private Sector
46.	Moses Banda	Kalahari Geo-Energy	Private Sector
47.	Peter Vivian Neal	Kalahari Geo-Energy	Private Sector
48.	Situmbeko Nyumbu	Davis & Shirtliff	Private Sector
49.	Kui Schrudev	AECOM	Private Sector
50.	Dismus Banda	Mphepo Power	Private Sector
51.	Ngosa Mbolela	Embassy of Sweden	Cooperating Partner
52.	Magdellna Svensson	Embassy of Sweden	Cooperating Partner
53.	Sabera Khan	REEER/OGTF	Cooperating Partner
54.	Mwape Kapumpa	Japanese International Cooperation Agency (JICA)	Cooperating Partner
55.	Davide Bixio	European Union Delegation to Zambia (EUD)	Cooperating Partner
56.	Graham Chingambu	European Union Delegation to Zambia (EUD)	Cooperating Partner
57.	Prakash C Ghimire	SNV Zambia	NGO
58.	Fabian Banda	University of Zambia (UNZ) –Technology Development and Advisory Unit (TDAU)	Academia
59.	Amos Banda	University of Zambia (UNZA) –Technology Development and Advisory Unit (TDAU)	Academia

Annex 3: CONCEPT BRIEFS

Component 1: Electricity Access in Rural and Peri-Urban Areas

Problem Statement

Zambia is endowed with a wide range of renewable energy resources, particularly solar, mini/micro hydro, biomass, geothermal, and wind. These renewable energy sources are increasingly being used but still remain insignificant in terms of contribution to the total national energy supply. In the short- to medium term, these resources have potential to add to the energy generation mix to cover around 5-10% of generation capacity. This is attributed mainly in relative terms, to inadequate policy and regulatory frameworks, high investment capital costs for small scale systems, which need guarantees of long-term stable income streams to ensure financial viability. Component 1 will therefore promote diversification of the power sector by adding a portfolio of small- and medium-sized renewable energy projects in the short term.

Access to modern energy services is key for fostering economic growth, reducing poverty and supporting provision of basic social services. Electricity access in Zambia is very low estimated at 31.2% nationwide with 67.3% in urban areas and 4.4% (on-grid) in rural areas (LCMS, 2015). The low access rate especially in rural areas is not desirable given the set electrification target to increase electricity connectivity from current levels to 50% by 2030. This lag in rural electrification has been attributed to several factors including inadequate policy/regulatory frameworks, low population density in rural areas and lack suitable financing mechanisms and consequently inadequate funding.

Due to the lack of access to electricity and modern energy, households use kerosene and candles for lighting as well as wood fuel in the form of charcoal and firewood for cooking and heating. In addition to being laborious and time-consuming, the over reliance and utilisation of these fuels could have detrimental effects on human health especially for women and children.

Objective

The objectives of the component include:

- Increasing access to electricity and clean cooking solutions for rural and peri-urban households;
- Enhance quality of power supply to support community productive uses;
- Increased private sector participation in off-grid and mini-grid systems.

Scope

The objectives under this component will be achieved by providing partial grants, smart subsidies, and working capital to support private sector-led electrification of rural and peri-urban communities through renewable energy mini-grids and standalone solar systems. The application of funds will be technology neutral, supporting micro, small and medium enterprises (MSMEs) offering a variety of off-grid solutions including solar PV kits/home system, and mini-grids.

Partial grant and smart subsidy beneficiaries are expected to be selected through a competitive bidding process to assess readiness, impact, and the potential for market impact. Smart subsidies will be designed as private sector facing to offset the high electricity connection cost for poor and vulnerable people, living within the areas served by the off-grid facilities and will seek to minimise long-term distortions on the market to improve sustainability. The subsidy would cover the difference between the cost of providing the mini-grid connections and what consumers are able to pay for it. Subsidies would be paid directly to service providers upon verification of service at the consumer level. End-user beneficiaries include households, community service facilities and small businesses.

The provision of working capital is expected to focus on the establishment of a credit line, administered by the Development Bank of Zambia (DBZ). On-lending to the private sector players in the off-grid market could include foreign exchange lending to Private Sector Enterprises (PSEs) for qualifying product imports and capitalization of micro-finance institutions for household-level lending subject to qualifying product purchases. Allocations by entity or technology are expected to be left up to the market. Collateral requirements, equity down-payment and other parameters are expected to be determined at appraisal stage. Such financing mechanisms could also be expanded to include clean cooking. This component will build on the achievements of the on-going Electricity Services Access Project, currently under implementation (see Annex 4 for more details).

Proposed Contribution to Initiating Transformation

The implementation of the component is expected to increase access to financing by MSMEs, and contribute to economic growth and improved livelihoods by providing stable power supply to the community to engage in productive uses of electricity such as agro-processing, and other infrastructure related benefits envisioned through the project include increased access to clean cooking in rural areas ultimately reducing health risks to women and children arising from use of kerosene and wood fuel for cooking and heating.

