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Energy Efficiency Strategy and Action Plan

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Foreword

Access to clean and modern energy services is important to ensure socio-economic development in the country. To this effect, the Government of the Republic of Zambia (GRZ) has made significant efforts to develop energy infrastructure across the country. Despite these efforts, there is significant loss of energy across its value chain, translating to losses of huge amounts of income.

The GRZ is committed to ensuring that efficient energy practices are promoted and integrated in all sectors of the economy in line with the National Energy Policy 2019 (NEP 2019). This action will contribute to reduction in energy losses and reduce the income people spend on their daily energy needs.

It is worth noting that the GRZ has proactively supported Energy Efficiency (EE) measures across all sectors of the economy through implementation of various interventions such as: banning of incandescent lamps; undertaking of free energy audits in industries; introduction of power factor surcharges; and awareness campaigns on EE. These measures however have been undertaken in an *ad hoc* manner hence the development of the Energy Efficiency Strategy and Action Plan (EESAP) which will support systematic implementation of various EE measures.

It is important to point out that this is the first EESAP for the country and as such it will undergo periodical reviews to reflect the evolving needs of the energy sector and the country in general. The EESAP has proposed various EE activities which will support the country to achieve the national target of sustainable energy development and the creation of a market environment that will promote increased private sector participation. The areas in which activities have been proposed include the residential sector, the transport sector and the industrial sector. The EESAP also seeks to build capacity in various relevant stakeholders that will participate in the implementation of the proposed activities. It has also proposed various activities of ensuring that the EE market is grown to assist in realising the set targets.

The Ministry of Energy will work closely with other stakeholders through inter-sectoral collaboration to implement the activities proposed in the EESAP. The successful implementation of the proposed activities will drive the country's economic growth by harnessing its EE potential, reducing energy costs and promoting energy services.

Peter C. Kapala MP
MINISTER OF ENERGY

Acknowledgements

The development of the Energy Efficiency Strategy and Action Plan (EESAP) was based on a countrywide consultative process involving various stakeholders. Accordingly, appreciation is extended to all the key stakeholders who took part in the EESAP development process. These included representatives from the following institutions:

(1) Cabinet Office;

(2) Various Government Ministries/Institutions;

(3) Energy Utilities;

(4) European Union and other Cooperating Partners;

(5) Private Sector;

(6) Academia; and

(7) Civil Society.

The successful implementation of the EESAP will depend on the continued participation of the institutions listed above and the support of all the Zambian citizens.

The development and publication of the EESAP would not have been possible without the generous financial support and technical assistance of the European Union (EU). Therefore, I wish to register special thanks to the EU for their support to the development of the EESAP and for their continued support to Zambia's energy sector as a whole.

Francesca C. Zyambo (Mrs.)
Permanent Secretary
MINISTRY OF ENERGY

Definitions

Actions	The process of taking on specific activities, typically to achieve a specific objective.
Action Plan	Steps set forth by various government bodies directed towards meeting sector goals.
Authority	A governmental body that has political or administrative power and controls a particular activity within the local market.
Capacity Building	The process by which individuals or other entities obtain, improve and retain skills, tools and knowledge to perform specific activities competently.
Energy	Power derived from the utilisation of chemical and/or natural resources to provide electricity, heat and/or light to machines, devices and/or appliances.
Energy Efficiency	Method of reducing energy consumption by using less energy to attain the same amount of useful output.
Market Development	Steps taken by individuals or entities that help develop market uptake and the perceptions of stakeholders regarding specific products or services.
Market Enabler	Method or tool used either to facilitate or hinder the movement of a specific product or service within the market.
Policy	A course of principles and/or actions set forth by governmental bodies.
Regulator	A government body that supervises a particular activity within their jurisdiction.
Strategy	A set of general directions related to a specific subject set forth by a governmental body.
Regulator	A government body that supervises a particular activity within their jurisdiction.

Abbreviations

ACEZ	Association of Consulting Engineers of Zambia
CASO	Compressed Air System Optimisation
CFL	Compact Fluorescent Lights
CMZ	Chamber of Mines of Zambia
CPPM	Cost-Plus Pricing Model
EE	Energy Efficiency
EIZ	Engineering Institution of Zambia
EnMS	Energy Management System
ERB	Energy Regulation Board
ESCO	Energy Service Companies
EV	Electric Vehicle
FM	Fuel Marking
GRZ	Government of the Republic of Zambia
GWh	Gigawatt Hour
HFO	Heavy Fuel Oil
IFI	International Financial Institution
INDENI	INDENI Petroleum Refinery Company Ltd
ktoe	Kilotonne of Oil Equivalent
LDV	Light-Duty Vehicle
LPG	Liquefied Petroleum Gas
MDD	Management Development Division
MEP	Minimum Energy Performance
MMT	Methylcyclopentadienyl Manganese Tricarbonyl
MCTI	Ministry of Commerce, Trade and Industry
MoE	Ministry of Energy
MIHUD	Ministry of Infrastructure, Housing and Urban Development
MSO	Motor System Optimisation
Mt	Megatonne
MoTL	Ministry of Transport and Logistics
MW	Megawatts
NDP	National Development Plan
NEP	National Energy Policy
NWASCO	National Water Supply and Sanitation Council
OMC	Oil Marketing Company
PJ	Pentajoule
PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable Energy
REA	Rural Electrification Authority
SADC	Southern Africa Development Community
SO	Strategic Objective
TAZAMA	Tanzania Zambia Mafuta Pipelines Limited
TDAU	Technology Development and Advisory Unit of the University of Zambia
TPPL	TAZAMA Petroleum Products Limited
UNZA	University of Zambia
USD	United States Dollar
ZABS	Zambia Bureau Of Standards
ZACCI	Zambia Chambers of Commerce and Industry
ZAM	Zambia Association of Manufacturers
ZamStats	Zambia Statistics Agency
ZDA	Zambia Development Agency
ZEMA	Zambia Environmental Management Agency
ZENGO	Zambia Energy and Environmental Organization
ZESCO	ZESCO Limited
ZGEN	Zambia Gender and Energy Network
ZIA	Zambia Institute of Architects
ZMW	Zambian Kwacha
ZNFU	Zambia National Farmers Union

Executive Summary

The efficient use of energy is of great importance to a nation's development and economic independence. The Government of the Republic of Zambia (GRZ) has set ambitious development goals, and energy security is vital to achieving them. The Energy Efficiency Strategy and Action Plan (EESAP), the first in the history of Zambia, with its set of prescribed actions, was developed to support that purpose. The EESAP will be reviewed periodically to reflect future needs.

The EESAP stems from the principles of the National Energy Policy 2019 (NEP 2019). The NEP 2019 has played a crucial role as a guide to the energy sector in Zambia. The NEP 2019 was preceded by the National Energy Policy 2008 (NEP 2008) which endeavoured to help achieve macro-economic objectives regarding sustainable energy development and the creation of a market environment promoting increased private sector participation. Due to changes in the local and global energy sectors, NEP 2008 was revised to develop NEP 2019.

The EESAP contains the Strategic Objectives (SOs) and the accompanying set of actions necessary to achieve the overall objective of the NEP 2019. Ultimately, this objective is optimal energy-resource use to meet Zambia's domestic and non-domestic needs at the lowest total economic, financial, social, environmental and opportunity costs along with the establishment of Zambia as a net exporter of energy.

This first EESAP is built with the vision of creating a firmly established Energy Efficiency (EE) market in Zambia by 2030, with most stakeholders being keen to reduce their expenditures and enhance their competitiveness by investing in energy-saving technologies and practices within almost all economic sectors. To realise this vision, measurable time-bounded targets have been specified to achieve an annual decrease in the Total Primary Energy Supply (TPES) of 2% until the year 2030 over a period of 12 years, with 2018 as a base year. In 2030, Zambia's energy intensity should be at 76% of the 2018 value, as shown in Figure 1.

To achieve this 2030 energy intensity target, specific SOs were developed and are elaborated throughout the first section of the EESAP. This is followed by a detailed Action Plan that will support the successful achievement of the target. Guided by the NEP 2019, the SOs are designed to enable and support actions that will expand the deployment of energy-efficient technologies and practices by creating a platform to remove barriers and provide effective and affirming demonstrations of technologies and practices that reduce energy consumption.

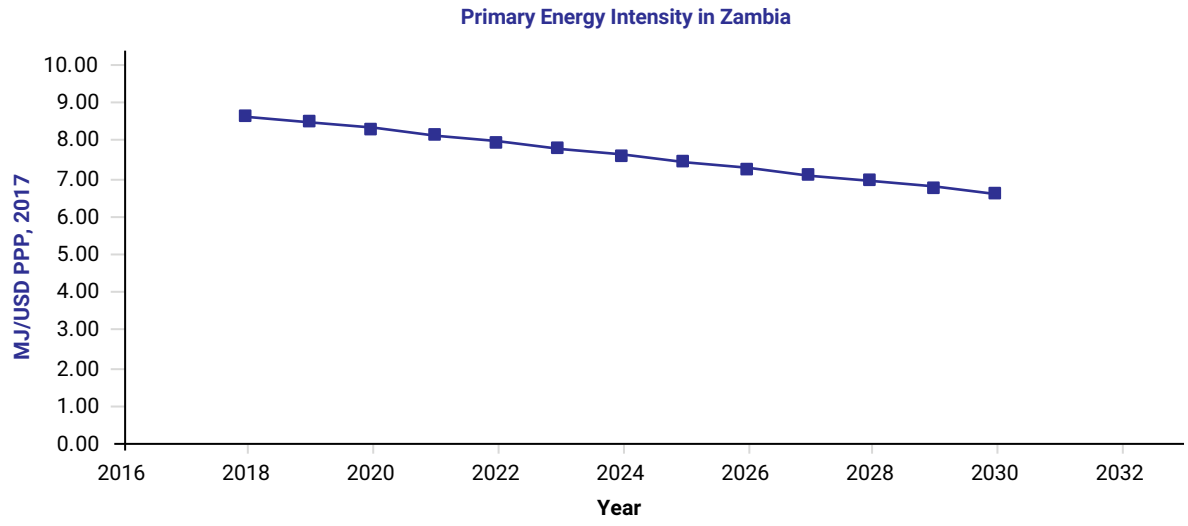

Figure 1. Target Primary Energy Intensity Decrease from 2018 to 2030

A summary of the SOs as pillars for achieving the aforementioned targets is given as follows:

(1) **Strategic Objective 1 –** To develop and establish a regulatory framework to support energy efficiency in accordance with the NEP 2019;

(2) **Strategic Objective 2 –** To develop a common strategy to promote the utilisation of best practices in industry by developing and adopting energy efficiency benchmarks specific to the Zambian industrial sector;

(3) **Strategic Objective 3 –** To adopt market-based mechanisms to integrate energy efficiency in business practices;

(4) **Strategic Objective 4 –** To utilise energy pricing as a tool to promote energy efficiency technologies;

(5) **Strategic Objective 5 –** To utilise awareness and capacity building programmes for institutions, experts and the public to promote energy-saving policies and adopt standards and procedures, while empowering women to support energy efficiency decisions and activities; and

(6) **Strategic Objective 6 –** To ensure coordinated collaboration of all stakeholders to achieve energy efficient economy.

This EESAP specifically focusses on the residential, industrial and transport sectors. The selection of these sectors is based on the current energy landscape and a situation analysis of the energy supply and consumption profiles in Zambia. The successful implementation of this EESAP will drive the country's economic growth by harnessing its EE potential, reducing energy costs, promoting energy services and reducing greenhouse gas emissions.

A summary of the measures and actions necessary for achieving the six EESAP SOs are presented in the table below.

Table 1: Matrix of Energy Efficiency Action Plan Relevant to the Strategic Objectives

EE Actions	Targets	Expected Outcomes	Timeline	Implementation Bodies
SO1: To develop and Establish a Regulatory Framework to Support Energy Efficiency.				
LPG Cylinder Exchange Programme (Ch. 5.1.2., Table 5)	*a)* Adopt legislation for cylinder exchange programme.	*i)* Access to clean cooking solutions increased.	2022–2024	MoE, ZABS, ERB
Sustainable Building Code (Ch.5.2.1.2, Table 13)	*a)* Develop an obligatory sustainable building code for new construction projects.	*i)* Mandatory building code for new buildings developed. *ii)* Building energy consumption reduced. *iii)* Final energy consumption projections based on energy use and building category determined and compared to historic data.	2022–2030	NCC, MoE, MIHUD
LED Lighting (Ch. 5.1.2.,Table 9)	*a)* Distribute 1 million LED lamps for the households by 2023. *b)* Distribute 3.5 million LED lamps at half price with a guarantee of 20,000 working hours by 2027. *c)* Distribute 11.5 million LED lamps by 2032.	*i)* Incandescent lamps phased out. *ii)* CFL lamps upgraded to LED lamps. *iii)* Financial incentive schemes for lighting upgrades established.	2022–2030	ZESCO, MoE
Fuel Blending Programme (Ch. 5.3.2., Table 24)	*a)* Attain 5% biodiesel and 10% bioethanol blending ratios in diesel and petrol engines, respectively.	*i)* Use of blended fuels for combustion engines popularised.	2022–2026	MoE, MoTL, MoA, BAZ, MCTI, ZAM, ZACCI, CMZ, Land Owners, Biofuel Producers, Traders

EE Actions	Targets	Expected Outcomes	Timeline	Implementation Bodies
SO2: To develop a Common Strategy to Promote the Utilisation of Best Practices in Industry by Developing and Adopting Energy Efficiency Benchmarks Specific to the Zambian Industrial Sector.				
National Benchmark Programme (Ch.5.2.2., Table 15)	*a)* Establish national energy benchmark for selected heavy industries.	*i)* Energy practices improved and energy consumption reduced.	2022–2025	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Mandatory Energy Audits and ISO 50001 (Ch.5.2.2., Table 16)	*a)* Attain 15% energy savings for the industry and agriculture sectors.	*i)* Mandatory energy audits conducted for all industrial facilities and definition of energy saving opportunities. *ii)* EnMS implemented according to the ISO 50001 standard.	2022–2026	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Voluntary Energy Audit Programme to Reduce Energy Consumption (Ch.5.2.3., Table 19)	*a)* Attain 10% energy savings for industry and 15% savings for the water utilities and agriculture sectors.	*i)* Awareness of EE and RE opportunities increased. *ii)* No-/low-cost energy-saving opportunities and behaviour change implemented.	2023–2025	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs, Water Utilities
SO3: To adopt Market-Based Mechanisms to Integrate Energy Efficiency in Business Practices.				
Promotion of ESCO Model (Ch.5.2.3., Table 20)	a) Establish ESCO development programme. *b)* Develop funding mechanism for ESCO financing. *c)* Strengthen technology service providers.	*i)* EE and RE projects in Zambia deployed through Green Economy Financing Mechanism. *ii)* A market for the ESCO business model created.	2025–2030	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Energy Labelling for Appliances (Ch.5.1.2., Table 11)	*a)* Develop energy labelling code for four appliances (light bulbs, refrigerators, air conditioners and tvs).	*i)* Energy labelling code developed. *ii)* Minimum Energy Performance Standards developed.	2022–2025	MoE, MCTI, ERB, ZABS, ZRA

EE Actions	Targets	Expected Outcomes	Timeline	Implementation Bodies
DSM Programme (Ch.5.2.3., Table 18)	*a)* Deploy energy-efficient equipment in the market (20,000 refrigerators and 10,000 inverter ac units).	*i)* Energy-efficient appliances utilised throughout different economic sectors in Zambia.	2023–2026	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
SO4: To utilise Energy Pricing as a Tool to Promote Energy Efficiency Technologies				
Produce Biogas from Organic Waste for Cooking (Ch. 5.1.2., Table 3)	*a)* Attain 20% increase of biodigesters across the country.	*i)* Biogas technologies market uptake created. *ii)* Access to clean cooking solutions increased. *iii)* Enabling environment for ESCO business created.	2024–2030	MoE, Line Ministries
Pay As You Go Cooking Solutions (Ch. 5.2.1., Table 6)	*a)* Deploy 100,000 efficient stoves by 2027. *b)* Attain 10,000 MT of wood pellets usage per year.	*i)* Access to clean cooking solutions increased. *ii)* Inefficient stoves and open firewood systems substituted with efficient pellet stoves. *iii)* Socioeconomic benefits realised.	2022–2027	ERB, MoE
LPG and Biomass Cooking Systems (Ch. 5.1.2., Table 4)	*a)* Deploy biomass and improved cookstoves. *b)* Establish LPG distribution and storage centres in Northern, Eastern and Central Provinces.	*i)* Access to clean cooking solutions increased. *ii)* Inefficient stoves and open firewood systems substituted with LPG and efficient cookstoves.	2022–2027	MoE, Line Ministries, ZABS

EE Actions	Targets	Expected Outcomes	Timeline	Implementation Bodies
Energy-Efficient Cooking (Ch. 5.1.2., Table 7)	*a)* Attain 20% of cooking using energy-efficient cooking	*i)* Access to clean cooking solutions increased. *ii)* Inefficient stoves and open firewood systems substituted with energy-efficient cooking systems.	2022–2030	MoE, ZESCO
SO5: To implement Awareness and Capacity Building Programmes for Institutions, Experts and the Public to Promote Energy-Saving Policies and Adopt Standards and Procedures, while Empowering Women to Support Energy Efficiency Decisions and Activities.				
Awareness and Capacity Building Programmes for Light Industry (Ch.5.2.3., Table 17)	*a)* Attain 15% energy savings for light industries, including water utilities.	*i)* Awareness raised regarding the importance of EE and RE projects. *ii)* Capacity building programmes established for EE measures for the industrial and commercial sectors. *iii)* No-/low-cost measures applied. *iv)* Awareness of the negative environmental impacts of using charcoal undertaken.	2022–2024	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs, Water Utilities
Awareness and Capacity Building Programmes for Heavy Industry (Ch.5.2.2, Table 14)	*a)* Attain 10% energy savings for heavy industries.	*i)* Capacity building programmes established/conducted regarding EE measures for different heavy industries.	2022–2024	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Vehicle Tuning Programme (Ch.5.3.2., Table 23)	*a)* Vehicle tuning programme introduced and tuning stations established in all Zambian provinces.	*i)* Cost savings on fuels promoted for end-users to join the initiative. *ii)* New business models generated and employment increased.	2022–2024	MoE, MoTL, NGOs

EE Actions	Targets	Expected Outcomes	Timeline	Implementation Bodies
SO6: To ensure Coordinated Collaboration of all Stakeholders to Achieve Energy Efficient Economy.				
Development of Energy-Efficient Building Materials (Ch.5.1.2., Table 10)	*a)* Develop energy-efficient building materials using elements from the local environment to reduce energy losses in building.	*i)* Methodology and machinery to produce energy-efficient building blocks and other building materials developed.	2022–2025	MoE, TDAU, ZABS, ERB, MCTI
Promote Increased Use of Public Transport (Ch.5.3.2., Table 25)	*a)* Transition 5% of private car commuters to public transportation.	*i)* Access to affordable, energy-efficient and high-quality mass transit among citizens increased.	2022–2028	MoTL
Eco-Driving Programme (Ch.5.3.2., Table 26)	*a)* Conduct a market potential and gap analysis study.	*i)* Next steps towards the future utilisation of EVs understand tho.	2025–2030	MoE, MoTL, IFIs
Railway Development Programme (Ch.5.3.2., Table 27)	*a)* Attain 15% increase in cargo volumes and passengers transported by rail.	*i)* Energy consumption reduced on implementation of the National Railway Transport Action Plan.	2025–2030	MoTL, IFIs

1. Introduction

1.1. Overview

Zambia has a population of 17.9 million (base year: 2019),[1] which is growing at close to 3% annually. More than half of the population lives in rural areas; however, the population density is higher in urban areas as compared with rural ones. Population growth in recent years has resulted in an increased demand for energy resources, such as wood fuel, due to its high availability and low cost.

