ENERGY REGULATION BOARD

調査

2022 ENERGY SECTOR REPORT





To be the benchmark of excellence in energy regulation in Africa by 2026

Efficiently regulate the energy sector and be responsive to stakeholder needs in order to achieve sustainable, reliable, and quality energy products and services





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ABBREVIATIONS

	Af 's an David survey I David
ATDB	African Development Bank
AFRI	African Refiners Association
Avgas	Aviation gasoline
BOZ	Bank of Zambia
BPC	Bangweulu Power Company limited
BSA	Bulk Supply Agreement
CEC	Copperbelt Energy Corporation Plc
CIG	Cities Infrastructure Growth Zambia
CoSS	Cost of Service Study
COVID-19	Corona Virus Disease
DNSP	Distribution Network Service Provider
EF	Energy Fund
ERB	Energy Regulation Board
ESAP	Electricity Services Access Project
ESI	Electricity Supply Industry
EU	European Union
GDP	Gross Domestic Product
GET FIT	Global Energy Transfer Feed-in Tariff
GRZ	Government of the Republic of Zambia
HFO	Heavy Fuel Oil
IAEREP	Increased Access to Electricity and Renewable Energy Production
IDC	Industrial Development Corporation
IMF	International Monetary Fund
INDENI	INDENI Petroleum Refinery Company Limited
IPP (Petroleum) ⁱ	Import Parity Pricing
IPP (Electricity)"	Independent Power Producer
IRP	Integrated Resource Plan
ITT	Itezhi Tezhi Dam
KGL	Kafue Gorge Lower
KGLDC	Kafue Gorge Lower Development Corporation Limited
KGU	Kafue Gorge Upper
KNB	Kariba North Bank
KNBE	Kariba North Bank Extension
KNBEPC	Kariba North Bank Extension Power Corporation Limited
KPI	Key Performance Indicator
LHPC	Lunsemfwa Hydropower Company Limited
LPG	Liquefied Petroleum Gas
LSG	Low Sulphur Gasoil
MCL	Maamba Collieries Limited

Relates to Import Parity Pricing model for petroleum sections of the report Relates to Independent Power Producer for Electricity sections of the report

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MD	Maximum Demand
MoE	Ministry of Energy
MYTF	Multi-Year Tariff Framework
NAZOP	Namibia- Zambia Oil Pipeline
NECL	Ndola Energy Company Limited
NEP	National Energy Policy
NFT	Ndola Fuel Terminal
NPCL	Ngonye Power Company Limited
NSOE	Non-State Owned Enterprise
NWEC	Northwestern Energy Corporation Limited
OMC	Oil Marketing Company
OPEC	Organisation of the Petroleum Exporting Countries
PAP	Posted Airfield Price
PPA	Power Purchase Agreement
PQD	Power Quality Directives
PQMS	Power Quality Management System
PQRs	Power Quality Recorders
PSA	Power Supply Agreement
REA	Rural Electrification Authority
REMP	Rural Electrification Master Plan
SADC	Southern Africa Development Community
SAPP	Southern African Power Pool
SBP	Strategic Business Plan
SDG	Sustainable Development Goal
SI	Statutory Instrument
SME	Small and Medium Enterprise
SMG	Standard Micro Grid
SOE	State Owned Enterprise
SRF	Strategic Reserve Fund
UPP	Uniform Pump Price
USAID	United States Agency for International Development
TAZAMA	TAZAMA Pipelines Limited
TEVETA	Technical Education, Vocational and Entrepreneurship Training Authority
TPPL	TAZAMA Petroleum Products Limited
WTI	West Texas Intermediate
ZABS	Zambia Bureau of Standards
ZEMA	Zambia Environmental Management Agency
ZMD	Zambia Meteorological Department
ZRA	Zambia Revenue Authority
ZSA	Zambia Statistics Agency
ZPL	Zengamina Power Company Limited
ZESCO	ZESCO Limited
ZPDF	Zambia Power Development Framework

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UNITS OF MEASUREMENT

Bbl	Barrels of oil
GWh	Giga-Watt hour (1,000 MWh)
Κ	Zambian Kwacha
Kg	Kilograms
Km	Kilometre
kV	Kilo Volt
kVA	Kilo Volt Amperes (1,000 Volt Amps)
kW	Kilo Watt
kWh	Kilo Watt Hour
L	Litre
m/bd	Million barrels per day
MW	Mega Watt
MWh	Mega Watt Hour (1,000 kWh)
MT	Metric Tonne (in this document means a mass equivalent to 1,000 kg)
m ³	Cubic Meters
US\$	United States of America dollar

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Ngonye Power Company Limited
Northwestern Energy Corporation Limited
Office for Promotion of Private Power Investment
Oil Marketing Companies
Road Transport and Safety Agency
Rural Electrification Authority
Standard Microgrid Zambia
TAZAMA Pipelines Limited
TAZAMA Petroleum Products Limited
Zambia Revenue Authority
Zambia Statistics Agency
Zengamina Power Limited
ZESCO Limited

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FOREWORD



The energy sector is a key driver for economic activity world over, in this regard, changes in the sector have a significant impact on any economy. During the past year, unforeseen global events led to unprecedented impacts in the global energy sector and local economies, of which, Zambia was not spared. However, our local economy showed resilience and recorded 4.7 percent growth¹ at a time when there was economic turmoil globally. Against this background, it is my foremost pleasure to present the 2022 Energy Regulation Board (ERB) Energy Sector Report.