Regarding the clean cooking, the proposed component will build both a public sector framework amenable to transforming the country to a reliance on cleaner and more efficient cookstoves and fuels as well as investing through Result-Based-Financing (RBF) in strengthening the supply chain for the supply of more efficient stoves and clean stoves and fuels. This will be implemented as follows:

1. **Creation of Favorable Enabling Environment for Clean Cooking**

Under this component, the GRZ will use consultants to assess the current status of the market for cookstoves and cooking fuels to identify particular shortcomings or disincentives to the adoption of cleaner cooking practices. These will range from an assessment of and recommended policy changes relating to stumpage fee collection; to the identification of policy barriers to the uptake of clean stoves and fuels; and appropriate adoption and enforcement of taxes, including import duties and VAT; and the adoption of standards and labels for efficient cook stoves and clean fuels. Public awareness raising in the form of “above-the-line” marketing or advertizing will be an

important part of this programme to ensure that the nation is provided with scientifically credible information about the advantages of these efficient and clean options.f

2. Stimulation of Urban and Peri-Urban Market using Results-Based-Financing

Given that urban and peri-urban consumers in Zambia rely heavily on charcoal produced and imported from the rural areas, the persistence of the charcoal market presents an opportunity to create market incentives to the adoption of more efficient charcoal stoves and even super-efficient stoves using clean biomass fuels, LPG and possibly even electricity. Fewer than 1 percent of Zambians cook with LPG, which presents an opportunity for growth, but one heavily reliant on behaviour-change communication to alter negative public impressions of the safety of LPG use. Electricity pricing reforms (since 2010) have resulted in 10% of urban households in Zambia switching from electric cooking back to charcoal cooking, further increasing charcoal demand and forest pressure. As a result, both pricing and safety concerns have been identified as serious obstacles preventing the widespread adoption of clean cooking techniques in Zambia.

At the same time, several new entrants in the Zambian cookstove markets are making market in-roads toward supply both efficient and clean options. At least one local firm has partnered with an international stove manufacturer to import and sell high-quality efficient charcoal stoves in Zambia's urban and peri-urban areas. A second producer of similarly efficient, high quality charcoal stoves is negotiating to enter the market at scale. Still a third firm has emerged as a supplier of pellets and fan gasifier stoves using a monthly-subscription model priced to be competitive with charcoal use. Supporting the scale-up and growth of the sales of these efficient and clean options through RBF financing will require careful analysis and stakeholder consultation. But compared to the design of the rural programme where prices are not as influential, these markets constitute relatively low-hanging fruit.

Such an RBF programme will provide support for inventory management, sales incentives, and distribution channel strengthening. Public information of the "below-the-line" advertising genre (product-specific promotion) will form a critical part of such packages.

3. Formulation and Implementation of Rural Stove Programme

This programme will begin the preparatory analysis for a national-level cleaner cooking programme. Because most rural dwellers in Zambia cook with gathered firewood over a three-stone hearth, market-incentives will not be the clear drivers toward efficiency and cleanliness that they are in the urban and peri-urban areas. However, there have been a handful of relatively successful programs in rural Zambia that are beginning to disseminate stoves in the hundreds of thousands. As the urban and peri-urban subcomponent gets under way, attention will then focus on how best to stimulate change toward cleaner and more efficient cooking solutions in rural areas. This programme will make use of RBF as well as support to micro-financing institutions to deal with affordability challenges on the part of rural consumers, but the goal remains the longer-term adoption of cleaner and more efficient cooking fuels and technologies across rural Zambia.

Implementation Readiness

Implementation arrangements for this component are expected to replicate mechanisms in place for the World Bank-funded Electricity Service Access Project. SREP funds will be allocated to the GRZ, through the Ministry of Finance (MoF), which will, through a subsidiary grant agreement, on-grant the funds to REA. REA will be responsible for project fiduciary responsibilities. It will account for the deposits and withdrawals, perform the audits and provide financial reports in accordance with the World Bank rules and guidelines and monitor the utilisation of the project resources by each beneficiary, including itself, and provide expenditure projections.

The mini-grid and off-grid market space will be determined in large part following the completion of the ongoing GIS-based least cost electrification roll out plan and the testing of mini-grid sites to be tendered by REA under the ESAP and a parallel EU initiative. It is expected that the least cost roll-out plan will result in a long-list of mini-grid sites for which developers will be invited to compete with some assurance of a return on investment. Whilst there may be significant overlap with the ~1,500 Regional Growth Centres initially outlined by the Government, the preferred form of electrification (on/off grid) will be confirmed on an economic/rational basis by the least cost roll-out plan as a function of National Electrification Programme's design choices determined by the Government in consultation with all sector stakeholders.

REA has a statutory mandate to administer and develop plans for grid and off-grid rural electrification, and monitor their implementation, mobilise funds to support rural electrification, encourage private sector participation in rural electrification through provision of subsides, competitive bidding, and community mobilisation, finance project preparation studies for rural electrification, and recommend suitable policies to the GRZ. REA has experience managing World Bank-funded projects, having previously managed the IDA credit for the IAES Project.

The Ministry of Energy will be responsible for coordination of project implementation, liaising with other Government institutions, monitoring of the performance of all actors, and enforcing adherence to the project implementation schedule. The DoE will form a joint project coordination team with regularly scheduled meetings to ensure smooth and timely implementation progress and address any issues that may cause delays in project implementation or disbursements.

The Development Bank of Zambia (DBZ) will have overall responsibility for the implementation of off-grid lending activities (that is, managing an operationalised credit line). To that effect, REA will enter into a subsidiary agreement with the DBZ for implementing the related activities. As a potential financial intermediary, the DBZ will also have fiduciary and safeguard oversight responsibilities.