The cumulative growth rate pattern of the Total Primary Energy Supply (TPES) shows that in 2018, the total energy supply had an approximate increase of 55% compared to its value in 2008, with an average yearly increase of 4.5%. This pattern is expected to continue given the projected growth of the Zambian economy.

In 2018, the TPES in Zambia reached 525 PJ. The total energy supply comprises five categories: coal, petroleum products, hydropower, bioenergy and imported electricity.

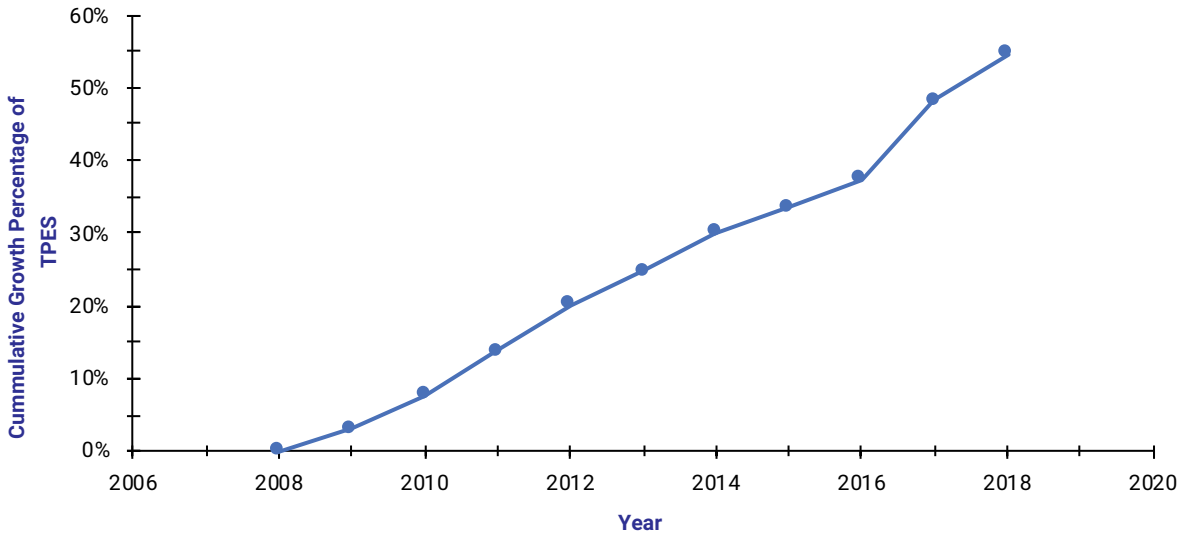

Figure 2: Primary Energy Consumption Cumulative Growth Rate[2]

The population in Zambia has exhibited a growth pattern similar to that of the primary energy supply (Figure 3). The average cumulative growth rate of the population is 3.45%, which is notably lower than the average annual growth rate of the primary energy supply of 4.5%. This slight difference is due to the economic growth of the country.

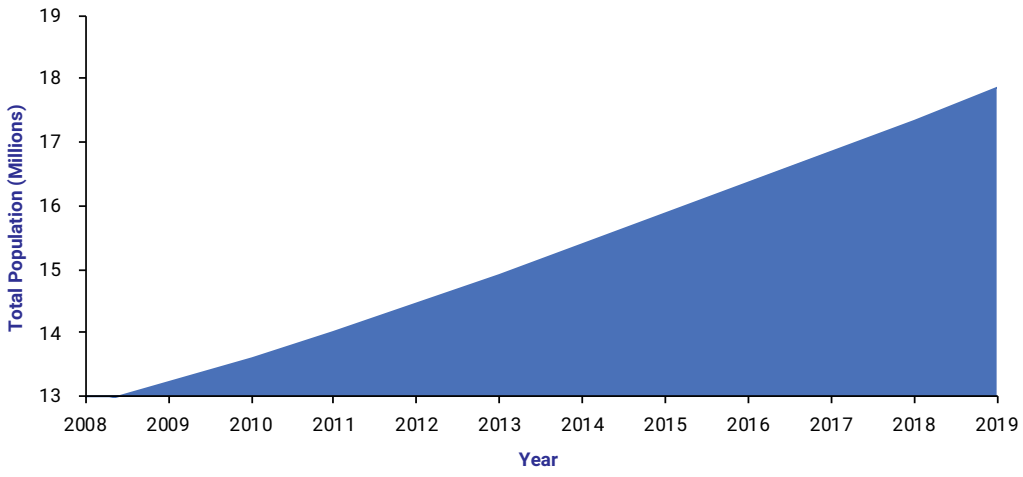

Figure 3: Population Growth in Zambia[2]

1 https://www.zamstats.gov.zm/
2 https://www.iea.org/countries/zambia

1.2. National Energy Policy as a Trigger to Sustainable Development Goals

Energy Efficiency (EE) is a concept that goes beyond reduction of natural resources and fossil fuels consumption. It touches on a broad range of factors, including economic prosperity due to increased profits and reduced energy bills; new business opportunities for individuals and firms; expansion of trade; supply chain of green equipment and technologies, as well as human health improvement, environmental protection and restoration.

Zambia is endowed with a wide range of energy resources, including solar, hydro, wind, geothermal, coal, uranium and biomass. The Government of the Republic of Zambia (GRZ) has consistently developed its energy policy to achieve the sustainable energy sector. The first major energy sector reforms in Zambia occurred in the 1990s with the formulation of the National Energy Policy 1994 (NEP 1994), the establishment of the Energy Regulation Board (ERB), the abolishment of the Zambia Electricity Supply Corporation (ZESCO) Limited monopoly and the participation of several private operators.

The energy policy has played a vital role in providing guidance within the energy sector in Zambia. Between 2008 and 2019, the GRZ was implementing the NEP 2008. The NEP 2008 attained its macro-level economic policy objectives inclusive of sustainable energy development, which led to enhanced private sector participation. Following developments in the energy sector, the GRZ revised the NEP 2008 and developed the NEP 2019 to address the evolving needs of the sector. The NEP 2019 aims at achieving optimal energy resource utilization while meeting the country's needs and eventually establishing it as a potential net exporter of energy.

The successful implementation of the NEP 2019 objectives requires a solid strategy with a deeper definition of measurable and time-bound objectives. Such a strategy requires definition of specific measures that would result in energy savings across Zambia, accompanied by a relevant action plan. It is for this purpose that the Energy Efficiency Strategy and Action Plan (EESAP) was developed.

The NEP 2019 outlines a general framework for sustainable development of the energy sector based on its specific objectives. The document envisions the development of the EE market by increasing institutional and human capacity, laying a legal framework foundation, promoting the efficient use of biomass and other energy resources and promoting private sector participation and innovation.

The Strategic Objectives (SO) of the EESAP are designed in line with the NEP 2019, and are further supported by the EE actions outlined in this document. The objective of the EESAP is to drive economic growth and reduce the cost of energy services while improving the quality of life for Zambians. This will be achieved through the promotion of short- and medium-term EE actions developed as part of the EESAP. It is envisaged that the EESAP will facilitate expansion of the deployment of energy-efficient technologies and practices by creating a platform to address barriers to the private sector investment and provide effective and affirming demonstrations of technologies and practices that reduce energy consumption.

2. Situation Analysis

2.1. Total Primary Energy Supply

Zambia has five main energy supply sources: coal, petroleum products, hydropower, bioenergy and imported electricity. The following chart outlines the primary energy supply in Zambia in 2016. It is worth mentioning that in that same year, approximately 87% of the TPES in Zambia was produced locally, while the remaining 13% was imported.

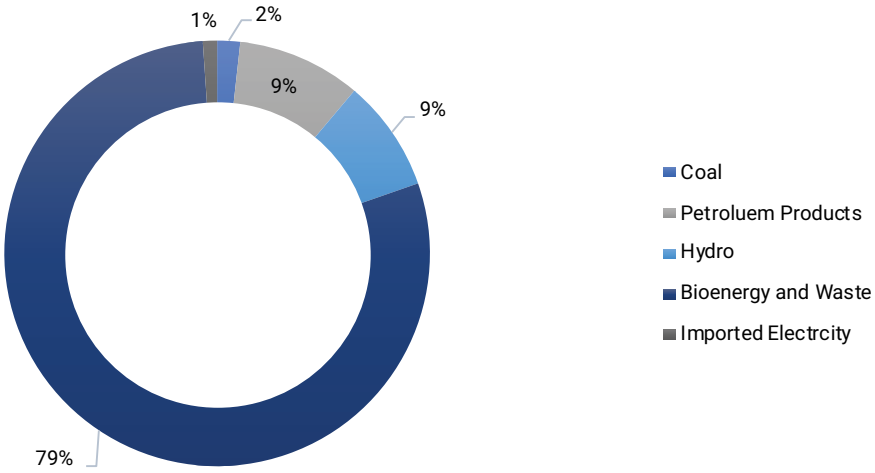

Figure 4: Primary Energy Supply Breakdown in Zambia in 2016[3]

Bioenergy dominated the Zambian energy supply in 2016, with a share of 79%. This was followed by hydropower and petroleum products, each with a share of 9%. Imported electricity, solar photovoltaic (PV) energy and coal had minor shares of the TPES.

The sectorial energy usage in 2016 was 365.8 PJ. Figure 5 shows a breakdown of the sectorial energy usage.

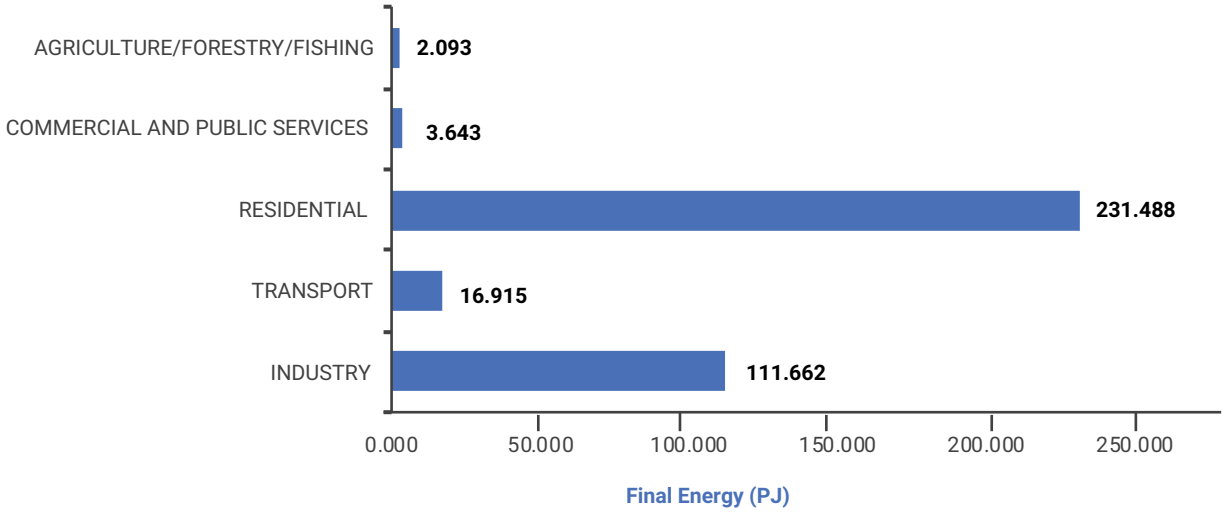

Figure 5: Sectorial Energy Breakdown in Zambia in 2016[4]

The two largest sectors that consumed the most energy in 2016 were the residential and industrial, accounting for 63.2% and 33% of total energy consumption, respectively. The transport sector accounted for 4.6%.

3 Source: Zambia, Energy Efficiency Quick Win Actions and Specific Electricity Indicators (Deliverable 7). March 2018.

Wood fuel is the primary source of residential energy in Zambia. A majority of the population in rural areas is largely dependent on firewood for cooking and heating, while those in urban areas largely depend on charcoal. The high dependence on wood fuel is largely due to lack of access and high costs associated with electricity and other alternatives for heating and cooking, such as Liquefied Petroleum Gas (LPG) and solar technologies.

2.2. Electricity

Zambia's electricity supply grew by 49.6% over the 10-year period from 2005 to 2015, averaging 4.95% annual growth. Electricity consumption grew by 51.31% over the same 10-year period, averaging 5.13% annual growth.[4]

The country's total installed electricity generation capacity is 2,981.23 MW.[5] This includes hydropower, coal, heavy fuel oil, diesel and solar PV, representing 2,398.5 MW, 300 MW, 110 MW, 83.6 MW and 89.1 MW, respectively. Figure 6 shows a breakdown of the national electricity generation.

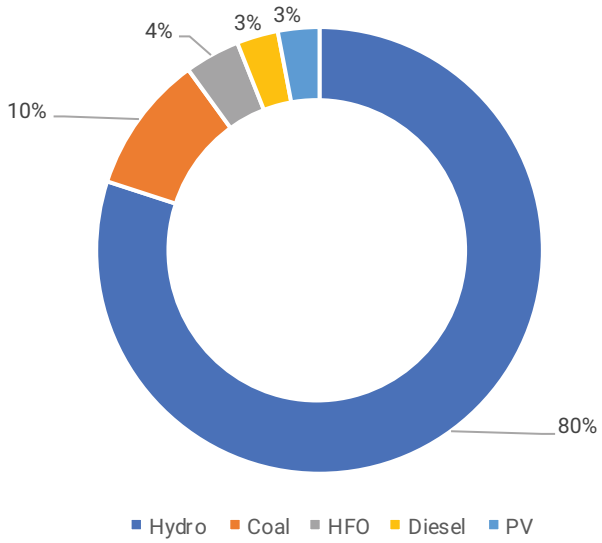

Figure 6: Electricity Generation Breakdown in 2019

In 2015–2016, Zambia experienced poor rainfall pattern compared to previous years. As most of the electricity generated in the country comes from hydropower plants (84.6% in 2018), the overall electricity generation in 2016 declined by 15% compared to 2015, reaching the lowest point of 11 TWh. In 2018, the electricity generation was still lower than that in 2014 by 2.5% (Figure 7).

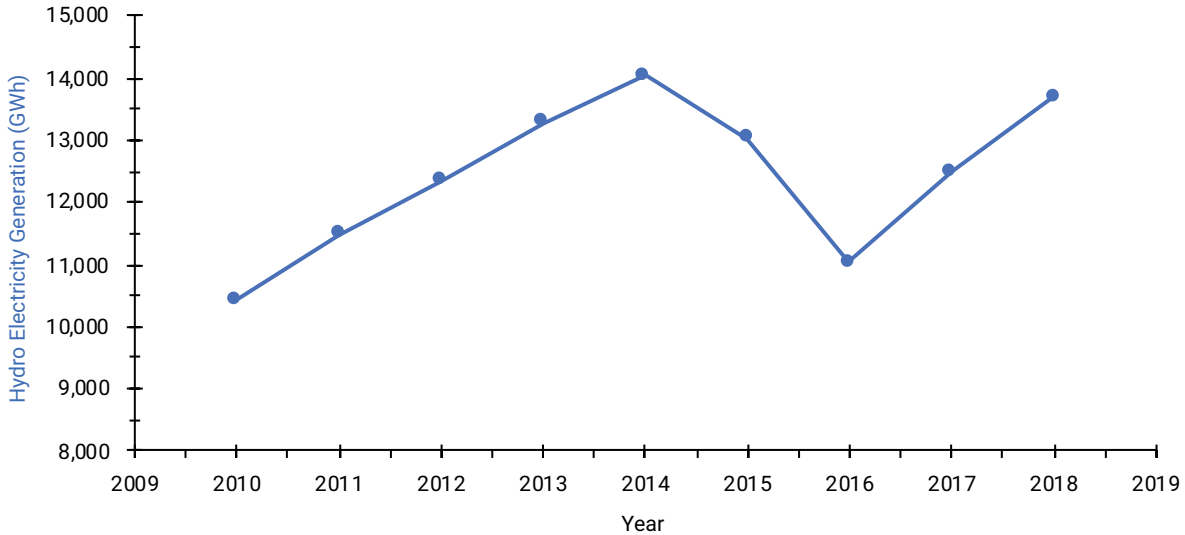

Figure 7: Electricity Generation from Hydropower[6]

4 SE4ALL – Eastern and Southern Africa. March 2018. ES-0068: Zambia, Energy Efficiency Quick Win Actions and Specific Electricity Indicators. Deliverable 13.
5 ERB. 2020. The Energy Sector Report 2019. Energy Regulation Board. Lusaka.
6 Key energy statistics in Zambia. IEA, 2018.