This edition of the Energy Sector Report highlights the key developments that have taken place in the sector, focusing on three main sub-sectors, namely; electricity, renewable energy and petroleum. In the electricity sub-sector, growth was demonstrated by the increase in the generation capacity from 3,318.4MW in 2021 to 3,777.3MW in 2022. The increase was attributed to the construction and commissioning of Kafue Gorge Lower (KGL) Hydro Power Station owned by ZESCO Limited (ZESCO). This inevitably led to a 10 percent increase in generation sent out from 17,635.1GWh in 2021 to 19,399.1GWh in 2022. Moreover, some other notable

developments in the sector included the issuance of a white paper on the Electricity Cost of Service Study (CoSS) which outlined the government's position on the findings of the study.

In the petroleum sub-sector, consumption growth was attributed to the removal of global COVID-19 restrictions. There was a rise in the consumption of Jet A-1 which resulted in a 5.7 percent increase in total petroleum product consumption from 1,465,703.84 MT in 2021 to 1,549,274.44 MT in 2022. In addition, numerous reforms were implemented in the sector including the conversion of TAZAMA pipelines to a carrier of finished petroleum products, specifically, Low Sulphur Gasoil (LSG) only and the reconfiguration of INDENI Petroleum Refinery Company Limited (IDENI) to an Oil Marketing Company (OMC). Further, there was a policy directive aimed at increasing private sector participation in the importation of petroleum products, these reforms are discussed in greater detail in this edition of the Energy Sector Report.

During the year 2022, the ERB commenced pricing of Jet A-1 using the Import Parity Pricing (IPP) model. The model was implemented following extensive stakeholder consultation and a pilot phase which ran from June to October 2021, in order to assess the practicality of the transition from the Cost Plus Model (CPM) and to address any potential challenges. The decision to implement the IPP during the second quarter of 2022 was supported by the migration to the thirty (30) day pricing Cycle, for all petroleum products, following the Government's pronounced reforms for the petroleum sub-sector.

Further in 2022, the sale and distribution of high sulphur diesel² on the Zambian market was discontinued. This was in line with the AFRI-4 (African Refiners Association) road map to migrate to low sulphur content in gasoil of 50ppm and below by 2020; and the Southern African Development Community's (SADC) road maps to migrate to low sulphur content in gasoil of 50ppm and below by 2022.

¹Zamstats Volume Number 240, March 2023.

² High sulphur diesel relates to ordinary diesel



From a regulatory point of view, the number of licences issued by the ERB increased from 117 in 2021 to 361 in 2022 demonstrating our commitment to facilitate participation of new and existing players in the sector. The ERB noted the increased interest in setting up of service stations and proactively developed guidelines on the same to enhance public safety and predictability in the sub-sector. Moreover, the ERB continued to work with collaborative partners to make progress on regulatory interventions which will be highlighted in this report.

In addition to the aforementioned, the 2022 Energy Sector Report includes recent energy sector statistics for all three sub-sectors including licensing statistics for the past year. The report will also highlight the challenges experienced and prospects for the sector, beyond 2022. It is my sincere hope that this edition of the report will provide relevant and useful information to our readers.

Eng. Yohane Mukabe Director General **July 2023**





1.0 INTRODUCTION

Overview of Global Economic Performance

In 2022, the global economy was set on a path of modest economic recovery following reduced severity of the COVID-19 pandemic, as such; the initial growth forecast for the world economy was estimated at 4.4 percent³. However, resulting from the Russian invasion of Ukraine coupled with an array of factors ranging from an economic slowdown in China, emergence of new COVID-19 strains, soaring levels of global inflation and restrictive monetary policy; global growth prospects quickly diminished with forecasts revised downwards to 3.2 percent⁴.

As each country grappled with the unforeseen economic turmoil globally, domestic market pressures reduced demand for commodities particularly in China and Europe which are Africa's main trading partners. In this regard, the African Development Bank (AfDB) estimated that the continent's real Gross Domestic Product (GDP) would decline to 3.8 percent in 2022 from an estimated 4.8 percent in 2021. This resulted from the combined impacts of climate change risks, spillover effects from geopolitical tension, and lasting impacts from the COVID-19 pandemic⁵. Furthermore, the International Monetary Fund (IMF) reported that the regional economic outlook in Sub-Saharan Africa was negatively impacted by the slowdown in advanced economies, volatile commodity prices and tightening global financial conditions⁶.