As it concerns any clean cooking activities, it is expected that these will be implemented by DBZ with further technical assistance to the sub-sector provided through an appropriate project implementation unit yet to be determined.

Rationale for SREP Financing

Zambia's electricity access in rural areas is currently about 8.4%. Over the past decade, public investment in the off-grid sub-sector has not been deployed at a rate that is commensurate with the population growth and the pressing need to create economic opportunities for the poor. In addition, private actors have struggled to deploy off-grid electrification solutions not only due to the lack of an adequate regulatory framework and development plans but also, the limited access to finance and/or the high cost of financing required by commercial banks. The SREP complements the efforts of GRZ and other development partners by providing affordable sources of financing for on-lending to the micro, small and medium enterprises (MSEs) that wish to invest in off-grid electrification. Doing so, will demonstrate the viability of lending programmes targeting the off-grid subsector to attract additional capital providers.

Results Indicators

The results indicators for this project are as follows:

- Annual electricity output from renewable energy, as a result of SREP interventions
- Number of women and men, businesses, and community services benefitting from improved access to electricity and/or other modern energy services, as a result of SREP interventions
- Number of women-headed households benefiting from new electricity connected
- Increased public and private investments in targeted subsectors, as a result of SREP interventions
- Capacity (direct/indirect) from renewable energy (MW), as a result of SREP interventions
- GHG emissions avoided
- The number of households provided with cleaner and more efficient cooking solutions

Indicative Financing Plan

	Total	SREP[(i)]	AfDB	IFC	WB	Other donors	Private sector	GRZ[(iv)]
Component 1 – Energy Access in Rural and Peri-Urban Areas								
Investment in off-grid and mini-grid electrification solutions	161.7	10	-	-	45.9[(ii)]	55[(iii)]	50	0.8
Sub-total	161.7	10			45.9	55	50	0.8
SREP leverage					1:16			

Notes:

(i) All SREP funds are assumed to be grants.

(ii) Relates to the ongoing Electricity Service Access Project[4] (US$5.9 million) and the new electricity access project currently under preparation

(iii) US$55 million grants from other donors refers to the Beyond the Grid initiative and the EU programme

(iv) All GRZ contribution are derived from commitments already made under the 7NDP

Project Implementation Timetable

The overall implementation schedule for the Project is proposed as follows:

- Project preparation: Q1 - Q3 2019
- Submission to the SREP-Sub-committee: Q4 2019
- MDB Board approval: Q2 2020
- Effectiveness and implementation: Q3 2021

Request for Investment Preparation Funding

Not applicable

[4] A complete description is available here: http://documents.worldbank.org/curated/en/556221498788150527/Zambia-Electricity-Service-Access-Project

Component 2: Wind Power Promotion

Problem Statement

The Government of the Republic of Zambia (GRZ) is promoting the development of wind energy in the country to diversify the current energy mix and to address the challenge of sole dependence on hydropower, a technology that is highly vulnerable to climate change events such as droughts. In 2015, the GRZ through the Ministry of Energy and with support from the World Bank embarked on a wind resource assessment programme to gather wind measurement data. The objective was to overcome one of the most difficult barriers facing wind power development in Zambia - a lack of credible and investment grade wind data capable of attracting investments into wind technologies. In addition, this marked the beginning of a national wind mapping programme.

Despite these interventions and strong interest shown from different private players, the development of wind power is still constrained by the lack of a regulatory and legal framework to engage private sector in an effective and affordable manner. This problem is exacerbated by the low creditworthiness of ZESCO as an off-taker of power and a lack of wind expertise on the ground.

These factors make it very difficult to attract the much-needed private investments that would make up for scarce available public funding and allow Zambia to harness the wind energy potential of the country. The nation-wide wind energy potential is yet to be estimated, however, detailed feasibility studies conducted so far by both public and private power sectors players indicate a potential of over 100 MW.

A wider policy challenge for electricity investment in Zambia relates to the fact that the sector is still subsidised where the regulated tariffs are set below the cost recovery level.

Based on wind resource map data collection exercise which was carried over a period of two years, to give firm data on the long-term wind regime and estimate energy production, based on a generic 4 MW wind turbine, with a rotor of 140 meters and a hub height of 130 meters was evaluated at each location. According to the preliminary results, the average wind speed at the 8 measurement sites varies between 7 - 8.2 m/s, measured at 80-meter height indicating significant potential for electricity generation.

Objective and Proposed Transformation

With the Renewable Energy resource map data collection exercise, Zambia has now established a network of state-of-the-art wind measurement masts around the country which continues to provide wind data which can be used by stakeholder to undertake feasibility studies to ascertain wind capacity and type of technology to be used for wind power generation. A total of 8 masts were sited around the country at 80 meters height in areas where wind development could be considered viable and potentially bankable with current turbine technologies. The programme is with support of ESMAP.