In 2018, the largest consumer of electricity was the mining industry, with a 50.4% (6,359.44 GWh) share of the total energy consumption. This was followed by domestic consumption, which accounted for 31.9% (4,022.54 GWh). The remaining sectors accounted for 17.7% (2,143.71 GWh). In 2018, 34% of the Zambian population had access to electricity, 69% of whom were in urban areas, while 8% were in rural areas[7] (Figure 8).

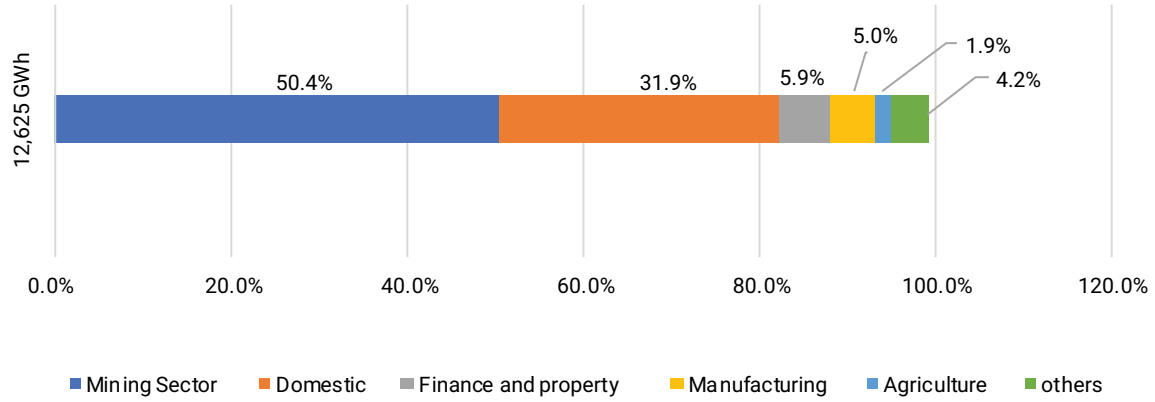

Figure 8: Sectoral Electricity Consumption in 2019

2.2.1 Tariff Restructuring

As of January 1, 2020, the ERB approved a 113% tariff increase to migrate towards cost reflective tariffs and attract investments in the energy sector.

2.2.2 Power Factor Correction

One of the main factors influencing the supply-side efficiency and power quality through the distribution network is the power factor. To improve the grid quality, the government gazetted Statutory Instrument (SI) No. 79 of 2013, which provides that the minimum accepted power factor at the connection point be 92% lagging or higher.

2.2.3 Present Measures Undertaken Towards Energy Efficiency

To date, measures concerning EE have been implemented in an *ad hoc* manner. Major EE interventions have included the development of technical standards for energy-consuming equipment with Minimum Energy Performance Standards (MEPS) applied to lighting, rotating equipment and, more recently, solar water heaters. This work has been driven by ERB and the Zambia Bureau of Standards (ZABS). Once the standards are adopted, there will be need to prescribe enforcement mechanisms.

In 2015, Zambia experienced power shortages that led the GRZ to introduce a range of EE interventions. These include interventions on both the supply and demand sides. ZESCO's Demand Side Management (DSM) department implemented the following interventions: a Compact Fluorescent Lamp (CFL) programme; a programme focussed on the installation of 'solar geysers' for hot water production; and a programme for free energy audits aimed at improving the power factor.

The CFL programme encouraged the efficient use of energy and saved an estimated 45 MW of capacity through the provision of 1 million energy-saving CFLs. For this reason, the exercise was adopted by ZESCO's DSM department and continued as an internal function. As of June 30, 2015, over 2 million CFLs had been procured internally for further distribution.[8]

2.3. Petroleum

Zambia meets its demand for petroleum products through commingled feedstock imported via the Tanzania Zambia Mafuta Pipelines Limited (TAZAMA) pipeline and refined petroleum products (also known as finished

7 Demographic and Health Survey. 2018.

8 Increased Access to Electricity Services Project. Document of the World Bank, Report No: ICR3523. January 2016.

petroleum products) imported via road and, to a lesser extent, by rail.

The TAZAMA pipeline is designed to handle 1.1 million metric tonnes (MT) of commingled feedstock per year. This petroleum is refined at the Indeni Petroleum Refinery in Ndola into finished petroleum products that account for 40% of the market share. Overall, imported refined petroleum products contribute 60% of the market share.

Petroleum products account for 9.4% of the total national energy demand. The main key players in the petroleum sector are Indeni Petroleum Refinery Company Ltd (Indeni), TAZAMA and Tazama Petroleum Products Limited (TPPL), along with Oil Marketing Companies (OMCs) and retailers. Among petroleum products, crude oil and finished products are mainly imported from the middle east. The amount of imported petroleum feedstock in 2019 (704,657 MT) increased by 13.9% compared with 2018 (618,441 MT). Due to market demand, the number of imported cargoes increased from six in 2018 to seven in 2019.[9]

The 1,710 km TAZAMA pipeline is old and has corroded, reducing its output to 800,000 MT per year. At the end of 2019, the crude oil contribution to national demand was 43.3%. Indeni has a nameplate capacity of 1.1 million MT per year, but over the years, the annual production capacity has been reduced to 850,000 MT owing to the wear and tear of the plant. Indeni's annual production is heavily reliant on petroleum feedstock received from TAZAMA. The national consumption of petroleum includes heavy fuel oils, Liquefied Petroleum Gas (LPG), jet A1, kerosene, unleaded petrol and diesel.

The petroleum products are then distributed to various government-owned depots, where OMCs uplift the finished products and distribute them to their own depots, service stations and commercial customers. The growth rate of petroleum products is forecast to have an average of between 3% and 6.8% up to 2030.

To augment the petroleum supply, the government is promoting the use of biofuels in the transport sector. Biofuel production is considerably lower than petroleum production, with only one commercial producer registered to date. A number of factors are delaying increased investment in biofuels, including a lack of mandatory blending ratios, a lack of demonstrated capacity to produce, delays in agreement on producer prices, industry incentives across the value chain and a lack of blending facilities.

With regard to such challenges, the petroleum subsector is shaped by fluctuations in international oil prices, fluctuations in the exchange rate of the Zambian Kwacha (ZMW) against major trading currencies (Figure 9), an overdependence on imported petroleum products and inadequate petroleum storage and transportation infrastructure. The following graph shows the historical exchange rate between the ZMW and United States Dollar (USD).

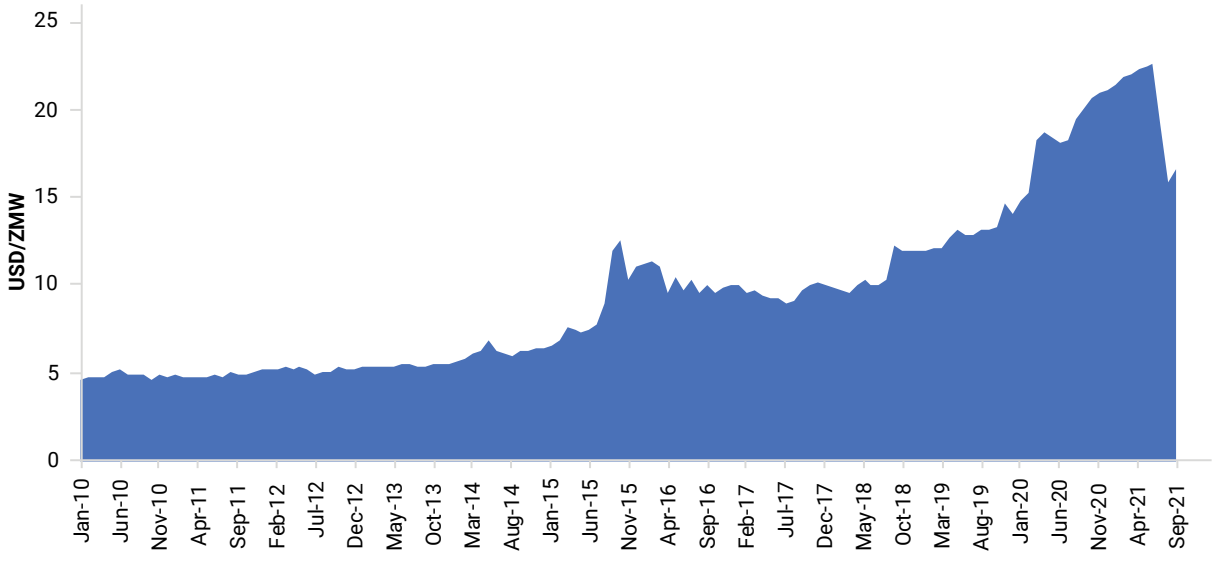

Figure 9: USD/ZMW Historical Exchange Rate

9 The Demand and Market Structure for Liquified Petroleum Gas (LPG) in Zambia. Energy Regulation Board, December 2019.

The rate increased from ZMW 11.95/USD in January 2019 to ZMW 21.33/USD in January 2021, with annual increases of 23.3% and 44.7% for the years 2019 and 2020, respectively. However, due to government efforts to strengthen local manufacturing and improve the national economy, the rate decreased reaching ZMW 16.6/USD in September 2021.

National petroleum product consumption increased from 1,344,908 MT in 2018 to 1,453,190 MT in 2019, reflecting an increase of 8.1%. Kerosene consumption has been decreasing since 2015 due to low market demand, as it has been substituted at the household level by modern energy sources, such as electricity, solar lamps and batteries.

In 2019, the retail sector dominated petroleum consumption (97.4%), followed by the non-mining sector (2.4%). In terms of diesel consumption, the retail, non-mining and mining sectors represented 37.7%, 28.3% and 32.3%, respectively. The following graph breaks down the consumption of petroleum products in terms of economic sector.[10]

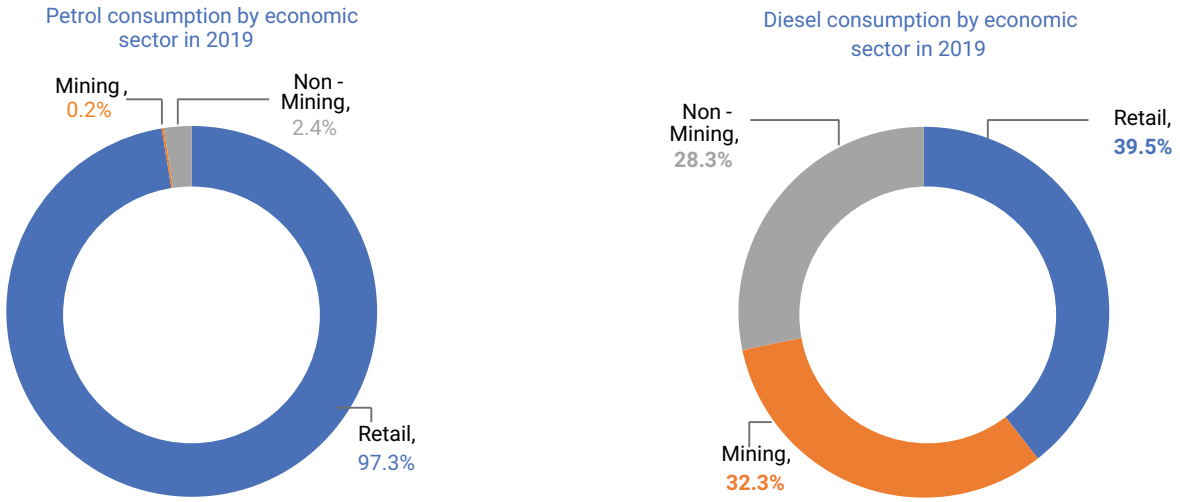

Figure 10: Consumption of Petroleum Products by Economic Sector in 2019

In February 2019, fuel prices were reduced and then revised upwards in September and December 2019. The alterations in fuel prices were largely due to the devaluation of ZMW against USD and the rise of crude oil prices on the global market.[11]

In line with the National Development Plans (NDPs), the government has continued increasing the in-country strategic fuel reserves to ensure security of supply.

There are three mandatory standards[12] regarding fuel quality with a focus on sulphur content: 5,000 Parts Per Million (PMM) for gas oil refined locally (due to the limitations of the refining machinery) and 50 PPM for the low sulphur gas oil.

The ERB has developed blending standards for B5 diesel and E10 petrol. However, these standards are not compulsory.

There are a number of different taxes on various petroleum products, as outlined in the following table.

10 Energy Sector Report. Energy Regulatory Board, 2019.
11 Fuel Marking Programme in Zambia. Energy Regulatory Board, 2020.
12 There is a discrepancy of data pertaining to the production of the national refinery between the SLET document and the NEP 2019 for Zambia. The SLET data is more conservative.

Table 2: Customs and Taxes on Petroleum Products

Item	Petrol	Diesel	Keroseneene	HFO	Jet A-1	LPG
Customs Duty (Imported by an Entity other than the Government)	25%	25%	-	5%	-	15%
Customs Duty (Imported by the Government)	0%	0%	-	5%	-	15%
Strategic Reserve Fund	0.15/L	0.15/L	0.15/L	0.15/Kg	0.15/Kg	0.15/Kg
ERB Fees	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Value-Added Tax	16%	16%	-	16%	-	16%

2.3.2 Liquefied Petroleum Gas

(a) Current Situation

Despite LPG's positive attributes, including its burning characteristics and environmental friendliness, it has continued to see low market uptake in Zambia in comparison to other forms of energy, especially charcoal, wood fuel and electricity for cooking and space heating. According to the Zambia Statistics Agency (ZamStats), LPG was the least-used source of energy for cooking in 2015, accounting for only 0.1% of household cooking use compared to 50.7% for firewood and 32.9% for charcoal.

Historically, local demand for LPG in Zambia has been very low at the household level, which has indirectly contributed to gas flaring in refineries. There are four reasons LPG has predominantly been confined to commercial sectors: the public perception that LPG usage is not safe; challenges with accessibility; the use of other energy sources such as charcoal and electricity; and the high cost of LPG appliances. The average LPG consumption in Zambia was found to be 0.42 kg per capita[13] per year compared to Africa's average of 3 kg per capita per year.

Licensed LPG importers mainly import LPG from South Africa, and there has been an increase in the number of LPG retailers in Zambia since 2015, when 48 key players existed. In 2019, the number had increased by 25% to 60. The LPG market in Zambia is intermediary in nature. It includes several buyers and dealers who resell the LPG to commercial customers and export markets (Figure 11). The traders should be encouraged to streamline their marketing messages on the EE-related benefits of LPG usage.

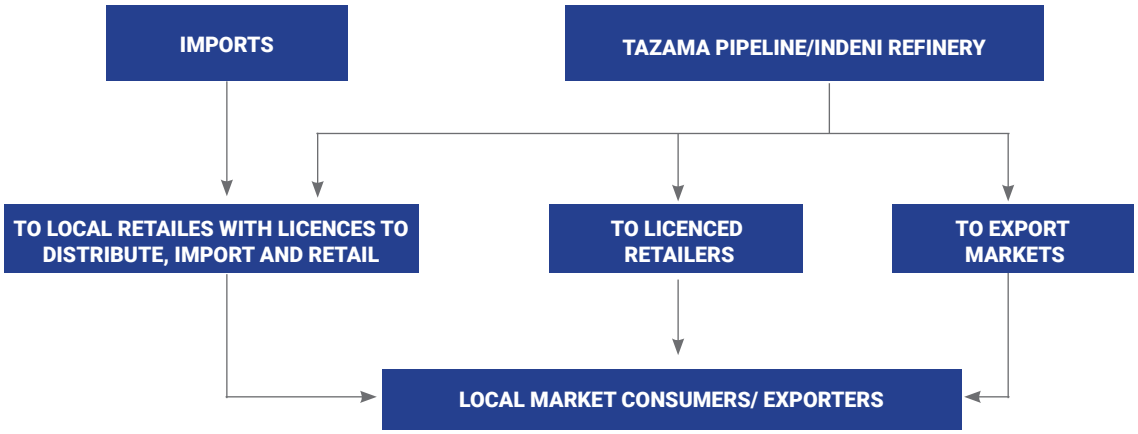

Figure 11: LPG Value Chain in Zambia[14]

13 The Demand and Market Structure for Liquified Petroleum Gas (LPG) in Zambia. Energy Regulation Board, December 2019.
14 Recreated from: The Demand and Market Structure for Liquified Petroleum Gas (LPG) in Zambia. Energy Regulation Board, December 2019.

(b) Liquefied Petroleum Gas Supply and Demand

Figure 12 below shows the production, imports and local consumption of LPG from 2016 to 2018. Based on the presented values, the average annual production of LPG was 4,426 MT, with average annual imports of 985 MT. It is also noted that the average demand of LPG in the local market was 4,830 MT. The surplus amounts of LPG were exported,[15] mainly to Zimbabwe, which had the highest value, accounting for 87.2%, followed by Kenya at 7.3%. Rwanda and Uganda had the lowest export values, accounting for a total of 0.4%.