The economic impacts of the Russia-Ukraine war are said to have impacted the Sub-Saharan region through three mediums namely: non-energy and energy commodity prices, financial markets and supply chain disruptions. Notably, these resulted in negative implications for African economies. In past years, agricultural exports from Russia and Ukraine to Africa (including maize, wheat, and vegetable oil) had accounted for at least 40 percent of each country's merchandise exports to the continent. However, resulting from the disruptions, food prices had soared to levels not seen before⁷. Additionally, the region also experienced numerous currencies depreciation against the United States dollar following the implementation of restrictive monetary policy in the United States⁸. This was partly due to the Federal Reserve rate hikes in an attempt to curb inflationary pressures. As a result, net importing nations were negatively impacted by the increased cost of imported goods during an already tumultuous time at which food and energy prices were soaring globally.

Overview of Domestic Economic Performance

Preliminary estimates indicated that the Zambian economy grew at a rate of 4.7 percent in 2022, a slight uptick from the 4.6 percent recorded in 2021⁹. The growth was attributed to amongst others, the growth of the Education, Transport and storage as well as the Information and communication sectors.

On the other hand, despite rising global inflation, prudent financial management of the local economy resulted in an inflation rate of 9.9 percent recorded in December 2022 compared to 16.4 percent recorded in December 2021. The inflation rate was declining throughout the year and reached a low of 9.7 percent (recorded in June and October before increasing slightly to end the year at 9.9 percent owing to seasonal demand for goods and services during the festive period)¹⁰. In this regard, the kwacha reported a depreciating trend towards the end of 2022 after recording some gains at the start of the year. The factors that contributed to the depreciation included low foreign currency supply amidst high demand to facilitate import payments for activities such as petroleum fuel, medicines, and agricultural inputs among others. It is worth noting that the monetary policy

³ International Monetary Fund, World Economic Outlook Update, January 2022.

⁴International Monetary Fund, World Economic Outlook Update, July 2022.

⁵ African Development Bank, *Africa's Macroeconomic Performance and Outlook*, January 2023. ⁶International Monetary Fund, *Regional Economic Outlook Sub Saharan Africa*, October 2022.

⁷African Development Bank, *African Economic Outlook*, May 2022.

⁸International Monetary Fund, *World Economic Outlook Update*, October 2022.

⁹ Zamstats Volume Number 240, March 2023.

¹⁰ Zamstats Volume Number 237, December 2022.



rate remained unchanged throughout the year at 9 percent owing to sustained deceleration of inflation and positive progress made on national debt restructuring¹¹.

During the last month of 2021 and the first two (2) months of 2022, the kwacha depreciated from K16.81/US\$ in December 2021 to K18.12/US\$ in February 2022 owing to foreign exchange demand pressures mainly attributed to the importation of petroleum products¹². However, despite the global trend of exchange rate depreciation, for the next 7 months the kwacha reported gradual gains to reach an average high of K15.65/US\$ in September 2022 owing to positive market sentiments resulting from the approval of the IMF Extended Credit Facility¹³. Further, the appreciation was also supported by increased supply of foreign exchange. However, demand pressures to facilitate the importation of agricultural inputs and petroleum products led to the kwacha depreciating to an end of year rate of K17.61/US\$ which was higher than the rate of K16.78/US\$ recorded a year earlier.

Energy Sector Contribution to GDP

The Zambia Statistics Agency (ZSA) Preliminary National Accounts estimated at constant 2010 prices highlighted that the economy grew at a rate of 4.7 percent from K144,090 million in 2021 to K150,927.40 million in 2022. Electricity contributed 0.2 percent to GDP as shown in the table below.

Industry	2021 (K'million)	2022 (K'million)	Annual Growth Rate (%)	% Contribution to Growth
Agriculture, forestry, and fishing	11,086	10,817	-2.4	-0.2
Mining and quarrying	14,343	13,711	-4.4	-0.4
Manufacturing	12,151	12,681	4.4	0.4
Electricity	2,624	2,873	9.5	0.2
Water supply	356	379	6.4	0.0
Construction	15,621	14,485	-7.3	-0.8
Wholesale and Retail Trade	26,713	27,127	1.5	0.3
Transportation and storage	5,986	7,690	28.5	1.2
Accommodation	2,195	2,670	21.6	0.3
Information and communication	10,019	11,497	14.8	1.0
Financial and Insurance activities	7,184	7,272	1.2	0.1
Real estate activities	5,226	5,417	3.7	0.1
Professional, scientific, and technical	2,747	3,216	17.1	0.3
Administrative and support service	1,441	1,360	-5.6	-0.1
Public administration and defence	6,411	6,758	5.4	0.2
Education	8,870	11,582	30.6	1.9
Human health	2,632	2,749	4.5	0.1
Arts, entertainment, and recreation	207	406	96.7	0.1
Other service activities	1,179	1,027	-12.9	-0.1
Total Gross Value Added for the economy	136,990	143,716	4.9	4.7
Taxes less subsidies	7,100	7,210	1.5	0.1
Total for the economy, at market prices	144,090	150,927	4.7	4.7

Table 1-1: Gross Value Added by industry at constant 2010 prices, 2021-2022

Source: Zambia Statistics Agency, National Accounts



¹¹Bank of Zambia, MPC Statement, November 2022.