In the future, this network of masts will also provide the industry with a source of long-term reference station data which could greatly reduce uncertainties for potential developers. The data collected from these masts is promising in terms of quality and coverage and effectively allows the GRZ in partnership with interested financiers, including the MDBs, to start planning the deployment of the first set of wind power plants in the country but prior to that additional work must be undertaken to strengthen the policy, regulatory and legal frameworks as well as institutional capacity in order to successfully engage private players in the sector through the preparation, launch and management of tender processes to select preferred bidders to finance, build, own, operate and maintain these assets. In order to do that, SREP resources are being proposed to be deployed in the context of this project in two different forms: (i) a Project Preparation Grant (PPG) of up to USD 1.15 million which AfDB will seek to co-finance through the mobilization of the Sustainable Energy Fund for Africa (SEFA) to undertake all the preparatory work up to the selection of the preferred bidder(s), and (ii) a SREP non-grant instrument in the amount of USD 10 million to de-risk the first project(s) and make it more affordable while establishing valuable track record so that future projects can be bankable without concessional resources and be competitive on their own. This is especially important in a country like Zambia where availability of long-term financing is still a huge barrier to private investors.

Investments in wind technologies will open new local market segments and contribute to build Zambia's skills-base.

Implementation Readiness

The PPG will identify areas of the country that have sufficient wind potential to allow the construction of the utility-scale wind power plants. Once these areas are identified, the GRZ will develop a plan including a timeline to launch, manage and complete a tender process to select a single (or multiple) private companies that would be responsible for financing, building, operating and maintaining the envisaged power plant(s).
The meteorological masts installed under the World Bank supported measurement campaign were sited in their current eight different locations primarily for the purpose of validating the national wind atlas, upon completion of 24 months of data acquisition. It suffices to note that several of these meteorological mast locations are sited in areas where wind development could be considered viable and potentially bankable with current turbine technology.

Soon after the auction(s) are completed, and the preferred bidders selected, AfDB and the GRZ will engage with the different parties and negotiate the deployment of SREP long-term financing as in the form established during the preparatory work and as communicated to bidders participating in the auction(s). This financing will be deployed in accordance with the blended finance principles for private sector and may be deployed in the form of a loan, a guarantee or a combination of both and.

The proposed SREP long-term financing would play a key role in de-risking the project and/or lowering the capital expenditures of the project allowing ZESCO to purchase power at a very competitive price. In order for this structure to work, the obligations of ZESCO under the Power Purchase Agreement would have to be guaranteed by the GRZ or other credible and creditworthy counterpart. This would provide the much needed certainty on the revenue side of the projects,

address project specific risks and contribute to the crowding-in of investors and financiers into the energy sector in the country.

The low cost financing would be instrumental in strengthening the commercial viability of the project. However, it is worth mentioning that a careful balance will be required to stimulate the market without creating long-term dependence on subsidies. Apart from its co-financing share, AfDB will seek to provide the minimum concessionality needed to catalyze this particular investment while contributing to the long-term viability of private sector-led power generation in Zambia. In accordance with this principle, the SREP instrument will be chosen on a case-by-case basis to address the specific barriers and mitigate specific risks.

Once up and running, the project will serve as a demonstration of the economic, environmental & social and financial viability of wind power in Zambia and attract additional investments into the sector.

Rationale for SREP Financing

The project will increase the installed capacity from renewable energy sources in Zambia, reduce the high dependency on hydropower and contribute to the replication of wind assets that will contribute to reduce the supply electricity gap in the country.

Without the SREP financing - especially the PPG - the envisaged wind programme could be delayed by a number of years. While wind technology costs have been going down over the years, the proposed structure is yet to be deployed in the country and as such no demonstration effects are still in place. These are vital to provide the private sector with the much-needed confidence that these structures can be materialised in a fair, transparent, less risky and competitive manner.

The SREP funds will support the following activities: (i) identify and develop relevant regulations for the development of wind energy, (ii) identify and address impediments hindering the involvement of private sector in the development of wind technologies in the country, (iii) support the development of one (or more) wind power project to serve as a first-of-a-kind project(s), (iii) contribute to build technical capacity on wind energy at the national level, and (iv) promote wind energy as a viable investment for private sector players.

This project will lay strong foundations supporting the development of wind power and could assist Zambia in diversifying its sources of energy away from hydropower, a technology greatly exposed to the negative impacts of climate change.