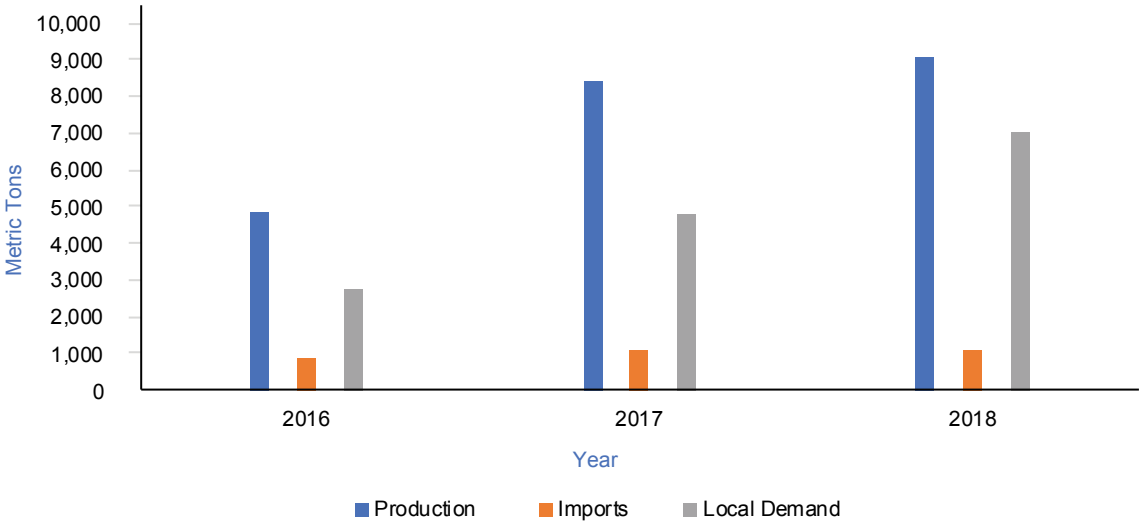

Figure 12: LPG Supply and Demand In Zambia

(c) Product Marketing and Pricing

Zambia has established specific standards that identify three grades of LPG, namely, LPG gas mixture, commercial propane and commercial butane. At the same time, there are two methods of LPG cylinder ownership and exchange in Zambia: company ownership and customer ownership. For the company ownership of cylinders, the retailer can either loan or lease these cylinders to customers, and the customer can exchange the empty cylinder for the LPG filling price. For this scheme, the company is responsible for filling and supplying safety cylinders to its customers. In the customer-owned cylinder scheme, there are two modalities:

(i) Centralised filling, according to which the customer exchanges a legally owned cylinder for a typical filled one of the same size and brand; and

(ii) Bulk distribution, according to which each customer refills a cylinder he/she owns.

The wholesale price is set by ERB using a typical CPPM, while the retail price is determined by the local market. Based on the market export price, TAZAMA makes the decision as to whether to sell LPG locally or export it.[16] LPG pricing in the commercial sector is governed by negotiations between customers and suppliers. Nonetheless, the growth in LPG sales suggests that with more households switching to LPG, retail prices are important as it is imperative to ensure that customers are not unnecessarily overcharged.

15 ZRA, 2018.

16 Source: The Demand and Market Structure for Liquefied Petroleum Gas (LPG) In Zambia. ERB, 2019.

2.4. Coal

Coal represents 1% of the TPES in Zambia.[17] Zambia's current proven coal reserves are estimated to house approximately 30 million MT.[18] The current annual demand for coal is approximately 240,000 MT, while 15,000 MT of coal is exported to Tanzania, the Democratic Republic of Congo and Malawi on a monthly basis.[19] Coal is mainly consumed by electricity, mining and industry. The generation capacity from coal accounts for 10% of Zambia's total installed capacity. Current practices of electricity production from coal are considered unclean, which poses a challenge in the mobilisation of financing for these projects. This resource has the potential to provide power and improve the security of the electricity supply.

2.5. Wood Fuel

Biomass is the predominant source of energy in Zambia, accounting for 79% of the TPES. The main forms and products of biomass include wood fuel (charcoal and firewood), biogas, pellets, briquettes, biofuel and gel fuel, which are mainly used as household fuels for cooking and heating. Wood fuel is the most widely used fuel for cooking, though its use is considered unsustainable because the harvest of biomass exceeds the regrowth, contributing to climate change and causing negative health effects. Zambia's high dependence on wood fuel is due to a difficult-to-access and unreliable electricity supply, the high cost of efficient alternatives and inadequate enforcement of legislation and coordination among key sector institutions.[19]

In 2015, approximately 5.4 million MT of firewood and 1.69 million MT of charcoal were consumed in Zambia.[20] A breakdown of wood fuel consumption by sector is shown in Figure 13. Households are the main consumers of firewood and charcoal, consuming approximately 79% of firewood and 91% of charcoal in 2015.

Current practices for the use of wood fuel are associated with environmental and health concerns. They are also considered the main driver of deforestation and forest degradation in Zambia. Hence, formalising the wood fuel value chain and conducting the production in a sustainable manner will positively contribute to the national economy.

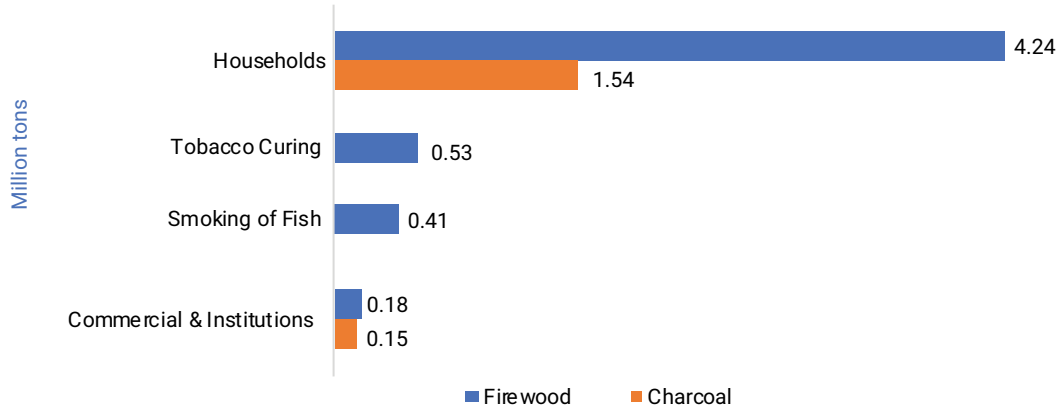

Figure 13: Breakdown of Wood Fuel Consumption in Millions of MT by Sector In 2015[21]

Charcoal production and consumption are highly inefficient: the earth kilns and cookstoves result in large amounts of wastage. Typical earth kilns efficiency ranges between 15%–25%, while the efficiency of ordinary cookstoves (called *mbaula*) is approximately 10%. Most of the charcoal consumed in Zambia is produced by the informal sector from wood on the basis of inefficient technologies. The efficiency of traditional kilns ranges from 10% to 22% but can be increased to as high as 30% to 42%.[21]

17 Zambia SEforAll Action Agenda. Ministry of Energy, 2018.
18 NEP 2019.
19 Energy Sector Profile. Zambia Development Agency, 2015.
20 National Wood Fuel Study. Ministry of Energy, December 2017.
21 National Wood Fuel Study. Ministry of Energy, December 2017.

3. Vision, Rationale and Guiding Principles

3.1. Vision

The vision of the EESAP is to improve the energy value chain through the efficient use of primary energy on the supply side and the efficient management of energy on the demand side to achieve sustainable socioeconomic development aligned with existing policy and national development goals.

3.2. Rationale

The energy sector in Zambia is characterised by inefficiencies at various points in the value chain. Therefore, it is necessary to develop this EESAP, which will help to address these inefficiencies towards the realisation of the NEP 2019 objective for optimising use of energy resources.

3.3. Guiding Principles

The guiding principles for the EESAP, aligned with the NEP 2019, are as follows:

Morality and Ethics	In implementing this strategy, the government will ensure that energy resources are utilised in an ethical manner. It will also ensure that the players in the market uphold morality and ethics in conducting their business.
Patriotism and National Unity	Patriotism and national unity are a cornerstone of socioeconomic development. In the energy sector, infrastructure is key to ensuring the efficient delivery of services. Over the years, the sector has seen vandalism of key energy sector infrastructure. The general public will have to exercise patriotism and national unity to protect ownership of infrastructure.
Social Justice	In implementing this strategy, government will ensure that it protects vulnerable groups in society.
Equality and Non-Discrimination	The government will endeavour not to discriminate in the implementation of energy efficiency programmes and provision of energy services.
Accountability	All stakeholders in the energy sector should be able to explain and account for their actions as well as be open to subject themselves to scrutiny. Government will ensure that all actors will provide information on the energy efficiency services offered in the sector.

3.4. Gender and Energy Efficiency

In order to increase EE on the household level, it is critical to understand the traditional roles and responsibilities of men and women and identify and respond to gender-specific needs and barriers. Approximately 90% of the energy consumed for cooking in the residential sector comes from bioenergy sources, mainly consisting of firewood in rural areas and charcoal in urban areas. The continued use of wood fuel is highly energy inefficient and labour intensive.

In rural households, the task of collecting and transporting firewood is typically the responsibility of women and children, whereas cutting is performed by both women and men. Women also spend considerably longer amount of time cooking or in the cooking area compared to men.

Due to the disproportionate amounts of time that women spend on fuel acquisition and preparation as well as cooking, they are considerably more impacted by energy poverty (i.e. a lack of access to clean energy) and so have less time to engage in income generation as well as educational and recreational activities. There are also negative health impacts associated with cooking with biomass. In Zambia, 25% of households cook inside the home, creating smoke that increases the risks of respiratory diseases and eye problems.

Accordingly, energy-efficient cooking solutions are an important energy requirement for women, as such solutions could reduce their workload and improve their well-being. There is also evidence indicating that access to modern cooking solutions increases the share of cooking among men and boys relative to women and girls, thus contributing to gender equality within the household.

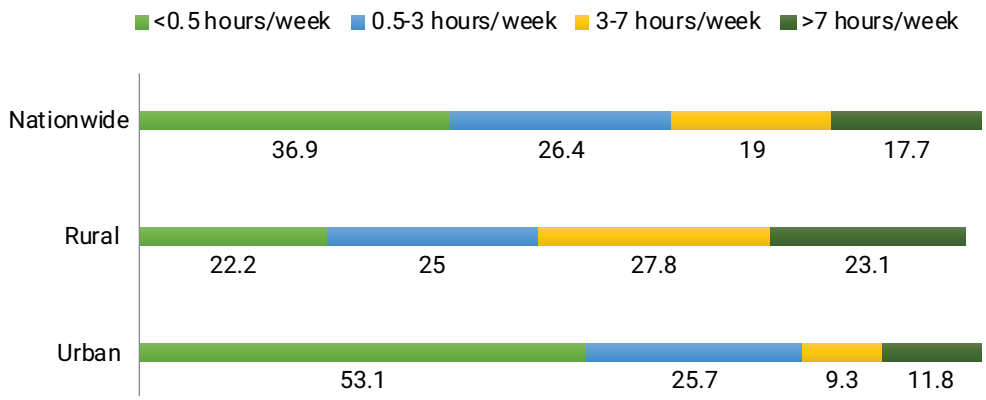

Figure 14: Fuel Convenience Among Households in Different Areas (Time Spent on Fuel Collection and Preparation)

EE programmes should also take into consideration the gender gaps in literacy rates and level of education, as these are likely to have an impact on any sensitisation and awareness initiatives on EE as well as on the uptake of efficient energy sources and technologies. The increased demand for energy-efficient solutions among companies and individuals calls for increased capacity among stakeholders in the energy sector.

4. Strategic Objectives

The Strategic Objectives of the EESAP that will ensure that the vision of the EESAP is achieved, are as follows:

(a) **Strategic Objective 1: To Develop and Establish a Regulatory Framework to Support Energy Efficiency.** This objective is aimed at developing and enabling the legal instruments required to promote the efficient use of energy by increasing access to and facilitating the utilisation of energy-efficient equipment and services as well as by integrating clean energy sources into the Zambian economy.

(b) **Strategic Objective 2: To Promote Best Practices in Industry by Adopting and Utilising Energy Efficiency Benchmarks Specific to the Zambian Industrial Sector.** This objective is aimed at empowering and supporting regulators to strengthen standards, which will work as an effective tool to promote EE in the industrial sector by introducing best practices and the enforcement of benchmarks. The harmonised standards will be tailored to the nation's specific context while also considering regional and international best practices. This will enable accountability for the efficient consumption of energy resources. Developing and utilising benchmarks will work as an effective tool to promote EE at different levels, and the benchmarks will be applied progressively over time based on market readiness.

(c) **Strategic Objective 3: To Adopt Market-Based Mechanisms to Integrate Energy Efficiency in Business Practices.** This objective is aimed at providing the public and private sectors with financial and technical tools to incentivise the efficient use of energy and streamline the financing process for EE projects. Market-based financial instruments will act as catalysts to materialise the necessary actions.

(d) **Strategic Objective 4: To Utilise Energy Pricing as a Tool to Promote Energy Efficiency Technologies.** This objective is aimed at encouraging the adoption and use of sustainable and alternative sources of energy and promoting EE through energy tariff structures. The goal of this objective is to modify and update the electricity tariff such that it rewards energy-efficient practices, thus enabling the market to move towards an overall efficient use of energy.

(e) **Strategic Objective 5: To Utilise Awareness and Capacity Building Programmes for Institutions, Experts and the Public.** This objective is aimed at creating capacity to promote energy savings while adhering to standards and procedures. The goal is to establish an ongoing capacity building programme and awareness campaigns to improve the internal technical capacity of professionals, consultants, governmental staff, consulting firms and contractors whose business is related to energy and the environment.

(f) **Strategic Objective 6: To Ensure Coordinated Collaboration of all Stakeholders to Achieve Energy Efficient Economy.** This objective is aimed at ensuring continuous and evolving collaboration between the public and private sector, universities, intergovernmental organisations, financial institutions, multilateral partners and all relevant stakeholders active in the field of energy that will lead to achievement of the desired EE targets.

A list of key actions supporting the strategic objectives is discussed in detail in the EE Action Plan which is part of this document.

5. Energy Efficiency Action Plan

5.1. Residential Sector

5.1.1. Sectoral Analysis

(a) Energy for Cooking

In 2019, Zambia's population was estimated at 17.4 million people, among whom 56.9% live in rural areas. Primary energy consumption by the residential sector represents 63% of the total primary energy consumption. Approximately 90% of the energy consumed for cooking in the residential sector is derived from bioenergy sources, mainly including firewood in rural areas and charcoal in urban areas. The main reasons behind the significant dependence on bioenergy in the residential sector are:

(i) Firewood is affordable, as it is either free or very cheap, with no barriers to access. Thus, it is considered the most convenient fuel source for many people in rural areas.

(i) In rural areas, firewood is in many cases a source of livelihood.

(ii) LPG is facing commercial and social challenges due to safety concerns, infrastructure and cost, despite its positive attributes, including its burning characteristics and environmental friendliness. Its market uptake in Zambia has continued to be low in comparison to other forms of energy, especially charcoal, wood fuel and electricity for cooking. According to ZamStats, LPG was the least-used source of energy for cooking purposes in 2015, accounting for only 0.1% of cooking in households, compared to 50.7% for firewood and 32.9% for charcoal.

(iii) Access to electricity is still limited. In 2015, the urban access to electricity was 67.3%, while the overall electrification ratio was 31.4%. In 2018, 34% of the Zambian population had access to electricity, 69% of whom were in urban areas, while 8% were in rural areas. While access to electricity is increasing, the rate of increase has been limited.

(iv) Load shedding measures due to rainfall rates have further increased the use of wood fuel. The use of hydroelectric power as the main source of electricity has forced many households that use electricity for cooking to own a charcoal stove or completely switch to charcoal due to the heavy load shedding in recent years. In 2013, 12% of households were using electricity as their primary fuel source for cooking but then reverted to charcoal because electricity was unavailable. The continued use of wood fuel is highly energy inefficient and labour-intensive, and it puts pressure on forest resources and land. In 2015, the estimated total household consumption of charcoal in Lusaka Province alone was 402,000 MT, which is 15 times more than that used in the industrial and commercial sectors. It has been projected that this amount is likely to increase by 42% by 2030.[22]

Most charcoal is produced inefficiently, with no specific guidelines or restrictions on kilns and labour standards. Though it is difficult to estimate the exact impact on deforestation, it has been assessed that over 75% of charcoal production is from forest areas as opposed to farming areas, while over 40% of national and local forest reserves have not been spared from charcoal production.[23]

1,200 sq.m of woodland are necessary to produce 1 t of charcoal.

Charcoal and wood are used in traditional cookstoves called *mbaula* or three-stone stove. In addition to being inefficient cooking options, the use of traditional fuels leads to severe health issues, particularly impacting women and children.

22 Mwitwa. J and Makano A. (2012). Charcoal production, supply and demand assessment in Eastern and Lusaka provinces.
23 Becker, M. S., Milanzi, J., Nyirenda, M. (2015). Human encroachment into protected area.

(b) Energy for Lighting

Lighting accounts for 42% of electricity consumption in the residential sector. Improving lighting systems through installing energy-efficient lighting, such as LEDs, will play a vital role in reducing the electricity bill for most households.