¹²Bank of Zambia, MPC statement, February 2023.

¹³Bank of Zambia, MPC statement, November 2022.



Performance of the Global Energy Sector

In 2022, the global energy sector grappled with unique challenges largely caused by the Russian invasion of Ukraine, the economic slowdown in China and persistent global inflationary pressures. The Russian-Ukraine war led to unprecedented effects which included an unforeseen global energy crisis particularly in Europe which resulted into an increase in the cost of living and dampened economic activity. More specifically, European gas prices have more than quadrupled since 2021 as Russia has significantly scaled back exportation of the commodity which serves as a staple for cooking and heating at household level.¹⁴

Further, the Russian-Ukraine war has had an undesirable impact of reducing access to electricity as it becomes more unaffordable and impedes the drive towards clean energy. This is because the most vulnerable in society are forced to switch to less cleaner alternatives such as firewood which is more affordable. Evidently, as a world leader in the export of petroleum products, the impact of sanctions to Russia had disrupted the world energy supply and specifically for natural gas. As a result, the market prices had increased to highs of US\$250/bbl which is significant as "high gas and coal prices account for 90 percent of the upward pressure on electricity costs around the world" ¹⁵. The combined impact of the war and global financial distress is that progress towards achievement of Sustainable Development Goal (SDG) 7 of ensuring access to affordable, reliable, sustainable, and modern energy by 2030 is being set back as energy prices increase substantially¹⁶.

However, there is a strong policy drive globally to fast-track investment in renewables in order to tackle the crisis and this will continue to take centre stage in tandem with other climate reforms¹⁷. Notwithstanding the energy crisis, global electricity demand grew by 2 percent in 2022 driven by increased sale of electric vehicles and heat pumps. Further, growth prospects appear promising in the global electricity sector owing to increased investment in both renewable and nuclear energy in the next few years with a majority of the generation emanating from China and the European Union (EU).¹⁸

During 2022, crude oil prices fluctuated between US\$122.71/bbl recorded in June 2022 and US\$76.44/ bbl in December 2022. Crude oil prices were on an upward trajectory during the first half of the year before declining to as low as US\$76.44/bbl in December 2022. Notably, the upward trajectory during the first half of the year was due to supply concerns stemming from the combination of geopolitical tension between Russia and Ukraine; and low global crude oil inventories. With regards to the second half of the year, crude oil prices generally decreased due to concerns about a possible economic recession. This resulted in reduced demand that coupled with severe COVID-19 containment measures in China (one of the major consumers of oil), further contributed to lower global petroleum demand. In addition, there was an increase in crude oil supply from the United States and international Strategic Petroleum Reserve release programs, which increased the global supply of crude oil, thus pushing prices downwards.

Performance of the Local Energy Sector

Performance of Electricity Sub-sector

In 2022, the installed electricity generation capacity significantly increased as a result of the construction and commissioning of KGL power project. In this regard, the national installed electricity generation capacity increased to 3,777.3MW from 3,318.4MW recorded in 2021. It is worth noting that out of the total electricity generation installed capacity, 5.5MW was attributed to mini-grids. On the other hand, 3,771.8MW was on-grid generation capacity which also included Copperbelt Energy Corporation (CEC) standby emergency generators with a combined capacity of 80MW.

Zambia's national installed capacity was dominated by hydro generation accounting for 84 percent from 87.3 percent in 2021. The national electricity generation sent out increased by 10 percent to 19,399.12GWh in 2022 from 17,635.05GWh recorded in 2021. This growth was attributed to the commissioning of three (3) additional

¹⁵International Energy Agency, World Energy Outlook 2022

¹⁴ International Monetary Fund, World Economic Outlook Update, October 2022

¹⁶ IEA, IRENA, UNSD, World Bank, WHO, Tracking SDG 7: The Energy Progress Report, 2022

¹⁷International Energy Agency, Renewables 2022

¹⁸International Energy Agency, Electricity Market Report 2023, February 2023



150MW generation units recently commissioned at KGL Power Station. Further, electricity generation from the IPPs increased by 73 percent from 3,638.0GWh in 2021 to 6,280.0GWh in 2022. The increase was attributed to increased generation from KGL and Maamba Collieries Limited (MCL) which posted increases in generation of 232 and 67 percent respectively.

In order to maximize growth potential for the electricity sub-sector, a number of policy developments took place in 2022. In this regard, the Ministry of Energy (MoE) with support from Cities Infrastructure Growth Zambia (CIG Zambia) successfully completed the development of the Zambian Integrated Resource Plan (IRP) which is expected to be launched in 2023. The IRP provides a structured plan for generation, transmission, and distribution infrastructure in Zambia for the next 30 years while accounting for security of supply and environmental protection.

In addition, the Zambia Power Development Framework (ZPDF) was developed to lessen the burden to investors in terms of inquiring the procedures and processes for obtaining licenses for power projects. To this effect, the framework improves efficiency as it clearly stipulates the procedures and processes involved in the development of projects in the electricity sub-sector. Furthermore, in order to optimize use of financial resources, the Energy Efficiency Strategy and Action Plan were launched to support systematic implementation of various energy efficiency measures with a goal to realize energy savings and thus defer investments in energy infrastructure.