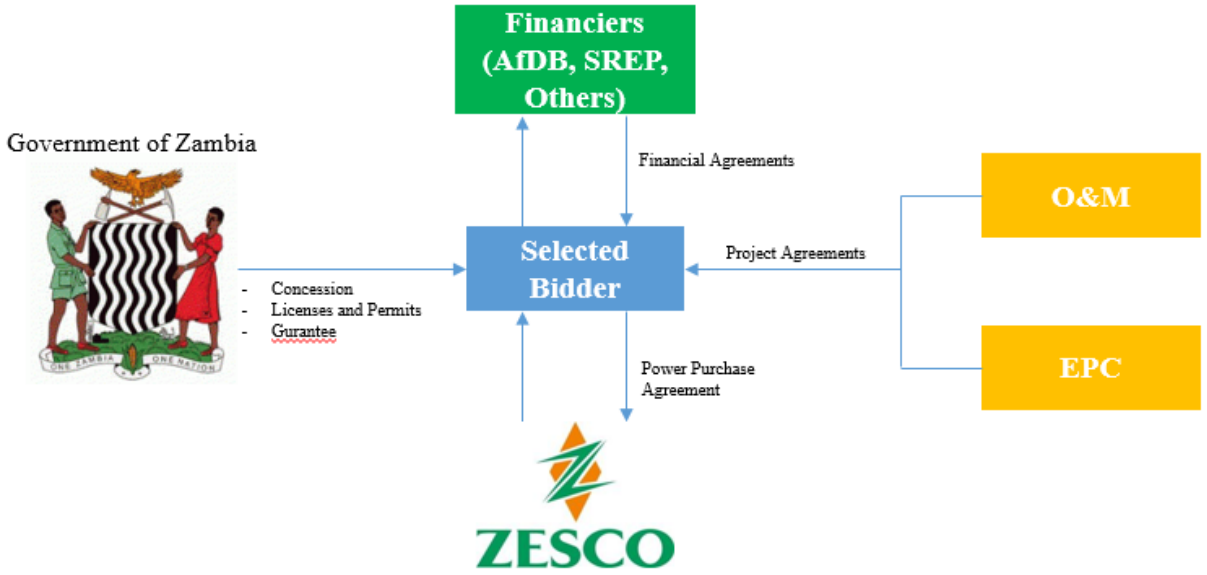
Result Indicators

The results indicators for the proposed project are included in the table below and shall be confirmed during project appraisal.

Installed Capacity (in MW)	40
Annual Electricity Output (in kWh)[5]	140,160,000
Number of Men, Women, Businesses and Community Services benefiting from improved access to electricity	To be determined
Increased Public and Private Investments (in USD million)	51.0

Project Structure and Financing Table

The diagram presented below, provides an indication of what the final project structure may look like. The Project Company (Selected Preferred Bidder) – a company established under Zambian law – shall be responsible for the design, financing, construction, operations and maintenance of the project. The parties will seek to develop and establish a structure that allocates risk among different parties in a way that enhance commercial viability. The use of SREP concessional resources will play a critical role.



The proposed SREP allocation is USD 10 million and would be deployed in the form of a concessional loan and/or guarantee and in accordance with the SREP Financing Modalities for Private Sector Projects.

The financing table of the proposed project is as follows:

[5] Assuming a capacity factor of 40%

Indicative Financing Plan

	Total	SREP[(i)]	AfDB	IFC	WB	Other donors	Private sector	GRZ[(iv)]
Component 2 – Wind Power Promotion								
Project Preparation Grant	2.1	1.15	0.90	-	-	-	-	0.05
Wind IPP	61.0	10	18.3			14.4	18.3	
Subtotal	*63.1*	*11.15*	*19.2*			*14.4*	*18.3*	*0.05*
SREP leverage	***1:5.66***							

Notes:

(i) All SREP funds are assumed to be grants.

(ii) All GRZ contribution are derived from commitments already made under the 7NDP

Project Timeline

The overall implementation schedule for the proposed project is as follows:

1. Approval and Signature of SREP PPG: 2Q 2019
2. Closure Date of SREP PPG: 2Q 2021[6]
3. Negotiations and Project Structuring: 2Q 2022
4. Project Approval: 2Q 2022

[6] This includes the launch, management and conclusion of the auction(s)

Component 3: Investment in Geothermal Development

Problem Statement

GRZ has placed diversification of the current energy mix at the top of GRZ energy agenda aimed at gradually moving the country towards a less monopolised electricity sub-sector with a clear ambition to broaden generation mix and involve the private sector. In this regard, it has been deemed desirable to gradually diversify the energy mix in terms of location, sector participants, and renewable energy sources to improve energy security and provide a mitigation measure for hydrological risk.

There is currently no geothermal electricity generation in Zambia. The only development in this energy resource was through an initiative with the Italian Government in the mid 1980s. This saw the development of the Kapishya Hot Springs Geothermal Plant in Northern Province to the extent that 2 x 120kW turbines were installed in 1987 to be operated by ZESCO Limited. However, the Kapishya Plant has not been operational since it was built and efforts to revive the plant have not yielded positive results. ZESCO together with the Geological Survey Department (GSD) has conducted reconnaissance studies on five sites. For these studies GSD, conducted the geological surface studies which forms an integral part of the inception report.

Additionally, there has been interest from private sector to explore the geothermal resource. More notably has been the exploration works been undertaken by Kalahari Geo-energy Company who have been carrying out exploration drilling in the southern part of the country with positive indications so far. Private investors have also expressed interest in developing direct uses of geothermal energy. In countries such as Kenya, Indonesia, New Zealand and Iceland geothermal energy is used in such areas as agriculture(greenhouses), dairy industry (milk pasteurisation), aquaculture (fish breeding and drying), district heating and cooling, industrial heat exchangers (heat to chilling) and in the promotion of tourism (hot spars and in the visits to the power generation plants).

At this stage, SREP co-financing is not sought for the implementation of Component 3 (Investment in Geothermal Development) due to the priorities of the SREP's implementing MDBs. However, geothermal development is an important part of GRZ's long-term development strategy and will require concessional funding for market initiation and scaled-up development. GRZ will continue to engage with cooperating partners to address the existing barriers.

Objective

The objective of this component is to:

- Promote use of geothermal resource for electricity generation and agro-industrial activities;
- Improve affordability of geothermal electricity generation by mitigating investment risk.