In 2015, the government initiated a regulation aimed at banning the import and manufacturing of incandescent lamps along with a programme for installing CFL bulbs as an alternative. Based on this programme, 1 million CFL lamps were distributed, resulting in 45 MW of power savings.

Access to electricity in Zambia requires substantial efforts to achieve normal electrification rates. Only 70.6% of people living in urban areas have access to electricity, a figure that drops to only 8.1% for rural areas.[24]

(c) Energy for Home Appliances

No data is available on home appliances and energy consumption patterns for home appliances in Zambia. Thus, a detailed market study should be conducted to obtain the necessary information on the types, technologies, manufacturing, import status, customs, regulations, etc.

(d) Building Envelope

Construction is the largest industrial sector in Zambia, contributing 34.9% of national Gross Domestic Product (GDP) in 2019 and exhibiting a growth rate of 6.5% from 2010 to 2019. One of the existing barriers to the widespread adoption of energy-efficient strategies in the residential sector is the lack of obligatory building codes to promote the efficient use of energy along with lacking local capacity for the enforcement of such codes. Vital safety-related activities, such as performing compression strength tests on concrete block samples during the construction phase, are not consistently performed.

As a consequence, there is a need to upgrade/develop sustainable building codes to align efforts with the National Council for Construction (NCC) so as to guide the construction of new energy-efficient buildings. There is also a need to ensure the proper enforcement of safety-related building codes before introducing another level of EE-related codes.

There is a deficit of at least 1.5 million residential units. This presents an opportunity to construct new buildings that are more energy-efficient and less expensive and to invest in producing locally designed, energy-efficient and affordable building materials. The Technology Development and Advisory Unit (TDAU) at the University of Zambia (UNZA), for example, has already begun this effort.

5.1.2. Energy Efficiency Actions for the Residential Sector

(a) Develop and/or Enhance Regulatory Framework for Sustainable Cooking Technologies

According to the Sustainable Energy for All (SEforAll), clean and modern cooking solutions include cooking with LPG or electricity (energy-efficient cooking), using energy-efficient stoves with pellets or briquettes and installing biogas capacity. This excludes stoves which use fuels with significant emissions and negative health impacts, such as kerosene and coal.[25] The SEforAll initiative has a target of providing 100% countrywide access to clean and modern cooking solutions. In urban areas, electricity will provide for 20% of cooking needs by 2030, and it is expected that the adjustment to more cost reflective tariffs will cause a shift to LPG, which will by then be providing 40% of cooking energy, with charcoal and biomass contributing 20% each. The same target of 100% access has been set for rural areas. However, this will mainly be achieved through the combined use of improved biomass cookstoves, feasible biogas installations and LPG.

24 Demographic Health Survey, 2018
25 SEforALL Action Agenda. 2019.

Cookstoves are tested for thermal efficiency, emissions, fine particulate matter, carbon monoxide, safety and durability. For each indicator, laboratory test results are rated along five tiers from 0 (lowest performing) to 5 (highest performing). Tiers 0–3 represent typical performance for open fires and the simplest cookstoves using charcoal. Tiers 4-5 represent typical values for modern cooking technologies, such as LPG, electricity, pellets, biogas and briquettes. Focus should be given to switching from lower-tier cookstoves to higher-tier solutions. This will not only have a positive impact on EE in the residential sector but will also bring health benefits across society. Though a switch from lower-tier (0–1) to medium-tier stoves (2–3) may seem more convenient and achievable than a switch from tiers 0–1 to 4–5, both transitions require an extensive behavioural change campaign. The highest-tier stoves are also usually associated with the lowest labour burdens and therefore carry the greatest positive impact on those who gather and produce fuel and are responsible for cooking, who are primarily women.

Given the current state of the cooking sector, where only 17% have access to modern clean cooking solutions nationwide (38.5% in urban areas and 2% in rural areas),[26] the ambitious goals and aims set by the government necessitate immediate action to ensure achievements are realised by 2030. Since there are no regulations, guidelines or standards for the cooking sector, a strategic regulatory framework is essential to ensure a nationwide switch in cooking and heating sources. Furthermore, switching to the highest-tier stoves can create an affordability barrier, calling for market incentives and financial support that can swiftly push the market towards higher-tier cooking solutions. Finally, given the low level of awareness surrounding the dangers associated with cooking over charcoal and open fires, such as long-term chronic health issues and carbon monoxide poisoning, combined with the inaccurate perceptions of cleaner cooking solutions, such as LPG, a nationwide behavioural change campaign is needed.

The actions and activities to be implemented as part of the EESAP in the near term are presented in the following tables.[27]

(i) Biodigesters

Table 3: Biodigester-Related Activities

Action Description	Produce Biogas from Organic Waste for Cooking
Type of Action	Market capacity development
Sector	Residential
Start/End Date	2024–2030
Target	*a)* Attain 20% increase of biodigesters across the country.
Implementation Body	MoE, Line Ministries.
Project Cost	ZMW 8,500,000[28]
CO_2 Emission Reduction	800 kg CO_2/year/digester
Necessary Activities	i) Undertake assessment of the current situation. ii) Establish the data required for public buildings topologies and energy needs. iii) Conduct assessment of technology. iv) Conduct cost–benefit analysis. v) Develop financial programmes.
Expected Outcomes	*i)* Biogas technologies market uptake created. *ii)* Access to clean cooking solutions increased. *iii)* Enabling environment for ESCO business created.

26 https://rise.esmap.org/data/files/library/zambia/Documents/Energy%20Efficiency/Zambia_SEforALL%20AA.pdf
27 Refer to Actions 1.1 and 1.3 in the Gender Equality Strategy and Action Plan.
28 The project will mainly focus on implementing 20 pilot projects for 20 public buildings as well as an awareness campaign addressing the environmental and social benefits resulted from the projects. In addition, it will support the government in developing financial programmes to mitigate financial barriers.

(ii) Liquefied Petroleum Gas and Biomass Cooking Systems

Table 4: Liquefied Petroleum Gas and Biomass-Related Activities

Action Description	LPG and Biomass Cooking Systems
Type of Action	Enabling capacity
Sector	Residential
Start/End Date	2022–2027
Target	*a)* Deploy biomass and improved cookstoves. *b)* Establish LPG distribution and storage centres in Northern, Eastern and Central Provinces. [29]
Implementation Body	MoE, Line Ministries, ZABS
Project Cost	ZMW 70,000,000
CO_2 Emission Reduction	340 kg CO_2eq/TJ[30]
Necessary Activities	i) Conduct a detailed techno-assessment study for the potential of producing charcoal in the most efficient manner. ii) Conduct a market demand study. iii) Develop legal framework for LPG usage. iv) Conduct an LPG pricing optimisation. v) Establish concessional public finance scheme for pipeline infrastructure.[31] vi) Undertake awareness campaigns for end-users regarding the benefits of switching to LPG and clean cookstoves. vii) Enforce mechanisms for the monitoring and inspection of LPG products in line with Zambian standards. viii) Review LPG standards in place and align with best international LPG standards. ix) Enforce proposed modifications to standards.
Expected Outcomes	*i)* Access to clean cooking solutions increased. *ii)* Inefficient stoves and open firewood systems substituted with LPG and efficient cookstoves.

29 The Demand and Market Structure for Liquified Petroleum Gas (LPG) in Zambia 2019. ERB, 2019.
30 The emission factor is calculated as 403 CO_2eq/TJ. The calculation methodology is based on the wood and charcoal used in the residential sector for cooking. The emission factors for wood and charcoal are 600 and 100 kg CO_2/TJ (https://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref3.pdf). Firewood and charcoal represent 50.7% and 32.9%, respectively, of cooking fuel.
31 Scaling-up Renewable Energy Programme in Low Income Countries Investment Plan 2019. MoE, 2019.

(iii) LPG Cylinder Exchange Programme

Table 5: Liquefied Petroleum Gas Cylinder Exchange Programme

Action Description	LPG Cylinder Exchange Programme
Type of Action	Enabling
Sector	Residential
Start/End Date	2022–2024
Target	*a)* Adopt legislation for cylinder exchange programme.
Implementation Body	ERB, MoE, ZABS
Project Cost	ZMW 1,700,000
CO_2 Emission Reduction	340 Kg CO_2eq/TJ[32]
Necessary Activities	*i)* Draft legislation for cylinder exchange programme. *ii)* Mandate licensed LPG companies to allow consumers to exchange cylinders distributed by other LPG distributors with their own cylinders. *iii)* Establish national standards for gas cylinders and LPG along with relevant testing facilities. *iv)* Implement cylinder exchange on the distributor-to-distributor level.
Expected Outcomes	*i)* Access to clean cooking solutions increased.

(iv) Pay As You Go Cooking Solutions

Table 6: Pay As You Go Related Activities

Action Description	Pay As You Go Cooking Solutions
Type of Action	Market capacity development
Sector	Residential
Start/End Date	2022–2027
Target	a) Deploy 100,000 efficient stoves by 2027. b) Attain 10,000 MT of wood pellets usage per year.
Implementation Body	ERB, MoE
Project Cost	ZMW 25,500,000
CO_2 Emission Reduction	20% reduction In CO_2 eq emission.
Necessary Activities	i) Raise awareness. ii) Develop supply chain for crop residues. iii) Facilitate technology transfer from international pellet/stoves manufacturers. vi) Establish public–private partnerships. v) Establish financing schemes.
Expected Outcomes	*i)* Access to clean cooking solutions increased. *ii)* Inefficient stoves and open firewood systems substituted with efficient pellet stoves. *iii)* Socioeconomic benefits (e.g. increased employment) realised.

32 The emission factor is calculated as 403 CO_2eq/TJ. The calculation methodology is based on the wood and charcoal used in the residential sector for cooking. The emission factors for wood and charcoal are 600 and 100 kg CO_2/TJ (https://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref3.pdf). Firewood and charcoal represent 50.7% and 32.9%, respectively, of cooking fuel.

(v) Energy-Efficient Cooking

Table 7: Energy-Efficient Cooking Related Activities

Action Description	Energy Efficient Cooking
Type of Action	Market capacity development
Sector	Households
Start/End Date	2022–2030
Target	*a)* Attain 20% of cooking using energy-efficient cooking equipment.
Implementation Body	MoE, ZESCO
Project Cost	ZMW 85,000,000[33]
CO_2 Emission Reduction	403 Kg CO_2 eq/TJ
Necessary Activities	i) Conduct market demand study. ii) Undertake awareness campaigns for end-users regarding the benefits of energy-efficient cooking, including the EE, shorter cooking time and simplicity. iii) Implement pilot project with 2,000 free energy-efficient cooking setups for end-users. iv) Establish personal concessional loans mechanism to finance energy-efficient cooking equipment. v) Develop M&E framework to monitor performance improvement under the umbrella of the financing mechanism.
Expected Outcomes	*i)* Access to clean cooking solutions increased. *ii)* Inefficient stoves and open firewood systems substituted with energy-efficient cooking systems.

(b) Ban the Use of Incandescent Lamps and Create Market-Enabling Tools for Light Emitting Diodes

The residential sector target is to replace 100% of incandescent lamps with LED lamps by 2030. The potential energy savings over the implementation period will be 17,200 GWh.

Incandescent lamps have an efficacy of 10 lumen/watt, while the efficacy of LED lamps is ≥80 lumen/watt. Therefore, a 100W incandescent lamp will generate the same lumen output as a 12W LED lamp. The projected scenario will be based on the replacement of 100W incandescent lamps with 12W LED lamps. The implementation period will be divided into three phases.

The first phase is the inception phase. This phase will include the replacement of 1 million incandescent lamps with LED lamps (2022–2023).

To initiate the market, the government will announce a grant procurement programme of 1 million LED lamps to replace the existing incandescent lamps. Further, awareness campaigns focussing on the importance of energy conservation measures, the benefits of LED lighting on electricity bills and a cost–benefit analysis of lighting upgrades to LED lamps will be initiated. The expected outcomes of this phase are the promotion of the market for LED lamps, the encouragement of private sector participation, the identification of gaps and the creation of a financing mechanism.

This phase will introduce a financing mechanism that partially supports the replacement of incandescent lamps by LED lamps and the scheme will be initiated by MoE and ZESCO.

The second phase (2023–2027) will target the replacement of 10% of all incandescent lamps annually over four years leading to the replacement of 3,564,000 lamps). A DSM programme developed by international financial institutions and supported by ZESCO with the participation of commercial banks will be a good

33 This programme will be included in the DSM programme.

market-enabling tool for the deployment of efficient lighting technologies.

In the third phase (2027–2032), the market will have matured, meaning no additional incentive programmes will be required. The target of this phase will be to replace 15% of incandescent lamps over the first three years and then 20% over the last two years to achieve the desired target. This will lead to the replacement of 11,400,000 lamps.

It is important to underscore the collaboration with neighbouring countries in the Southern African Development Community (SADC) region to ensure the effectiveness of enforcement of the incandescent lights ban.

The following table presents the annual targets for the distribution of LED lamps.

Table 8: Annual Targets for the Distribution of LED Lamps

	LED Replacement Target	No. of LED Lamps Distributed	Projected Energy Consumption (GWh)
2022	15.0%	1,030,000	1,811.062
2023	14.5%	1,000,000	1,757.064
2024	10.0%	764,473	1,778.862
2025	10.0%	844,785	1,796.297
2026	10.0%	931,031	1,808.899
2027	10.0%	1,023,597	1,816.168
2028	15.0%	1,684,334	1,673.295
2029	15.0%	1,844,010	1,510.293
2030	15.0%	2,015,109	1,325.564
2031	20.0%	2,931,146	929.104
2032	18.3%	2,925,063	559.363

The following table summarises the activities required to implement this action.

Table 9: LED Lighting-Related Actions

Action Description	LED Lighting
Type of Action	Enabling market capacity development
Sector	Residential
Start/End Date	2022–2030
Target	*a)* Distribute 1 million LED lamps for the households by 2023. *b)* Distribute 3.5 million LED lamps at half price with a guarantee of 20,000 working hours by 2027. *c)* Distribute 11.5 million LED lamps by 2032.
Implementation Body	MoE, ZESCO
Project Cost	ZMW 680,000,000
Potential Energy Saving	17,197.75 GWh
CO_2 Emission Reduction	2.55[34] MT CO_2eq
Necessary Activities	i) Enforce the removal of incandescent lamps from the national market. ii) Undertake LED lamp awareness campaigns. iii) Establish incentivised financing scheme to support the ability to repay lamp costs in instalments with electricity bills. iv) Conduct market demand study. v) Undertake awareness campaigns for end-users regarding the benefits of LED lamps, including the reduced energy consumption and shorter payback. vi) Establish personal concessional loans mechanism to finance lighting upgrades.
Expected Outcomes	*i)* Incandescent lamps phased out. *ii)* CFL lamps upgraded to LED lamps. *iii)* Financial incentive schemes for lighting upgrades established.

34 The electricity emission factor is 148 g CO_2/kWh (from the IFI Dataset of Default Grid Factors v. 2.3).

(c) Develop Energy-Efficient Building Materials

Research funding will be provided to local research centres, such as the TDAU, to innovate energy-efficient building materials using elements from the local environment.

Table 10: Development of Energy-Efficient Building Materials

Action Description	Development of EE Building Materials
Type of Action	Market development
Sector	Building
Start/End Date	2022–2025
Target	*a)* Develop energy-efficient building materials using elements from the local environment to reduce energy losses in buildings.
Implementation Body	MoE, TDAU, ZABS, ERB, MCTI
Project Cost	ZMW 3,400,000[35]
Potential Energy Saving	Up to 15%[36]
CO_2 Emission Reduction	Up to 15%
Necessary Activities	i) Expand on current efforts to manufacture energy-efficient building blocks. ii) Research on improving the energy performance of building materials. iii) Expand research on additional building materials, such as roofs and windows.
Expected Outcomes	*i)* Methodology and machinery to produce energy-efficient building blocks and other energy-efficient building materials developed.

(d) Develop Energy Labelling Code for Home Appliances

An energy labelling programme should help end-users evaluate home appliances based on energy performance. The energy labelling programme will be a first step towards implementing the MEPS.[37] The energy labelling is not limited to certain appliances, but the programme will begin by focussing on four appliances: lighting fixtures, refrigerators, room air conditioners and television sets.

Table 11: Energy Labelling Code-Related Actions

Action Description	Energy Labelling for Appliances
Type of Action	Market enabling
Sector	Residential
Start/End Date	2022–2025
Target	*a)* Develop energy labelling code for four appliances (light bulbs, refrigerators, air conditioners and tvs).
Implementation Body	MoE, MCTI, ERB, ZABS, ZRA
Project Cost	ZMW 49,500,00[38]
Potential Energy Saving	10%[39]
CO_2 Emission Reduction	10%
Necessary Activities	i) Conduct a survey of current appliance technologies and energy baselines. ii) Develop standards for local and domestic home appliances suitable for the local market. iii) Undertake a gap analysis to identify the required testing labs other than those available at ZABS. iv) Develop required testing labs. v) Develop a DSM programme to promote the purchase of energy-efficient appliances. vi) Establish relevant legal and regulatory framework. vii) Assess the energy performance of products currently sold on the market. viii) Design and implement a labelling programme.
Expected Outcomes	*i)* Energy labelling code developed. *ii)* MEPS developed.

35 Estimate for research budget.
36 Based on research results.
37 MEPs are technical attributes specifically tailored to appliances or any other devices that consume energy. Usually, MEPs are made mandatory by governmental bodies to prevent the manufacture, import and trade of devices that do not comply with certain standards.
38 Formulation Study Report: Energy Efficiency Actions. May 2019.
39 Improvement of the energy performance of the selected home appliances by classifying the new equipment based on its energy performance.

(e) Develop and Enforce the Energy-Efficient Building Code

(i) Building Insulation

Building insulation is the first action that must be taken to reduce the heating and cooling demand in existing and new buildings.