Furthermore, in August 2022, Government issued a Green Paper aimed at serving as a consultative document to enlist stakeholder input on the Government's preliminary positions on the findings and recommendations of the Cost of Service Study (CoSS). Moreover, following extensive stakeholder consultations in all the 10 Provinces of Zambia, a White Paper which contained the final positions and guidance of Government on the findings and recommendations of the study was issued.

Performance of Petroleum Sub-sector

In 2022, there was a recorded increase in national consumption for petroleum products by 5.7 percent from 1,465,703.84 MT in 2021 to 1,549,274.44 MT in 2022. This was mainly on account of a significant increase in consumption of Jet A-1 by 41.3 percent. It is noteworthy that while there was a general increase in consumption of all petroleum products, there was a substantial reduction in consumption of kerosene from 2,536.84 MT in 2021 to 833.04 MT in 2022 representing 67.2 percent.

Various reforms were undertaken in the petroleum sub-sector, in 2022 to improve efficiency in the petroleum supply chain. The first was the withdrawal of Government from the importation and supply of petroleum products. Following this development, all importation of petroleum products was left to the private sector with a view to create business and employment opportunities. Consequently, the ERB continued implementing this policy through cost reflective pricing, maintenance of strategic reserves, and fuel monitoring in line with its mandate of ensuring security of supply.

In another key development, work had commenced to institutionalize policy frameworks aimed at facilitating conversion of TAZAMA pipeline from a transporter of petroleum feedstock to a carrier of finished petroleum product, specifically LSG. In this regard, it was envisaged that once fully operational the transportation cost for importing LSG will reduce as all stock of LSG is currently transported in fuel tankers via road¹⁹. Similarly, INDENI Oil Refinery was converted to an OMC while work had commenced to facilitate conversion of INDENI infrastructure from a crude oil processing plant to a biofuel blending facility. In this regard, the refinery will undertake blending of locally produced biodiesel and ethanol with imported diesel.²⁰.

In 2022, the MoE successfully reviewed the Petroleum Act Cap 435 of the Laws of Zambia. The revision is aimed at enhancing operational efficiency in the petroleum sub-sector and upgrading provisions in line with international best practices. Moreover, in order to further support expansion of the petroleum sub-sector, an MoU between Namibia and Zambia for the Namibia-Zambia Oil Pipeline (NAZOP) was signed. The MoU was aimed at facilitating the development of a petroleum pipeline from Namibia to Zambia via Chirundu.



¹⁹ Minister of Finance, 2023 Budget Speech

²⁰ Presidential Speech from 2nd Session of National Assembly



The ERB undertook monthly revisions of the wholesale and pump prices of petroleum products based on the Cost-Plus pricing model during the year 2022. This entailed a revision of the 60 days fuel pricing cycle to 30 days following the market reforms in the operation of the state-owned petroleum utilities. As a result, the ERB remained proactive in ensuring that the prevailing pump prices were responsive to changes in market fundamentals which include the exchange rate and international oil prices. Further, following the reforms, the ERB equalized the pump price of ordinary diesel and low sulphur diesel which implied that there was only one pump price for diesel

Performance of Renewable Energy Sub-sector

During 2022, significant policy developments had taken place in the renewable energy sub-sector. In this regard, the Renewable Energy Strategy and Action Plan were launched to ensure systematic investment into the renewable energy market. Furthermore, the MoE working in collaboration with the Ministry of Green Economy and Environment endorsed the Zambia Renewable Energy Financing Framework. The framework is expected to catalyse private investment in the renewable energy sector thereby accelerating the achievement of electricity generation and diversification targets.

Energy Sector Outlook

At policy level, in the short term, planned developments for the sector include the following:

- i. Assenting of the Rural Electrification Bill;
- ii. Review of the Petroleum Development and Management Bill;
- iii. Review of the Rural Electrification Master Plan; and
- iv. Production of the Biogas Feasibility Study Report.

The electricity sub-sector outlook is promising both in the short term and the long term. In the short term, the ERB is scheduled to conclude the Multi-Year-Tariff Framework (MYTF) for Zambia's electricity sector through technical support from European Union (EU) through the Increased Access to Electricity and Renewable Energy Production (IAEREP) programme. Similarly, the ERB is scheduled to complete development of Open Access Regulations and new Market Design and Structure in 2023, through technical support from German Government, through KfW Development Bank.

With regards to power generation, it is expected that a 33MWp solar plant under construction by CEC will be commissioned. The plant will contribute to the global energy transition and the country's efforts to diversify its power sources and make available reliable, sustainable, and affordable electricity. In addition, it is expected that the last 150MW unit at KGL will be commissioned in early 2023, further increasing short term generation prospects.