Scope

It is proposed to use concessional funds for policy support of regulatory institutions for promotion and oversight of geothermal activities for electricity production and agro-industrial uses. This would include the development of the enabling framework and a comprehensive master plan providing a framework for using geothermal energy for community development and promotion of productive uses of energy. Regulatory support could include the elaboration of clear mechanisms for procurement of geothermal power including tariff mechanism. Additionally, concessional funding would be needed to provide a risk mitigation facility to offset exploration cost incurred by the private sector and buy-down the tariff to increase affordability. Possible support could take the form of long term loans to private sector, higher risk financing instruments (e.g. convertible debt, equity) and/or the provision of off-taker credit enhancement instruments to enhance the bankability of power purchase agreements. The scope will be further refined during project preparation activities.

Proposed Contribution to Initiating Transformation

The proposed intervention will pave the way for geothermal development in Zambia, defining a clear pathway for use of energy for both energy generation and agro-industrial activities. The base-load geothermal power will mitigate the impact of climate-sensitive hydro power, facilitating the scale-up deployment of variable renewable energy sources (e.g. wind, solar). Through the development of this resource, various co-benefits will be available for local communities: electricity generation; opening up of the areas through infrastructure development such as roads and water; opportunity for direct utilisation of geothermal heat and condensate for industrial and agricultural based activities leading to employment creation and income generation; increased security in the areas as a result of the economic activities and social amenities. Moreover, by world average, geothermal development is estimated to require 1 MW/employee and one support staff at a power plant. This means that geothermal development would directly create employment by two employees per MW. These activities will transform the livelihood of the people especially that of women (e.g water supply from geothermal development will lift the burden of searching for water from long distances, improve farming activities through irrigation leading to food security thereby boosting overall psychological and physical health for women).

Implementation Readiness

To be defined during project preparation.

Rationale for concessional Financing

As described above, geothermal development in Zambia will contribute to increased energy security of the country, enhance firm and reliable base load generation capacity, and promote low-carbon development.

The project will increase the installed electricity capacity and energy from renewable energy sources, and enhance private sector's confidence in geothermal power development. It is expected that multiple development partners will support the project once the counterpart funds are guaranteed.

Result Indicators

The following results indicators will be used to monitor the achievements:

- Increased/strengthened regulatory, institutional and policy frameworks to support the use of geothermal energy for electricity and agro-industrial uses;
- Increased public and private investments in the geothermal sector;
- Capacity (direct/indirect) from geothermal power (MW);
- Greenhouse gas emissions avoided.

Project Timeline

To be determined.

Indicative Financing Plan

	Total	**AfDB**	**IFC**	**WB**	**Other donors**	**Private sector**	**GRZ[iv]**
Policy support and community development master plan	-	-	-	-	-	-	
Investments – Risk mitigation facility	45.5	-	-	-	-	45	0.5
Subtotal	*45.5*	-	-	-	-	*45*	*0.5*

Notes:

(i) All GRZ contribution are derived from commitments already made under the 7NDP

Annex 4: DESCRIPTION OF THE ELECTRICITY SERVICE ACCESS PROJECT

The Electricity Service Access Project (ESAP) was approved by the World Bank in June 2017 to is to increase electricity access in Zambia's targeted rural areas.

It comprises four components as follows:

1. **Component A** provides financing for on-grid connections in rural areas using the approaches under the OBA/Connection Fee Subsidy Programme. To support the 'last mile' connections, the project also finances critical distribution network reinforcements and extensions through applying low-cost technologies where appropriate that will enable ZESCO to add new connections to the grid, complementing ongoing access expansion efforts by CPs in other parts of the country. The component aims to electrify 22,000 low income households and 1,000 SMEs in rural areas. It has been so successful that it has already achieved 11,000 in just five months.

   Subcomponent A1 – Expanding New Electricity Connections for Low-income Households through OBA type Financing: Supports last mile connections to about 22,000 low-income households and 1,000 MSEs (about 115,000 beneficiaries) in rural areas outside the 18 designated city and municipal councils. It uses the ongoing OBA approach, with results-based financing partially subsidizing the cost of new connections for low-income households and MSEs. To enable ZESCO to connect rural households and MSEs to the network, the project will reimburse ZESCO for the cost of connections less the subsidised connection fee to be paid by consumers.

   Subcomponent A2 - Extension and Strengthening of the Grid Network for New Connections: Includes the construction of 33/11 kV distribution lines, installation of distribution transformers, and construction of MV/LV distribution lines (400/230 V) and testing low-cost technologies. REA and ZESCO have jointly agreed on target areas where investments are to be made, which will be prioritised focusing on rural areas with higher population density and projects with positive economic rate of return.

2. **Component B** finances upstream activities to enable private sector participation in rural off-grid electrification, including identifying and scoping off-grid sites, helping the GRZ address the existing regulatory impediments, building the needed capacity at key institutions, and designing financial mechanisms. Subject to successful completion of the upstream capacity-building activities, to be confirmed by GRZ and the World Bank, the component will then fund the piloting of two financial mechanisms, namely an off-grid electrification smart subsidy programme for mini-grid developers and an off-grid loan facility for importers and distributors of off-grid solar equipment.