There are no enforced building codes in Zambia. Therefore, most of the existing buildings have no envelope insulation. Insulation action is expected to reduce cooling and heating demand by 30% to 40%. The recommended target is to insulate 10% of the existing and new buildings annually during the period between 2022 and 2030. The potential energy savings of this action over the implementation period will be 6,200 GWh. The following table shows the projected air conditioning demand as a baseline in comparison to that achieved by the proposed action.

Table 12: Projected Air Conditioning Demand Vs Suggested Action

Year	Annual Growth Rate	Action Target	Air Conditioning Electricity Consumption for the BAU Scenario (GWh)	Air Conditioning Electricity Consumption for the Proposed Scenario (GWh)
2022	12%	10%	1,638.6	1,638.6
2023		10%	1,835.2	1,780.2
2024		10%	2,055.4	1,932.1
2025		10%	2,302.1	2,094.9
2026		10%	2,578.3	2,268.9
2027		10%	2,887.7	2,454.6
2028		10%	3,234.3	2,652.1
2029		10%	3,622.4	2,861.7
2030		10%	4,057.1	3,083.4
2031		10%	4,543.9	3,317.1
2032		10%	5,089.2	3,562.4

This measure cannot be implemented without an enforcement instrument in the construction industry, that is, a sustainable building code.

(ii) Sustainable Building Codes

Other than a regulatory framework, code enforcements require engineering and architectural groups to review, approve and inspect code compliance at different construction stages and issue the necessary licences and permits. The following table summarises the necessary measures required for developing and adhering to sustainable building codes.

Table 13: Sustainable Building Code Activities

Action Description	Sustainable Building Code
Type of Action	Market enabling
Sector	New building construction
Start/End Date	2022–2030
Target	*a)* Develop an obligatory sustainable building code for new construction projects.
Implementation Body	NCC, MoE, MIHUD
Project Cost	ZMW 8,500,000
Potential Energy Saving	10%
CO_2 Emission Reduction	10%
Necessary Activities	i) Foster technical development of the building code. ii) Develop the building code through a consultative process. iii) Integrate usage of construction building materials to reduce the heating and cooling demands of new buildings. iv) Coordinate with different stakeholders to create a lever for enforcement. v) Offer incentives for compliance (i.e. subsidised loans).
Expected Outcomes	*i)* Mandatory building code for new buildings developed. *ii)* Building energy consumption reduced. *iii)* Final energy consumption projections based on energy use and building category determined and compared to historic data.

5.2. Industrial Sector

5.2.1. Sectoral Analysis

The industrial sector is of high importance to the national Gross Domestic Product (GDP). During the period from 2016 to 2019, the annual growth rate of the economy was approximately 3.2%. The government developmental targets in the NDPs place emphasis on the urgent need to invest in infrastructure and energy to improve the economic status of the country and to develop the manufacturing industry in particular to promote:

(1) Local production of food, while cross-benefiting the agricultural industry sector; and

(2) Diversification of the export-oriented mining sector.

In 2018, the total final energy consumption by the industrial sector was 2,856 ktoe, representing 29.5% of the total final energy consumed by all sectors. Of this final energy consumed by industry, 62% was from bioenergy and waste, 21% was from electricity, 14% was from petroleum products and 4% was from coal. It is worth mentioning that the total electricity consumption by the industrial sector represents more than 50% of the total electricity consumed by all economic sectors in the economy.

As a consequence, securing sustainable energy supplies to the industrial and manufacturing sectors is of great importance to the Zambian economy.

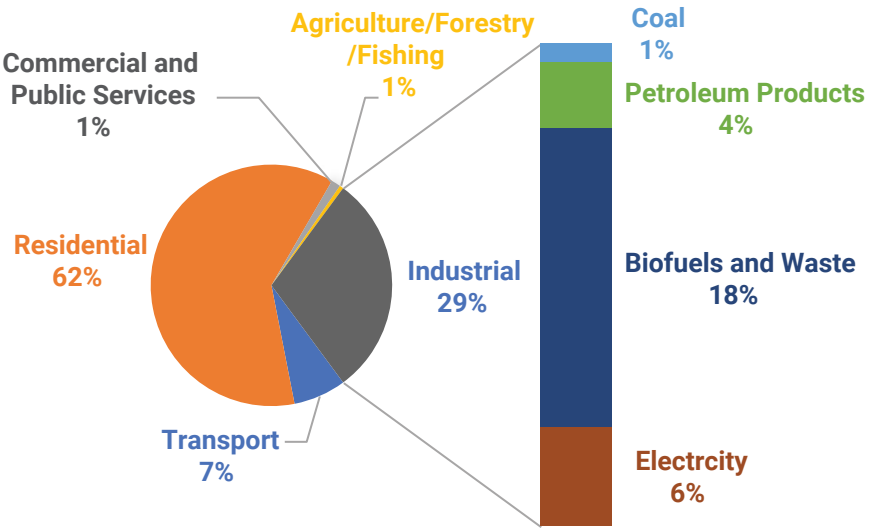

Figure 15: Energy Consumption Breakdown for the Industrial Sector

The Energy Service Company (ESCO) model supports industrial and commercial beneficiaries in investing in energy-saving measures, as ESCOs are responsible for mitigating the technical and financial risks of energy-saving measures. Several barriers hindering the successful implementation of the ESCO project exist in the Zambian market, such as high transaction costs, low utility rates, inadequate regulatory framework, inadequate general awareness, inadequate technical capacities and a poor understanding of performance contracting and outsourcing

5.2.1.1. Heavy Industries

(a) Mining Industry

- **Electricity represents 43% of the total energy consumption in the mining sector.**
- **Zambia is one of the 10 largest copper producers worldwide.**
- **Zambian copper is considered the highest-grade copper in the world.**
- **In 2017, the mineral production reached 1.6 Mt, of which 0.85Mt were copper.**
- **Energy consumption of copper mining production is approximately 39% higher than in Chile.**

Electricity consumers in Zambia can be divided into two main categories: mining customers and all others (non-mining). In 2017, the total electricity sold by ZESCO to its various clients was nearly 13,047 GWh, among which 48% was consumed by mining customers.

The specific energy consumption for copper mining in Zambia was calculated to be 5.03 MWh/MT, which is approximately 39% higher than that in Chile, the largest copper-producing country in the world. Consequently, after adjusting the consumption to operational reality, a great potential for electric energy savings exists in this sector.

(b) Sugarcane Industry

Zambia's sugar industry is dominated by three sugar milling companies: Zambia Sugar Plc, Kafue Sugar Plc and Kalungwishi Estate Ltd (Kasama Sugar). Zambia Sugar Plc is the largest contributing approximately 92.5% of the total sugar production while Kafue Sugar and Kalungwishi Estate contribute 7.2% and 0.3%, respectively.

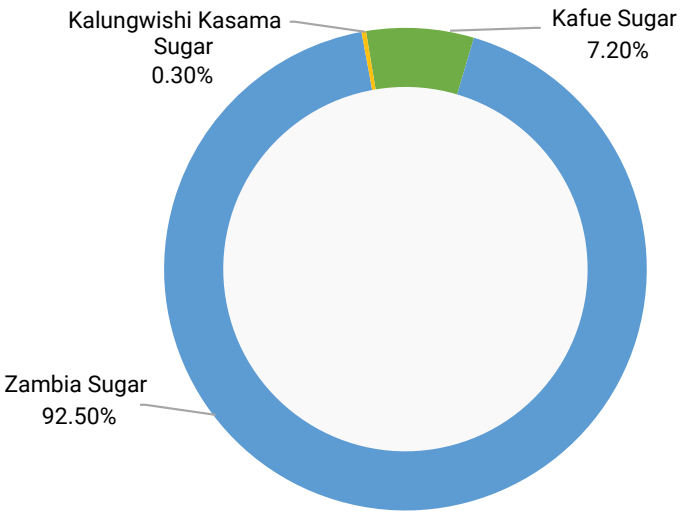

Figure 16: Sugarcane Milling Companies

Significant thermal energy is consumed in the evaporation and drying processes, while electric energy is used for the pumps and centrifuge processes. The utilisation of bagasse for power generation has been implemented with limited capacity, and the generation of additional power could be doubled by utilising waste heat from bagasse.[40]

(c) Grain Milling Industry

Zambia's milling industry comprises about 78 milling companies, which can be categorised into three main groups: large-scale or commercial millers, medium-scale millers and small-scale millers. Energy requirements for the milling industry differ from one phase to another depending on the product being milled. However, for common grains, such as maize and rice, energy requirements for the processing of 1 MT, ranges from 350 to 920 kWh. This has promising implications for the adoption and utilisation of highly-efficient energy systems in the milling industry.

(d) Cement Industry

There are 14 cement plants operational in Zambia, located in the Lusaka and Copperbelt Provinces. Growth in cement demand is driven by a continued strong domestic construction boom as well as external demand, mainly from the Democratic Republic of Congo and part of the East African market.

New cement companies have shown interest in establishing plants in Zambia. The entry of new cement industries means a greater demand for energy to meet the energy requirements for cement processing. Cement production can consume around 3.3 GJ/MT of clinker produced, accounting for at least 30%–40% of the production costs. At least 90–120 kwh of energy is consumed per MT of cement produced. The average specific energy consumption of the cement sector in Zambia is almost four times the international benchmark.

5.2.2.2 Commercial and Light Industries

(a) Water Utilities

The National Water Supply and Sanitation Council (NWASCO) was established under the Water Supply and Sanitation Act No. 28 of 1997. The mandate of NWASCO is to regulate water supply and sanitation services and it focuses on: sustainable service delivery, balancing commercial orientation and social consideration; increased access to affordable safe water and acceptable sanitation; and increased public awareness.

40 Interviews with Zambia Sugar and Kafue Sugar. September 2020.

NWASCO regulates all the public water and sanitation utility companies in the country.

In terms of energy savings potential, one energy assessment study for Lusaka Water and Sanitation Company identified more than 8 GWh of savings per year or an 11.4% reduction in energy consumption. There is huge potential for EE measures in water utilities. The four most significant energy uses in this respect are as follows:

Pumping Systems: Improving water and wastewater pumping systems is considered one of the most critical elements in improving energy performance and reducing energy losses. These systems can be improved through several measures, including but not limited to matching the pump size, purchasing high efficient pumps and motors, controlling the pump speed according to the requirements, optimising the distribution piping and improving the operations and maintenance programme.

Leak Management: Fixing leaks will achieve both a reduction of water losses and a reduction of the energy used to pump the leaked water.

System Automation: Automation systems range from simple metering devices to complex monitoring and control systems. These systems monitor all critical operating parameters in real time and act accordingly if any deviation for the measured parameters is identified. The potential savings will vary greatly from one project to another based on the specific conditions, but the automation system will generally lead to 10% water savings, 12%–30% electricity savings and a reduction in the maintenance costs and down time by 15%–30%.

Monitoring and Verification: Monitoring systems can support the identification of the prevailing conditions, energy performance indicators and key parameters affecting energy consumption. This will help detect losses and inefficient practices. It will also support the quantification and verification of real savings for any EE measures implemented in the facility.

(b) Beverages Industry

Zambia's beverage sector is involved in both the manufacturing and import of alcoholic and non-alcoholic drinks. While the non-alcoholic subsector engages in the production of soft drinks, mineral water and other fruit juice-based drinks, the alcoholic subsector engages in the production of opaque, non-opaque and clear beers. The industry has large-scale firms, medium-scale firms and small-scale firms (including home-based brewers).

The increasing competition among major beverage producers is a stimulating factor for EE measures. Energy, water, imported glass bottles, and environmental management are among the major cost components of the beverage production. The industry has significant EE potential mainly in the areas of water treatment, pumping, refrigeration, heating and motors.

(c) Textile and Leather Industry

The Zambian textile and leather industry is a significant contributor to the nation's economy. In 2010, the sector generated a total of USD 1.9 million, representing 1.25% of the country's annual GDP. Even though the textile and leather industry has generally been described as one that does not involve a significant use of energy, the industry involves different machines at different phases, and the combination of the energy consumption by all these machines along the textile production chain can lead to significant energy demands.

On average, in a typical textile production process, energy consumption in the dry processes knitting and weaving stands at 1.2 and 6.2 kWh/kg, respectively. However, for finishing, the consumption stands at 17.9 kWh/kg. These figures have significant implications for efficient energy delivery and management in the industry.

5.2.2. Energy Efficiency Actions for the Heavy Industrial Sector

(a) Capacity Building Programme and Awareness

A three-year (2022–2024) capacity building programme for heavy industry will be undertaken to help build the necessary in-house cadres capable of managing significant energy users and industrial systems. The training will be customised based on the training needs assessment conducted during the programme inception phase.

Table 14: Capacity Building Programme Related Actions

Action Description	Awareness and Capacity Building Programmes
Type of Action	Capacity building
Start/End Date	2022-2024
Sector	Heavy industry
Target	*a)* Attain 10% energy savings for heavy industries.
Implementation Body	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Project Cost	ZMW 12,750,000
Potential Energy Saving	10% cumulative savings during the first three years of implementation.
CO2 Emission Reduction	10%
Necessary Activities	i) Awareness campaigns for stakeholders on the necessity of EE and RE projects. ii) Capacity building for local experts and energy professionals, ensuring adequate participation among women[41]. iii) Develop a local certification body for energy managers.
Expected Outcomes	*i)* Capacity building programmes established regarding EE measures for different heavy industries.

(b) Development of National Benchmark for Heavy Industries

The national benchmark will identify potential savings in heavy industries. Certified trained professionals from the capacity building programme will be involved in the preliminary energy audits and energy data collection in the industry. One-on-one assistance of those professionals will take place for further data analysis delivery and to set the national energy consumption benchmark in Zambia. EE targets and objectives will be determined based on the best available technologies internationally.

Table 15: National Energy Benchmarking-Related Actions

Action Description	National Benchmark Programme
Type of Action	Market enabling and development
Start/End Date	2022–2025
Sector	Heavy industry
Target	*a)* Establish national energy benchmark for selected heavy industries.
Implementation Body	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Project Cost	ZMW 1,700,000
Potential Energy Saving	Up to 15% of energy consumption is from the heavy industrial sector.
CO2 Emission Reduction	15%
Necessary Activities	Establish a national energy benchmark programme to work with the heavy industrial sector. The programme will be responsible for: i) The screening of heavy industries; ii) Identifying the energy baseline for the selected industries; and iii) Benchmarking the selected industries and comparing them to international benchmarks.
Expected Outcomes	*i)* Energy practices improved and energy consumption reduced.

41 Refer to Activity 3.5 in the Gender Equality Strategy and Action Plan.

(c) Implement an Energy Management System in Accordance with ISO 50001

A customised guideline and manual for the best-suited Energy Management System (EnMS) will be delivered to streamline the energy auditing process conducted by certified training professionals to ensure the harmonised delivery of energy auditing quality. The engagement of international certification bodies to pursue ISO 50001 certification will take place in this phase.

Mandatory energy audits will help in increasing the level of awareness among the management of large industrial facilities regarding the importance of implementing no-/low-cost actions.

This action plan estimates that the total energy savings resulting from these no-/low-cost actions will reach 15% during the three-year implementation period.

Table 16: Mandatory Energy Audit Related Activities

Action Description	Mandatory Energy Audits & ISO 50001
Type of Action	Market development and capacity building
Start/End Date	2022–2026
Sector	Heavy industries
Target	*a)* Attain 15% energy savings for the industry and agriculture sectors.
Implementation Body	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Project Cost	ZMW 3,400,000
Potential Energy Savings	15% cumulative savings during the first three years of implementation.
CO_2 Emission Reduction	15% CO_2 emission reduction
Necessary Activities	i) Undertake capacity building for local experts and energy professionals. ii) Develop a local certification body for energy managers. iii) Develop a draft energy conservation law that imposes mandatory energy audits and employ certify energy managers in industrial facilities.
Expected Outcomes	*i)* Mandatory energy audits conducted for all industrial facilities and definition of energy savings opportunities. *ii)* EnMS implemented according to the ISO 50001 standard.

5.2.3. Energy Efficiency Actions for the Light Industrial Sector

(a) Awareness and Capacity Building Programme

A two-year capacity building programme will be implemented for professionals in the industrial and commercial sectors to develop their skills and expertise in the management of challenges related to their energy needs. Capacities will be further developed on possible renewable options that can be adopted to supplement existing supply systems.

Table 17: Capacity Building Programme Related Activities

Action Description	Awareness and Capacity Building Programmes for Light Industry
Type of Action	Capacity building
Start/End Date	2022–2024
Sector	Light industry
Target	*a)* Attain 15% energy savings for the light industries including water utilities.
Implementation Body	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs, Water Utilities
Project Cost	ZMW 8,500,000
Potential Energy Savings	15% cumulative savings during the first three years of implementation.
CO_2 Emission Reduction	15% CO_2 emission reduction
Necessary Activities	i) Undertake awareness campaigns for stakeholders on the necessity of EE and RE projects. ii) Undertake capacity building for local experts and energy professionals. iii) Develop a local certification body for energy managers.
Expected Outcomes	*i)* Awareness raised regarding the importance of EE and RE projects. *ii)* Capacity building programmes established for EE measures for the industrial and commercial sectors. *iii)* No-/low-cost measures applied. *iv)* Awareness of the negative environmental impacts of using charcoal, especially with the current inefficient production practices undertaken.

(b) Demand Side Management Programme

DSM aims to efficiently manage/reduce the energy consumption at the consumer side through a set of actions, such as replacing traditional lighting with LED bulbs, energy labelling programmes for home appliances and on- and off-peak tariffs.