The outlook for the Petroleum sub-sector also appears positive with increased prospects of security of supply following the planned commissioning of the New Lusaka Fuel depot in 2023. Further, it is expected that following reforms in the operation of the state-owned petroleum utilities, TAZAMA pipelines will commence to pump LSG into the country in 2023. This is envisioned to reduce the transportation cost of the commodity which should reduce the local price of LSG on the Zambian market.

Structure of the 2022 Energy Sector Report

This report is arranged in six sections as follows: section one is the introduction, while section two highlights the performance, challenges and outlook of the petroleum sub-sector. Section three discusses the performance and challenges as well as the outlook in the electricity sub-sector and section four discusses the performance of the renewable energy sub-sector. Finally, section five discusses licensing in the energy sector and section six discusses consumer affairs issues.



2.0 PETROLEUM SUB-SECTOR

This section explains the performance of the petroleum sub-sector in the year 2022. The petroleum sub-sector section includes: the petroleum value chain, the supply of national fuel requirements, operations of State Owned Enterprises (SOEs), national consumption of fuel, market share of OMCs and pricing of petroleum products. The section ends with the challenges and outlook for the petroleum sub-sector in Zambia.



Fuel storage tanks at INDENI

2.1 IMPORTATION OF FUEL

Prior to the pronouncement of the petroleum sub-sector reforms in the fourth quarter of 2021, Zambia's imports of petroleum products was in two modes: namely petroleum feedstock imports which was refined at INDENI and imports of finished petroleum products by Government contracted suppliers and the private OMCs.

However, in 2022, the country only imported finished petroleum products in line with Government pronounced reforms, through Government contracted suppliers and the private OMCs. Further, the Government contracted suppliers only imported petroleum products until fourth quarter of 2022 when Government announced to disengage from the procurement of national fuel requirement and handed over this role to the private OMCs.

2.1.1 Importation of Petroleum Feedstock

During the year 2022, the petroleum sub-sector was undergoing the implementation of the Government pronounced reforms in which the roles of INDENI and TAZAMA pipelines were revised. Under the Government reforms for the petroleum sub-sector, the new role that was assigned to INDENI was to be a biofuel blending centre and a storage facility for imported petroleum products for the market. Further, the INDENI refinery plant was to be placed under care and maintenance, while the company would be trading as an OMC. For TAZAMA pipeline, the new role that was assigned was the pipeline being converted from a petroleum feedstock carrier to a finished products carrier for LSG only.

In this regard, for the year 2022, there were no reported imports of petroleum feedstock at INDENI and TAZAMA. The trend in the imports of petroleum feedstock from 2010 to 2021 is presented in Appendix 1.

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2.1.2 Importation of Finished Petroleum Products

2.1.2.1 Importation of Petrol and Diesel by Government

Consequent to the pronounced petroleum sub-sector reforms, imports of petrol and diesel were met by Government contracted suppliers and private OMCs in 2022. The total imports of petrol and diesel made by Government contracted suppliers in the period under review were 135,143m³ and 220,726m³, respectively. In comparison to the imports recorded in 2021, Government imports of petrol declined from 218,251m³ to 135,143m³ representing a decrease of 38.08 percent. Similarly, Government imports for diesel decreased by 47.43 percent from 419,852m³ to 220,726m³. Figure 2-1 shows the trend in Government importation for diesel and petrol for the period 2010 to 2022.





2.1.2.2 Imports of Finished Petroleum Products by OMCs

Generally, there was an increase in the importation of finished petroleum products by OMCs between 2021 and 2022 except for Kerosene. The highest increase in imports was recorded at 57.4 percent for petrol from 281,613m³ in 2021 to 443,220.46m³ in 2022. This was followed by Jet A-1 and diesel that moved from 26,879.61 m³ and 852,212.00 m³ to 40,014.68m³ and 1,111,762.43 m³ respectively. This represents increases of 48.9 percent and 30.5 percent for Jet A-1 and diesel respectively. Conversely, the imports for kerosene decreased by 80.6 percent from 3,347.99m³ in 2021 to 649.11m³ in 2022. The table below depicts the imports of selected finished petroleum products between 2021 and 2022.

	Table 2-1: OMCs importa	tion of petroleum	products, 20	021-2022 ²¹
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Product	2021 (m³)	2022(m³)	% Change
Diesel	852 212.00	1 111 762.43	30.5
Jet A-1	26 879.61	40 014.68	48.9
Kerosene	3 347.99	649.11	-80.6
Petrol	281 613.00	443 220.46	57.4

²¹ Other petroleum products imported by OMCs include Heavy Fuel Oil, Bitumen and Liquefied Petroleum Gas. These have not been reported in this report

2.2 OPERATIONS AT TAZAMA PIPELINES LIMITED



Engine shade at Chinsali pumping station

TAZAMA Pipeline Limited (TAZAMA) owns, operates and maintains a petroleum products pipeline from the port of Dar-es-Salaam in Tanzania to Ndola in Zambia, covering a total distance of 1,710km (954km is 8 inch pipeline and 798km is 12 inch pipeline). Further, TAZAMA has petroleum products storage depot at Kingamboni in Tanzania at which product is first stored upon receipt from the shipment, before it is pumped through the pipeline. Along the pipeline, TAZAMA operates seven (7) pumping stations with five (5) located in Tanzania and two (2) located in Zambia.