   Subcomponent B1 - Off-Grid Electrification Smart Subsidy Programme: Will fund upstream work to create an enabling environment to support private sector-led off-grid electrification and activities aimed at designing, establishing, and piloting an Off-Grid Electrification Smart Subsidy Programme (OGESSP). The OGESSP is expected to provide partial grant subsidies to support the development of private sector-led mini-grids that may be complemented with stand-alone solar systems. The World Bank and International

Finance Corporation are working on the regulatory framework, together with the Energy Regulation Board (ERB) and Zambia Bureau of Standards (ZABS), focusing on identifying and developing selected technical standards and specifications for mini-grids. The activities in this sub-component have been identified through consultations with the private sector and are based on the experience so far in Zambia, including the initial stage of implementation of the SIDA-supported Power Africa: Beyond the Grid Fund for Zambia (BGFZ) confirming the private sector's interest in off-grid energy electrification. In the second phase, REA is expected to pilot the OGESSP, competitively selecting private operators to provide energy services to households, public facilities, and MSEs in the selected rural localities. While the OGESSP will not specify technology, it is expected that mini-grids will be primarily solar PV based, providing an agreed level of electricity service.

Subcomponent B2 - Off-Grid Loan Facility: Will fund upstream capacity-building work and, subject to its successful completion would further set up and finance piloting a loan/credit line facility for eligible borrowers, including companies importing and selling solar equipment, developers of mini-grids, and end users of solar equipment such as agribusinesses. The loan facility will aim to address the existing constraint of lack of access to finance, which is a key barrier to growth of the solar energy market. The DBZ will act as a financial intermediary for a US$2 million credit line and will either lend directly to eligible borrowers or act as wholesale lender to one or more commercial banks who would then lend to eligible borrowers. The first, upstream phase includes developing and implementing an Institutional Development Plan (IDP) for the DBZ to raise its capability and skillset in key areas (the procurement for this is ongoing), followed by the development of a DBZ operational manual and designing the Loan Facility structure and loan terms. The second phase will pilot the Loan Facility and operationalise the credit line.

3. **Component C** provides technical assistance (TA) to the GRZ to (a) ensure that the project reaches its objective of enhancing and improving the enabling environment needed for a substantially scaled-up electrification effort and (b) to support effective project implementation. Under this component, some important efforts are underway that will be complemented by SREP:

Geospatial least-cost electrification plan: Being developed for grid and off-grid rollout, to provide the basis for reviewing Zambia's National Electrification Strategy (NES), by presenting a systematic approach towards providing access to electricity for all. The goal is to scale up the electrification rate in Zambia according to GRZ's vision 2030 through least-cost geospatial electrification planning including, grid, mini-grid and SHS deployment as well as capacity building and training sessions along the way.

National Electrification Programme: Launched in October 2018 and spearheaded by the GRZ through the Ministry of Energy, the NEP is an integrated approach to electrification that will define the role of all stakeholders in the implementation and financing of universal electricity access in Zambia, with the organizing principle of "Many Players, One Team, One Plan." The energy sector will be led through a comprehensive process to redefine

electrification targets, clarify the roles of the sector's main agencies, and identify the essential and sustained investments for public, private, and cooperating partner financing.

More specifically, the NEP aims to define 1) targets, timetables, and a technical plan 2) an implementation plan, and 3) adequate and sustained funding for the duration of the programme of off-grid and on-grid connections. The targets, timetables, and technical plan will be defined by the GRZ based on existing Vision 2030 goals, the Multi-Tier Framework household survey results, and a least cost geospatial rollout plan for grid, mini-grid, and off-grid connections. The implementation plan will be informed by the institutional framework (the NES), a grid electrification readiness assessment, and an off-grid implementation and operational plan. A bankable investment prospectus to facilitate the syndication of financing will then be prepared based on all of these inputs.

The key objectives of the NES are to identify the principal constraints to effectively, efficiently, and sustainably acheiving the Government's targets and timetables for achieveing universal access, in accordance with the geospatial least-cost rollout plan that will be updated regularly, to take into account the expansion of the grid, incorporate delivery of off-grid solutions and changes in demographic and other characteristics; and recommend appropriate remedies taking into account relevant good practice experience. The NES, and subsequently the NEP, will be developed through extensive consultation with all relevant stakeholders, including local government, communities, and private sector.

Annex 5: COMMENTS FROM THE INDEPENDENT REVIEWER

The SREP IP was reviewed by an independent expect appointed by the Climate Investment Funds Administrative Unit. Two rounds of review were conducted and comments were incorporated in the preparation of the final draft.

The independent review report noted that the Zambia's Investment Plan is a comprehensive document with informative details about the country, energy sector, MDB and development partners' relevant activities, private sector and NGO participation, etc. It presents detailed analysis of the key challenge related to the poverty and inequality and shows how the SREP will contribute to fighting poverty, particularly in the rural areas. The IP also emphasises the need for diversification of energy sources. The IP is consistent with the general criteria and SREP operational criteria. Comments and concerns aim to further strengthen the commitment of the Government of the Republic of Zambia (GRZ) to promote Renewable Energy in the Country.

The table below presents the final recommendations received and responses from the Government of the Republic of Zambia.