Table 18: DSM Programme-Related Actions

Action Description	DSM Programme
Type of Action	Market development and capacity building
Start/End Date	2023–2026
Target	*a)* Deploy energy-efficient equipment in the market (20,000 refrigerators and 10,000 inverter ac units).
Sector	Light industry
Implementation Body	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Project Cost	ZMW 3,400,000
Potential Energy Savings	10% energy savings
CO_2 Emission Reduction	10% CO_2 emission reduction
Necessary Activities	i) Identify incentive mechanisms that support purchasing energy-efficient equipment. ii) Undertake awareness campaigns for stakeholders on the necessity of EE and RE projects.
Expected Outcomes	*i)* Energy-efficient appliances utilised throughout different economic sectors in Zambia.

(c) Improve Energy Consumption in Light Industries

A voluntary energy audit programme will be created to support the industrial and commercial sectors in identifying their energy use and potential energy-saving opportunities. The programme will offer an incentive mechanism to encourage beneficiaries to implement the identified energy-saving opportunities. In the first step, the programme will mainly focus on implementing no-/low-cost opportunities and behavioural change.

This will be considered as on-job training to the beneficiaries, helping them to understand the importance of energy savings and how to monitor their energy consumption. Two certification schemes for professionals will be developed in this phase: One for Motor System Optimisation (MSO) and the other for Compressed Air System Optimisation (CASO).

Table 19: Voluntary Energy Audit Programme Related Activities

Action Description	Voluntary Energy Audits Programme to Reduce Energy Consumption
Type of Action	Market development and capacity building
Start/End Date	2023–2025
Sector	Light Industry
Target	*a)* Attain 10% energy savings for the industry and 15% savings for the water utilities and agriculture sectors.
Implementation Body	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs, Water Utilities
Project Cost	ZMW 850,000
Potential Energy Savings	10% cumulative savings during the first three years of implementation
CO_2 Emission Reduction	10% CO_2 emission reduction
Necessary Activities	i) Identify incentive mechanisms that support the implementation of energy-saving opportunities. ii) Undertake awareness campaigns for stakeholders on the necessity of EE and RE projects. iii) Undertake capacity building for local experts and energy professionals on MSO and CASO. iv) Facilitate on-job training for beneficiaries on the EnMS. v) Provide sets of measurement devices that support the implementation of energy audits.
Expected Outcomes	*i)* Awareness on EE and RE opportunities increased. *ii)* No-/low-cost energy-saving opportunities and behaviour change activities implemented.

(d) Undertake Financing Promotion and Funding ESCO [42]

An ESCO financing scheme will strengthen the deployment of the EE market as it develops the required mitigation actions to overcome the technical, financial and commercial risks that face EE projects in the Zambian economy. However, the ESCO model is totally dependent on the technical and financial capabilities of the stakeholders, especially those suppliers who apply the model. The ESCO development programme will mitigate barriers to establishing a market for ESCO services.

42 Refer to Activities 3.3 and 3.5 in the Gender Equality Strategy and Action Plan.

Table 20: Promotion of ESCO Model-Related Actions

Action Description	Promotion of ESCO Model
Type of Action	Market development and capacity building
Start/End Date	2025–2030
Sector	Light industry
Target	*a)* Establish ESCO development programme. *b)* Develop funding mechanism for ESCO financing. *c)* Strengthen technology service providers.
Implementation Body	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Project Cost	ZMW 510,000,000
Potential Energy Savings	20%[43]
CO_2 Emission Reduction	20% CO_2 emission reduction
Necessary Activities	i) Conduct awareness campaigns for stakeholders on the ESCO model. ii) Conduct a Training Needs Assessment. iii) Undertake a capacity building for local experts, suppliers and energy professionals on energy performance contracting. iv) Create a gender-inclusive capacity building program. v) Establish funding mechanism for ESCO financing. vi) Ensure regulatory framework supports the implementation of the ESCO model. vii) Develop incentivised financing schemes.
Expected Outcomes	*i)* EE and RE projects in Zambia deployed through green economy financing mechanism. *ii)* Market for the ESCO business model created.

5.3. Transport Sector

5.3.1. Sectoral Analysis

The demand for mobility and transportation technologies is cross-linked to economic growth. Energy demand for transportation represents a substantial share of the total global energy demand, and consequently of energy-related carbon emissions. In 2018, the transport sector contributed to 22% of global energy-related carbon emissions. Among transport-related emissions, 73% was from road transport and more than 50% from Light-Duty Vehicles (LDVs). In emerging economies, it is common for a combination of middle-class and cheaper second-hand vehicles to dominate the market given their accessibility to a wider portion of the population.

- ***The GRZ aims to improve the road transport sector to be achieve beneficiary satisfaction.***
- ***More than 95% of passengers and 97% of cargos transported in 2018 were through public roads.***
- ***The transport sector consumes 38% of petroleum products (400 ktoe).***

Through the Ministry of Transport and Logistics (MoTL), the government has mandated the facilitation and development of the transport sector by lowering transportation costs, integrating all modes of transportation and enhancing safety to provide reliable service. Among the different modes of transportation available in Zambia, road transport accounts for the majority share of both passenger and cargo movement.

The growth of the aviation transport sector over the past years has been due mainly to increased airline activities, the introduction of new flights and increased competition among local players in the Zambian market. Passenger movements take place at four main airports: Kenneth Kaunda, Harry Mwaanga Nkumbula, Simon Mwansa Kapwepwe and Mfuwe International Airports.

43 Formulation Study Report: Energy Efficiency Actions. May 2019.

Railway transport takes place through two operators: Tanzania Zambia Railways (TAZARA) Limited, and Zambia Railways Limited (ZRL). Approximately 70% of passengers were transported by rail travel through TAZARA, while 82% of cargo transport takes place through ZRL. In 2018, the number of passengers transported through Mpulungu Port Harbour increased by 1.5% compared to the previous year, while the cargo handled at the harbour declined by 4.4%.

Overall, the energy intensity of the transport sector in Zambia is 14% higher than the global average.

The number of passengers and amount of cargo moved by the different transportation modes in Zambia are outlined in Table 21 and Table 22, respectively.

Table 21: Number of Transported Passengers Via Different Transportation Modes in 2018

Transportation Mode	No. of Passengers
Road Transport	57,230,580
Aviation	1,931,827
Railway	941,049
Maritime	1,277
Total	***60,104,733***

Table 22: Transported Cargo Via Different Transportation Modes in 2018

Transportation Mode	Transported Cargo (T)
Road Transport	37,592,868
Aviation	20,860
Railway	1,068,255
Maritime	165,591
Total	***38,847,574***

The numbers in the above tables confirm that among transportation modes, railroad transportation should receive special focus. More than 37 MT of cargo depends on road transportation compared to approximately 1 MT of cargo depending on railroad transportation. Similar to transported goods, approximately 95% of transported passengers travel via roads. Significant energy savings would be achieved by increasing the utilisation of railroads. Studies report that moving freight by rail is four times more fuel-efficient than moving it on the highway. In 2016, the total number of motor vehicles registered in Zambia was 782,136, compared to 696,474 in 2015. The number of passengers transported by public service vehicles declined by 37% in 2018 compared to its value in 2017. This was mainly due to the increased number of private motor vehicles, especially second-hand vehicles imported from Japan. In 2018, the total number of registered motor vehicles was 44,465. A breakdown of the vehicle categories is given in the figure 17 below.

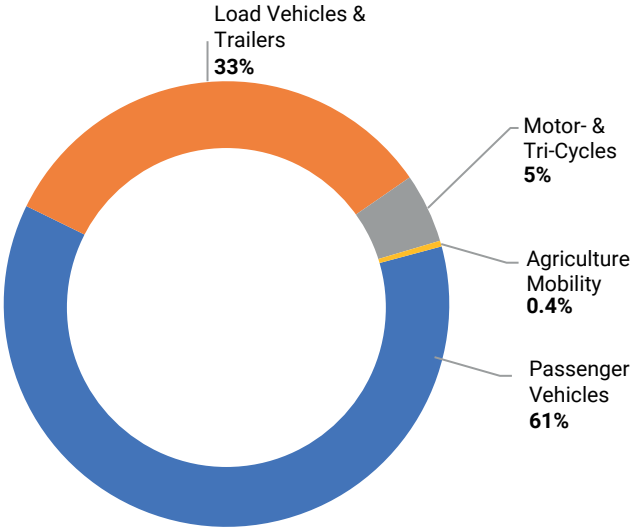

Figure 17: Breakdown of Motor Vehicles Registered in Zambia in 2018

Figure 17 shows that passenger vehicles represent a significant portion of road transport, followed by load vehicles and trailers. Hence, EE actions should primarily focus on passenger vehicles, especially given the great number of imported second-hand vehicles with excessive fuel consumption.

(a) Transport Sector Demand for Petroleum Products

Zambia meets its demand for petroleum products through refined and crude oil imported via TAZAMA's 1,710-km pipeline, which has the capacity to handle 1.1 MT per year (in 2014). The crude oil is then refined at the Indeni Petroleum Refinery in Ndola. The pipeline and its associated infrastructure are owned by the government (66.7%) and the United Republic of Tanzania (33.3%), while the refinery is wholly owned by the government.

Petroleum distribution inland relies on road and rail transport. In 2014, petroleum products (refined oil products and crude oil) accounted for approximately 10% of Zambia's primary energy supply. A large share of the petroleum products is used in the transport sector, which is expected to grow rapidly in the years to come. In 2016, equivalent imports of petroleum products were 1,048 ktoe, meeting the demand of economic sectors shown in the Figure 18 below. Petroleum products consumed by the transport sector represented over 38% of the total shares, which is nearly equivalent to 401 ktoe.

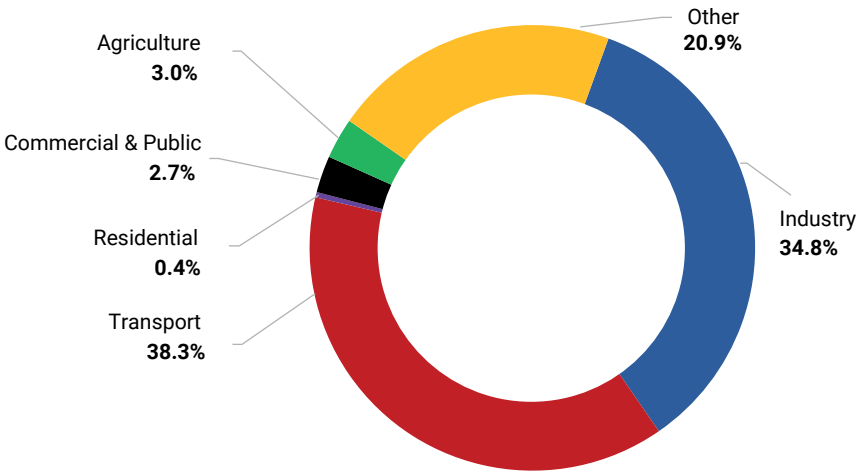

Figure 18: Proportion of Petroleum Products Consumed by Different Economic Sectors in 2016

The petroleum products consumed in Zambia mainly comprise petrol, diesel, kerosene, jet oil, LPG and fuel oil. A study conducted by Channoil modelled the demand for this fuel mix (Figure 19).

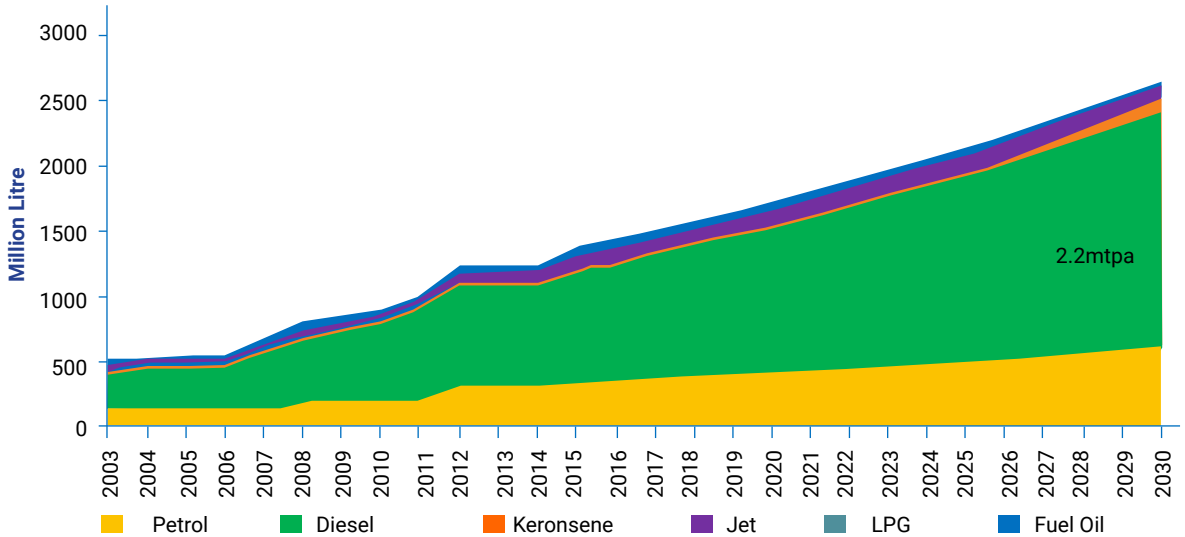

Figure 19. Modelled Liquid Fuel Mix Consumption in Zambia (Lower Case Scenario)

To enhance the competitiveness of the Zambian economy, the reliance on oil imports should be reduced, and improving the EE of the transport sector should become a top priority.

A 2019 study called 'Sustainable Low Emissions Transport Study for Zambia – SLET' developed by the Global Fuel Economy Initiative (GFEI) with its partner ZEMA to help Zambia launch its fuel economy and emissions control works. The findings of this study can be organised into the five categories presented below.

(i) Baseline Data

- Approximately 751,208 motor vehicles were registered in 2018, with a 60% share of LDVs (defined as weighing 3,500 kg or less).
- The necessary data represented by the CO_2 emissions and the average fuel consumed per travelled distance were not available. Hence, estimates were considered based on internationally accepted methodologies.
- Baseline specific fuel consumption was found to be 8.6 l/100 km.
- Baseline CO_2eq emissions were found to be 217.6 g/km.
- An established Business As Usual (BAU) scenario revealed that the Zambian fuel economy will have worsened by 53% regarding consumption and 63% in terms of CO_2Eq emissions.

(ii) Regulatory Framework

- No regulations exist for the deregistration of old vehicles.
- The importation of new vehicles no older than 5 years is indirectly promoted via the disincentivisation of the Motor Vehicle Surtax (MVS). This approach was found to be ineffective.
- Another ineffective charge, called the Carbon Emissions Surcharge, applied annually on all vehicles, was found to be irrelevant to purchase decisions regarding motor vehicles.
- Electric Vehicles (EVs) are incentivised well, with 100% free customs on imported vehicles. However, the market uptake of EVs in Zambia is negligible.

(iii) FuelQuality

- Three mandatory standards regarding fuel quality exist, with the main focus on sulphur content. However, these mandatory standards are too weak.
- One refinery produces 43% of national fuel in compliance with the fuel quality standards, while the remaining 57% is imported from neighbouring East African Countries and South Africa, which have quality levels higher than the Zambian standards.

(iv) SLET document recommends 23 policies under the following six thematic areas.

- Legal and institutional (i.e. developing fuel standards and banning the importation of old vehicles).
- Public awareness (i.e. high-impact awareness campaigns).
- Market-based incentives (i.e. incentives for the production of eco-transport components).
- Technology (i.e. research and development on eco-transport solutions).
- Infrastructure (i.e. strategic investments in EV/hybrid charging stations).
- National budget (i.e. acceptance of reduced revenues as a trade-off for environmental benefits).

The energy intensity of transport sector in Zambia is 14% higher than the global energy intensity.

5.3.2. Energy Efficiency Actions for the Transport Sector

The energy intensity of transport sector in Zambia is 14% higher than the global energy intensity. This presents an opportunity to save energy in the sector. The recommended actions must spur progress in two main areas:

1) Improving the EE (i.e. fuel economy) of vehicles; and

2) Increasing the availability and use of sustainable, low-carbon fuels.

(a) Vehicle Tuning Programme

The vehicle tuning programme will improve the efficiency of vehicles by improving their combustion efficiency. This will lead to reductions in fuel consumed, greenhouse gases and the running costs on vehicle owners.

Table 23: Vehicle Tuning Programme-Related Actions

Action Description	Vehicle Tuning Programme
Type of Action	Capacity building and development
Sector	Public, private and commercial transport.
Start/End Date	2022–2024
Target	*a)* Vehicle tuning programme introduced and tuning stations established in all Zambian provinces.
Implementation Body	MoE, MoTL, NGOs
Project Cost	ZMW 3,400,000
Potential Energy Savings	10% potential fuel savings for tuned vehicles
CO_2 Emission Reduction	10% potential savings on the fuel mix used in the tuned vehicles.
Necessary Activities	i) Tune 200 cars for free as a pilot phase. ii) Continue tuning activities at discounted fees. iii) Train mechanics in vehicle tuning. iv) Undertake vehicle tuning awareness campaigns. v) Develop the vehicle tuning programme. vi) Enforce vehicle tuning.
Expected Outcomes	*i)* Cost savings on fuels promoted for end users to join the initiative. *ii)* New business models generated and employment increased.

(b) Develop Legislative Decrees Supporting Biofuels

Fuel blending is considered an efficient method to displace petroleum with alternative fuels. Fuel blending will also lead to reduced CO_2 emissions, as the alternative fuels have lower CO_2 emission factors compared to petroleum products.