During the fourth quarter of 2022, TAZAMA commenced the preparations for the conversion of the pipeline from a petroleum feedstock carrier into a finished products carrier in line with the petroleum sub-sector reforms. The completion of the conversion process is expected to be finalised during the first quarter of 2023.



2.2.1 TAZAMA Throughput

An oil pipeline

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In view of the Government reforms for the petroleum sub-sector, to convert the pipeline from a petroleum feedstock carrier into a finished products carrier, TAZAMA was on shut down throughout 2022 due to lack of pumpable petroleum feedstocks. Consequently, during the year under review, TAZAMA had no recorded throughput. The pipeline's annual throughput for the period 2017 to 2021 in which there was recorded throughput is provided in Appendix 2.

2.2.2 Rehabilitation and Maintenance Works at TAZAMA

In 2022, there were no major rehabilitation works undertaken by TAZAMA. However, all major operation equipment and pipelines were serviceable.

2.3 OPERATIONS AT INDENI PETROLEUM REFINERY COMPANY LIMITED



INDENI Petroleum Refinery

INDENI was established in 1973 and was designed to process comingled petroleum feedstock or spiked crude. INDENI through the refinery process produces several petroleum products. The petroleum products, INDENI produces include: petrol, diesel/LSG, kerosene, jet A-1, Liquefied Petroleum Gas (LPG), Butane, Heavy Fuel Oil (HFO) and Bitumen.

During 2022, in line with the Government pronounced reforms and implementation of the new assigned role of INDENI, the company become an OMC as well as a national storage centre for petroleum products.

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2.3.1 INDENI Throughput



INDENI storage tanks

During the period under review, INDENI did not record throughput due to lack of petroleum feedstock. The refinery's annual throughput for the period 2017 to 2021 in which there was recorded throughput is provided in Appendix 3.

2.3.2 Indeni Refinery Production of Petroleum Products

In 2022, INDENI did not process any feedstock nor produce any finished petroleum products. It is envisaged that the company will refine the last crude of feedstock that was 92,036 m³ dead stock in the TAZAMA Pipeline. This is expected to take place during the first half of 2023. Appendix 4 shows the refinery production for the period, 2016 to 2021, in which the refinery was operational.

2.4 NATIONAL CONSUMPTION OF PETROLEUM PRODUCTS

In the period under review, the total national consumption for petroleum products increased by 5.70 percent from 1,464,822.16 MT in 2021 to 1,549,274.44 MT in 2022. The increase in the national consumption of petroleum products was mainly on account of a rise in consumption of jet A-1, which went up by 41.27 percent. This increase can be attributed to the full recovery of many national economies from COVID-19 restrictions. This was followed by avgas, Heavy Fuel Oil (HFO), unleaded petrol, LPG and gasoil which increased by 34.79 percent, 13.45 percent, 7.36 percent, 4.93 percent and 4.33 percent, respectively. The only decrease recorded was for kerosene, from 2,536.84 MT in 2021 to 833.04 MT in 2022 representing a reduction of 67.2 percent. Table 2-2 below shows the total national consumption of selected petroleum products for the period 2021 and 2022.

Table 2-2: National consumption of petroleum products, 2021-2022

Product	2021	2022	% Change
Avgas (MT)	881.67	1 188.44	34.79
Gasoil (MT)	1 020 200.98	1 064 414.36	4.33
Heavy Fuel Oil (MT)	15 384.94	17 454.85	13.45
Jet A-1 (MT)	22 056.93	31 159.66	41.27
Kerosene (MT)	2 536.84	833.04	-67.16
LPG (MT)	7 981.10	8 374.17	4.93
Unleaded Petrol (MT)	396 661.37	425 849.93	7.36
Grand Total	1 465 703.84	1 549 274.44	5.70

Note: The national consumption of these petroleum products in litres (L) and kilograms (Kg) is presented in Appendix 5



2.4.1 Daily National Average Consumption of Petroleum Products

Generally, the daily national average consumption for all petroleum products increased between 2021 and 2022 except for kerosene. The trend in the daily national average consumption of petroleum products for the period 2021 and 2022 is shown in Table 2-3 below.

Product	2021	2022	% Change
Avgas (L)	2 415.54	3 255.99	34.79
Gasoil (L)	3 327 465.70	3 471 671.10	4.33
Heavy Fuel Oil (Kg)	42 150.53	47 821.50	13.45
Jet A-1 (L)	76 012.50	107 382.31	41.27
Kerosene (L)	8 687.82	2 852.88	-67.16
LPG (Kg)	21 866.03	22 942.93	4.92
Unleaded Petrol (L)	1 448 991.30	1 555 616.18	7.36

Table 2-3 : Daily average consumption of petroleum products, 2021 – 2022

As illustrated in Table 2-3 above, the daily national average consumption for Avgas, Gasoil, HFO, Jet A-1, LPG and Unleaded petrol increased between 2021 and 2022. Meanwhile, the daily national average consumption for kerosene declined by 67.16 percent from 8,687.82 litres per day in 2021 to 2,852.88 litres per day in 2022.