#	Recommendation	Response
1.	It is recommended to provide more information about the private sector financing mechanism under the Component 3	This is well noted. GRZ intends to refine Component 3 during project preparation which among other activities will include market sounding in order to assess the needs.
2.	It is recommended to specify the projects (components) under the IP that will be implemented by the MDB, if any	GRZ will explore alternative sources of funding following endorsement of the IP. Additionally GRZ will continue discussions with other MDBs including the Green Climate Funds (GCF)
3.	It is recommended to make the Project Brief consistent with the whole document	This is well noted. GRZ has since reviewed the document to ensure consistency of the whole document

Annex 6: SREP PROJECT PREPARATION GRANT REQUEST

<table>
<tr><th colspan="4">SREP INVESTMENT PROGRAM

PROJECT PREPARATION GRANT REQUEST</th></tr>
<tr><td>1. Country/Region:</td><td>Zambia/Africa</td><td>2. CIF Project ID#:</td><td>(Trustee will assign ID)</td></tr>
<tr><td>3. Project Title:</td><td colspan="3">Wind Power Generation Project</td></tr>
<tr><td>4. Tentative SREP Funding Request (in US$ million total) for Project at the time of Investment Plan submission (concept stage):</td><td>Grant:</td><td colspan="2">Loan: USD 10 million</td></tr>
<tr><td>5. Preparation Grant Request (in US$):</td><td>USD 1.15 million</td><td colspan="2">MDB:
AfDB</td></tr>
<tr><td>6. National Project Focal Point:</td><td colspan="3">Harriet Zulu

Acting Assistant Director
Ministry of Energy
luzuhat@yahoo.co.uk</td></tr>
<tr><td>7. National Implementing Agency (project/program):</td><td colspan="3">Ministry of Energy</td></tr>
<tr><td>8. MDB SREP Focal Point and Project/Program Task Team Leader (TTL):</td><td>Focal point:
Leandro Azevedo
CIF Coordinator
l.azevedo@afdb.org</td><td colspan="2">Task Manager:
Nahmo Oh
Senior Investment Officer
n.oh@afdb.org</td></tr>
<tr><td colspan="4">Description of activities covered by the preparation grant:

The grant will support the Government of Zambia investment priorities in line with its Vision 2030 and the Seventh National Development Plan by seeking to cover the following activities required for involvement of the private sector in wind generation in the country.

(i) Develop a policy and regulatory framework to encourage private sector participation in wind power development; and
(ii) Undertake additional pre-feasibility studies to inform the development, launch and conclusions of an auction(s) process aiming at hiring private sector investors to design, finance, build, operate and maintain wind power generation assets.</td></tr>
<tr><td colspan="4">9. Outputs:</td></tr>
<tr><td colspan="3">Deliverable</td><td>Timeline</td></tr>
<tr><td colspan="3">• Technical Feasibility Studies

• Development, Launch, Management of an Auction(s) to select Private Sector Companies to Design, Finance, Build, Operate and Maintain Wind generation assets</td><td>12 months after approval

24 months after approval</td></tr>
</table>

10. Budget (indicative):	
Expenditures[b]	**Amount (in USD) – estimates**
Technical Assistance and Capacity Building	1,100,000
Contingency	50,000
Total cost	**2.100,000**
Other contributions: Government of Zambia	50,000
Sustainable Energy Fund for Africa	900,000

11. **Timeframe** (tentative):
2 years

12. **Other partners involved in project design and implementation**:
AfDB is currently engaging with the Sustainable Energy Fund for Africa (SEFA) exploring avenues to mobilise an additional preparation grant of up to USD 900.000 to co-finance the proposed activities under this grant. If unsuccessful, a discussion will be held with between AfDB and the GRZ to agree on a revised procurement plan with AfDB trying to ensure complementarity in the implementation of the AfDB's GCF approved project to Zambia named Renewable Energy Financing Framework which contains a number of soft activities aimed at scaling renewable energy in the country.

13. **If applicable, explanation for why the grant is MDB executed:**
It is expected that the grant will be executed by a Project Implementation Unit within the Ministry of Energy. It is important to note that AfDB will seek to coordinate with SEFA and eventually funds under the GCF funded *"Zambia Renewable Energy Financing Framework"* and implementation across these projects/facilities might be shared.

14. **Implementation Arrangements** (including procurement of goods and services)**:**
The grant will be implemented in accordance with AfDB's rules and procedures in terms of: (i) procurement, (ii) disbursement, (iii) financial management, and (iv) audit.

Annex 7: MDB REQUEST FOR PAYMENT OF PROJECT IMPLEMENTATION SERVICES

SCALING UP RENEWABLE ENERGY PROGRAM IN LOW-INCOME COUNTRIES **MDB Request for Payment of Implementation Services Costs**			
1. **Country/Region**:	Zambia	2. **CIF Project ID#**:	*(Trustee will assign)*
3. **Project Title:**	Energy Access in Urban and Peri-Urban Areas		
4. **Request for project funding (USD million):**	At time of country program submission (tentative): Grant: US$ 10 million Non-grant: -	At time of project approval: Grant: Non-grant: -	
5. **Estimated costs for MDB project implementation services (US$ million):**	Initial estimate - at time of Country program submission: $428,000 Final estimate - at time of project approval: TBD	MDB: World Bank Date: January 10, 2019	
6. **Request for payment of MDB Implementation Services Costs (US$ million):**	☑ First tranche: US$ 128,000 ☐ Second tranche: $300,000		
7. **Project/program financing category:**	a - Investment financing - additional to ongoing MDB project ☐ b- Investment financing - blended with proposed MDB project ☑ c - Investment financing - stand-alone ☐ d - Capacity building - stand alone ☐		
8. **Expected project duration** (no. of years):	5 years		
9. **Explanation of final estimate of MDB costs for implementation services:**	Non applicable		
10. **Justification for proposed stand-alone financing in cases of above 6 c or d:** non applicable			