Table 24: Legislative Decrees Supporting Biofuels Related Activities

Action Description	Fuel Blending Programme
Type of Action	Market enabling and development
Sector	Public, private and commercial transport.
Start/End Date	2022–2026
Target	*a)* Attain 5% biodiesel and 10% bioethanol blending ratios in diesel and petrol engines, respectively.
Implementation Body	MoE, MoTL, MoA, BAZ, MCTI, ZAM, ZACCI, CMZ, Landowners, Biofuel Producers, Traders
Project Cost	USD 50,000
Potential Energy Savings	3% energy savings
CO_2 Emission Reduction	Fuel blending under this programme will generate a 5%–8% reduction in petroleum product consumption in internal combustion engines.
Necessary Activities	i) Conduct a prefiguration study of economic and financial viability of production costs, land requirements to meet the mandates and environmental benefits of biofuel use in the transportation fuel mix.[44] ii) Test and certify the current producers of biofuels in Zambia. iii) Conduct market survey regarding the number of engines suitable for fuel-blending. iv) Undertake awareness campaigns. v) Conduct a market assessment regarding the production potential of biodiesel and bioethanol. vi) Conduct a market demand study on potential growth in biofuel demand. vii) Introduce incentives and conduct a market entry barrier assessment to promote the involvement of the private sector in the biofuel supply chain.
Expected Outcomes	*i)* Use of blended fuels for combustion engines popularised.

(c) Improve Energy Consumption in the Transport Sector

Public transportation use is one of the most effective actions individuals can take to reduce their energy consumption. Switching from the use of a private car to public transport can reduce CO_2 emissions by up to 30%.

Table 25: Improvement of Energy Consumption in Transport Sector Related Activities

Action Description	Promote Increased Use of Public Transport
Type of Action	Market development
Sector	Public transport
Start/End Date	2022–2028
Target	*a)* Transition 5% of private car commuters to public transportation.
Implementation Body	MoTL
Project Cost	ZMW 2,550,000
Potential Energy Savings	3% expected fuel savings
CO_2 Emission Reduction	3% expected emissions reduction
Necessary Activities	i) Conduct a study to determine the scope and mass transit lines to be added based on a cost–benefit analysis (a gender analysis of the transportation needs and patterns regarding men and women will be part of the study). ii) Increase public transport services during off-peak hours. iii) Designate emergency carpool lanes along all motorways and create park-and-ride lots and a match-riders programme.
Expected Outcomes	*i)* Access to affordable, energy-efficient and high-quality mass-transit means among citizens increased.

44 A programme for the promotion of biofuels in the transport industry was initiated following the adoption of the NEP 2019. An SI legalising biofuel; standards and a regulatory framework on biodiesel; and pricing methodologies were developed, while a zoning exercise was completed with the support from the Government of Brazil. This initiative subsequently saw the establishment of the Biofuels Association of Zambia, the Civil Society Biofuels Association, and district and provincial biofuels farmers' networks. The government has declared biofuels a priority sector, and this will see investors benefit from the appropriate incentives. However, the economic and financial viability of production costs, the land requirements to meet mandates and the environmental benefits have not yet been studied. At the same time, the Food and Agriculture Organisation resource assessment will to some extent incorporate these aspects. A viable biofuels industry will depend on a sustained supply of cost-effective feedstocks.

(d) Eco-Driving Programme

EVs have a lower carbon footprint compared to gasoline-powered cars, regardless of the source of electricity used to charge the vehicles. Renewable energy sources can enhance the environmental benefits of switching to EVs.

Table 26: Eco-Driving Programme Related Actions

Action Description	Eco-Driving Programme
Type of Action	Market enabling
Sector	Transport
Start/End Date	2025–2030
Target	*a)* Conduct a market potential and gap analysis study.
Implementation Body	MoE, MoTL, IFIs
Project Cost	ZMW 2,550,000
Potential Energy Savings	Energy savings will be determined based on the results of the study. Estimated energy savings from previous experience: 5%–10%.
CO_2 Emission Reduction	TBD
Needed Activities	i) Conduct a prefiguration study of the market potential of e-mobility in Zambia and the necessary intervention actions. ii) Conduct a detailed gap analysis and necessary policy and regulatory intervention actions for the market uptake of e-mobility in Zambia.
Expected Outcomes	*i)* Next steps towards the future utilisation of EVs understood thoroughly.

(e) Railway Development Programme

The use of bulk transportation modes for goods and passengers will reduce the reliance on a high number of private vehicles, resulting in reduced energy intensity for transport.

Table 27: Railway Development Programme Related Actions

Action Description	Railway Development Programme
Type of Action	Market enabling and development
Sector	Public transport
Start/End Date	2025–2030
Target	*a)* Attain 15% increase in cargo volumes and passengers transported by rail.
Implementation Body	MoTL, IFIs
Project Cost	ZMW 4,250,000
Potential Energy Savings	50% fuel savings for cargo switched from road transport to railways.
CO_2 Emission Reduction	TBD based on the study.
Necessary Activities	i) Develop and implement a railway transport strategy and action plan. ii) Conduct a gender analysis as part of the investigation in order to identify actions that respond to men's and women's needs.
Expected Outcomes	*i)* Energy consumption reduced upon implementation of the National Railway Transport Action Plan.

Table 28 provides a summary of the actions supporting the Strategic Objectives.

Table 28: Energy Efficiency Actions Matrix

EE Actions	Targets	Expected Outcomes	Timeline	Implementation Bodies
SO1: To develop and Establish a Regulatory Framework to Support Energy Efficiency.				
LPG Cylinder Exchange Programme (Ch. 5.1.2., Table 5)	*a)* Adopt legislation for cylinder exchange programme.	*i)* Access to clean cooking solutions increased.	2022–2024	MoE, ZABS, ERB
Sustainable Building Code (Ch.5.2.1.2, Table 13)	*a)* Develop an obligatory sustainable building code for new construction projects.	*i)* Mandatory building code for new buildings developed. *ii)* Building energy consumption reduced. *iii)* Final energy consumption projections based on energy use and building category determined and compared to historic data.	2022–2030	NCC, MoE, MIHUD
LED Lighting (Ch. 5.1.2.,Table 9)	*a)* Distribute 1 million LED lamps for the households by 2023. *b)* Distribute 3.5 million LED lamps at half price with a guarantee of 20,000 working hours by 2027. *c)* Distribute 11.5 million LED lamps by 2032.	*i)* Incandescent lamps phased out. *ii)* CFL lamps upgraded to LED lamps. *iii)* Financial incentive schemes for lighting upgrades established.	2022–2030	ZESCO, MoE
Fuel Blending Programme (Ch. 5.3.2., Table 24)	*a)* Attain 5% biodiesel and 10% bioethanol blending ratios in diesel and petrol engines, respectively.	*i)* Use of blended fuels for combustion engines popularised.	2022–2026	MoE, MoTL, MoA, BAZ, MCTI, ZAM, ZACCI, CMZ, Land Owners, Biofuel Producers, Traders

EE Actions	Targets	Expected Outcomes	Timeline	Implementation Bodies
SO2: To develop a Common Strategy to Promote the Utilisation of Best Practices in Industry by Developing and Adopting Energy Efficiency Benchmarks Specific to the Zambian Industrial Sector.				
National Benchmark Programme (Ch.5.2.2., Table 15)	*a)* Establish national energy benchmark for selected heavy industries.	*i)* Energy practices improved and energy consumption reduced.	2022–2025	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Mandatory Energy Audits and ISO 50001 (Ch.5.2.2., Table 16)	*a)* Attain 15% energy savings for the industry and agriculture sectors.	*i)* Mandatory energy audits conducted for all industrial facilities and definition of energy saving opportunities. *ii)* EnMS implemented according to the ISO 50001 standard.	2022–2026	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Voluntary Energy Audit Programme to Reduce Energy Consumption (Ch.5.2.3., Table 19)	*a)* Attain 10% energy savings for industry and 15% savings for the water utilities and agriculture sectors.	*i)* Awareness of EE and RE opportunities increased. *ii)* No-/low-cost energy-saving opportunities and behaviour change implemented.	2023–2025	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs, Water Utilities
SO3: To adopt Market-Based Mechanisms to Integrate Energy Efficiency in Business Practices.				
Promotion of ESCO Model (Ch.5.2.3., Table 20)	a) Establish ESCO development programme. *b)* Develop funding mechanism for ESCO financing. *c)* Strengthen technology service providers.	*i)* EE and RE projects in Zambia deployed through Green Economy Financing Mechanism. *ii)* A market for the ESCO business model created.	2025–2030	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Energy Labelling for Appliances (Ch.5.1.2., Table 11)	*a)* Develop energy labelling code for four appliances (light bulbs, refrigerators, air conditioners and tvs).	*i)* Energy labelling code developed. *ii)* Minimum Energy Performance Standards developed.	2022–2025	MoE, MCTI, ERB, ZABS, ZRA
DSM Programme (Ch.5.2.3., Table 18)	*a)* Deploy energy-efficient equipment in the market (20,000 refrigerators and 10,000 inverter ac units).	*i)* Energy-efficient appliances utilised throughout different economic sectors in Zambia.	2023–2026	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs

EE Actions	Targets	Expected Outcomes	Timeline	Implementation Bodies
SO4: To utilise Energy Pricing as a Tool to Promote Energy Efficiency Technologies				
Produce Biogas from Organic Waste for Cooking (Ch. 5.1.2., Table 3)	*a)* Attain 20% increase of biodigesters across the country.	*i)* Biogas technologies market uptake created. *ii)* Access to clean cooking solutions increased. *iii)* Enabling environment for ESCO business created.	2024–2030	MoE, Line Ministries
Pay As You Go Cooking Solutions (Ch. 5.2.1., Table 6)	*a)* Deploy 100,000 efficient stoves by 2027. *b)* Attain 10,000 MT of wood pellets usage per year.	*i)* Access to clean cooking solutions increased. *ii)* Inefficient stoves and open firewood systems substituted with efficient pellet stoves. *iii)* Socioeconomic benefits realised.	2022–2027	ERB, MoE
LPG and Biomass Cooking Systems (Ch. 5.1.2., Table 4)	*a)* Deploy biomass and improved cookstoves. *b)* Establish LPG distribution and storage centres in Northern, Eastern and Central Provinces.	*i)* Access to clean cooking solutions increased. ii) Inefficient stoves and open firewood systems substituted with LPG and efficient cookstoves.	2022–2027	MoE, Line Ministries, ZABS
Energy-Efficient Cooking (Ch. 5.1.2., Table 7)	*a)* Attain 20% of cooking using energy-efficient cooking	*i)* Access to clean cooking solutions increased. *ii)* Inefficient stoves and open firewood systems substituted with energy-efficient cooking systems.	2022–2030	MoE, ZESCO
SO5: To implement Awareness and Capacity Building Programmes for Institutions, Experts and the Public to Promote Energy-Saving Policies and Adopt Standards and Procedures, while Empowering Women to Support Energy Efficiency Decisions and Activities.				
Awareness and Capacity Building Programmes for Light Industry (Ch.5.2.3., Table 17)	*a)* Attain 15% energy savings for light industries, including water utilities.	*i)* Awareness raised regarding the importance of EE and RE projects. *ii)* Capacity building programmes established for EE measures for the industrial and commercial sectors. *iii)* No-/low-cost measures applied. *iv)* Awareness of the negative environmental impacts of using charcoal undertaken.	2022–2024	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs, Water Utilities

EE Actions	Targets	Expected Outcomes	Timeline	Implementation Bodies
Awareness and Capacity Building Programmes for Heavy Industry (Ch.5.2.2, Table 14)	*a)* Attain 10% energy savings for heavy industries.	*i)* Capacity building programmes established/ conducted regarding EE measures for different heavy industries.	2022–2024	MoE, MCTI, ZAM, ZACCI, CMZ, Certified Experts, ESCOs
Vehicle Tuning Programme (Ch.5.3.2., Table 23)	*a)* Vehicle tuning programme introduced and tuning stations established in all Zambian provinces.	*i)* Cost savings on fuels promoted for end-users to join the initiative. *ii)* New business models generated and employment increased.	2022–2024	MoE, MoTL, NGOs
SO6: To ensure Coordinated Collaboration of all Stakeholders to Achieve Energy Efficient Economy.				
Development of Energy-Efficient Building Materials (Ch.5.1.2., Table 10)	*a)* Develop energy-efficient building materials using elements from the local environment to reduce energy losses in building.	*i)* Methodology and machinery to produce energy-efficient building blocks and other building materials developed.	2022–2025	MoE, TDAU, ZABS, ERB, MCTI
Promote Increased Use of Public Transport (Ch.5.3.2., Table 25)	*a)* Transition 5% of private car commuters to public transportation.	*i)* Access to affordable, energy-efficient and high-quality mass transit among citizens increased.	2022–2028	MoTL
Eco-Driving Programme (Ch.5.3.2., Table 26)	*a)* Conduct a market potential and gap analysis study.	*i)* Next steps towards the future utilisation of EVs understand tho.	2025–2030	MoE, MoTL, IFIs
Railway Development Programme (Ch.5.3.2., Table 27)	*a)* Attain 15% increase in cargo volumes and passengers transported by rail.	*i)* Energy consumption reduced on implementation of the National Railway Transport Action Plan.	2025–2030	MoTL, IFIs

6. Implementation Framework

6.1. Institutional Arrangements

Implementation of the EESAP will be undertaken by a broad range of stakeholders led by MoE, as the custodian of the energy sector. MoE will be supported by key public sector institutions and line ministries, as well as the private sector and financial institutions. Academia, NGOs, local communities and Development Partners (DPs) will play a major role in supporting various activities. Effective implementation will require the efforts and close cooperation of these stakeholders.

6.2. Governance and Execution

6.2.1. Public Sector Entities

Since EE activities cut across many sectors, several government institutions will be involved in the implementation of sector-specific activities, working in collaboration with other public entities and key stakeholders. These roles and responsibilities for each activity have been presented in Chapter MoE will oversee and coordinate most activities and will be involved in all activities. Similarly, Ministry of Infrastructure, Housing and Urban Development (MIHUD), Ministry of Commerce, Trade and Industry (MCTI), MoTL and Ministry of Agriculture (MoA) will also play key roles in the implementation of proposed activities.

ERB will play a coordinating role for many activities as the independent regulator of the energy sector. Similarly, other public entities, such as ZESCO and NCC will be actively involved in the development and implementation of the identified interventions.

6.2.2. Private Sector

The private sector is increasingly responsible for EE investments alongside the public sector and plays an important role in delivering energy services using various business models. Most of the activities in this strategy are aimed at enabling private sector investment by removing market barriers that prevent efficient private sector participation. Therefore, the private sector will be actively involved by providing inputs into the design of the interventions, participating in working groups and actively participating in the implementation of the activities. In addition, the private sector is expected to provide feedback and data to MoE for monitoring and evaluation purposes.

6.2.3. Nongovernmental Organisations and Civil Society

NGOs and civil society play an important role in EE awareness, as their organisations work closely and directly with communities. They understand community needs and challenges better than other organisations, as they are embedded in communities. Therefore, NGOs will be involved in designing and implementing relevant community interventions. They will provide useful information to track implementation and on-the-ground support for EE projects and programmes.

6.2.4. Academia and Research and Development Institutions

Academic and research institutions will play an important role under this strategy in interventions related to capacity building, technology development and demonstration. Research and Development institutions will participate in thematic working groups to provide technical inputs and ensure interventions are grounded on sound scientific principles.

6.2.5. Development Partners

DPs have been playing an important role in catalysing EE investment in Zambia. They will be involved in the design and implementation of the interventions by providing support and resources to the government to undertake the various activities. This support will be in the form of technical assistance, capacity building and grants.

6.2.6. National Thematic Working Groups

For the effective implementation of the strategy, thematic and activity-specific working groups will need to be established under the coordination of the relevant governmental departments. These working groups will be composed of relevant stakeholders drawn from key government agencies, the private sector and key thematic experts. Overall coordination of the implementation of the strategy will be under the MoE's designated EE unit. This unit will provide strategic, policy and institutional guidance for the strategy implementation; guide the national working groups and ensure coordinated implementation of the strategy at a national level. In addition, the unit will be the link with the regional SADC and COMESA Renewable Energy and Energy Efficiency Strategy and Action Plan.

6.3. Legal Framework

The EESAP will be implemented within the existing legal framework through the various Acts of Parliament which govern the resource management and development for the energy sector. These pieces of legislation include among others: The Constitution of Zambia (Amendment Act No. 2 of 2016); The Electricity Act No. 11 of 2019; The Energy Regulation Act No.12 of 2019; The Rural Electrification Act No. 20 of 2003. In the process of implementation, any norms, practices or legislation that might inhibit the successful implementation of the EESAP will be reviewed and/or revised accordingly.

6.4. Resource Mobilisation and Financing

Implementation of the EESAP will require adequate human, financial, material and technical resources. Funding for the implementation of the EESAP will be secured from the following sources:

a) Government national budget;

b) Cooperating Partners;

c) Private Sector; and

d) Any other alternative funding source.

6.5. Monitoring and Evaluation

The implementation of the EESAP will be closely monitored to ensure that it is adequately institutionalised in line with its objectives. The monitoring will be done in accordance with the Monitoring and Evaluation (M&E) Plan for the energy sector. The monitoring, evaluation and reporting of the plan shall be result-oriented, with result-based indicators attached to each objective to measure results at the outcome level.

The EESAP will undergo a midterm review after four years and a final-term review after eight years. The midterm assessment will focus on progress made in the implementation of the plan and assess the appropriateness of the overall strategic direction. Therefore, it will be designed to inform the remaining period of the policy and recommend adjustments where needed. The final evaluation will be undertaken after eight years and will focus on the impact of the implementation of the EESAP.

Adequate technical and financial resources will be allocated to the midterm assessment and final evaluation, which will be a participatory process and shall include implementing agencies and other relevant stakeholders from the public, private and civil society sector.

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