2.4.2 National Consumption by Province

Table 2-4 shows the annual average consumption of petroleum products by province in 2022. As depicted in the table, Copperbelt, Lusaka and North-Western Provinces accounted for most of the consumption of petroleum products, while the least consumers were Muchinga, Luapula and Western provinces.

Province	Avgas (L)	Gasoil (L)	Heavy Fuel Oil (Kg)	Jet A-1 (L)	Kerosene (L)	LPG (Kg)	Unleaded Petrol (L)
Central	140 200.00	84 990 493.56	-		117 038.0	376 007.73	43 320 358.22
Copperbelt	33 680.00	383 336 819.35	16 423 458.00	9 522 883.00	124 013.59	1 852 758.32	108 479 620.18
Eastern	-	26 747 392.69	-	197 026.00	70 596.90	69 709.83	30 027 793.58
Luapula	-	14 740 115.45	-	-	88 695.16	3 823.0	11 531 952.94
Lusaka	911 153.00	412 431 554.03	1 031 390.00	28 497 357.00	570 898.72	5 632 102.60	282 353 167.58
Muchinga	-	13 323 251.82	-	-	-	3 734.00	6 925 059.26
Northern	4 551.00	18 014 310.47	-	261 592.00	24 464.17	11 826.60	14 443 072.62
North- Western	4 343.00	232 823 501.75	-	450 128.00	17 692.00	164 182.67	21 244 114.54
Southern	94 511.00	67 558 349.91	-	265 558.00	27 902.70	238 230.99	39 661 845.87
Western	-	13 194 161.89	-	-	-	21 791.94	9 812 919.69
Grand Total	1 188 438.00	1 267 159 950.92	17 454 848.00	39 194 544.00	1 041 301.24	8 374 167.68	567 799 904.49

Table 2-4: Annual national consumption of petroleum products by province, 2022

(11)

2.4.2.1 Daily National Average Consumption by Province

Table 2-5 shows the national daily consumption of petroleum products by province for the year 2022.

Province	Avgas (L)	Gasoil (L)	Heavy Fuel Oil (Kg)	Jet A-1 (L)	Kerosene (L)	LPG (Kg)	Unleaded Petrol (L)
Central	384.11	232 850.67	-	-	320.65	1 030.16	118 685.91
Copperbelt	92.27	1 050 237.86	44 995.78	26 090.09	339.76	5 076.05	297 204.44
Eastern	-	73 280.53	-	539.80	193.42	190.99	82 267.93
Luapula	-	40 383.88	-	-	243.00	10.47	31 594.39
Lusaka	2 496.31	1, 129 949.46	2 825.73	78 075.95	1 564.11	15 430.42	773 570.32
Muchinga	-	36 502.06	-	-	-	10.23	18 972.77
Northern	12.47	49 354.28	-	716.69	67.03	32.40	39 570.06
North-Western	11.90	637 872.61	-	1 233.23	48.47	449.82	58 203.05
Southern	258.93	185 091.37	-	727.56	76.45	652.69	108 662.59
Western	-	36 148.39	-	-	-	59.70	26 884.71
Grand Total	3,255.99	3 471 671.10	47 821.50	107 382.31	2 852.88	22 942.93	1 555 616.18

Table 2-5: Provincial average daily consumption of petroleum products, 2022

The average national daily consumption for avgas was 3,255.99 litres in 2022. Lusaka province had the highest consumption accounting for 76.67 percent followed by Central Province at 11.80 percent. The least consumers of avgas were Northern and North-Western Provinces at 0.38 and 0.37 percent, respectively. Meanwhile, Eastern, Luapula, Muchinga and Western provinces did not record any avgas consumption in the period under review.

The average national daily consumption for gasoil was 3,471,671.10 litres in 2022. Out of this consumption, Lusaka province accounted for the highest proportion of 32.55 percent followed by the Copperbelt province at 30.25 percent. The province with the least consumption for gasoil on a daily basis was Western which accounted for 1.04 percent.

The average national daily consumption for HFO was 47,821.50 kgs in 2022. There were only two provinces which consumed HFO and these were Copperbelt and Lusaka, representing 94.09 percent and 5.91 percent respectively.

The daily national average consumption for jet A-1 per province was highest in Lusaka at 78,074.95 litres or 72.71 percent of the overall daily average national consumption. This was followed by Copperbelt at 26,090.09 litres per day accounting for 24.30 percent of the daily national average consumption. The least daily consumption was recorded in Eastern at 539.80 litres with Northern recording 716.69 litres.

In 2022, the average national daily consumption for Kerosene stood at 2,852.88 litres with Lusaka accounting for 54.83 percent of the consumption. North-Western accounted for the least consumption at 1.70 percent. Muchinga and Western provinces did not record any consumption of Kerosene during the period under review.

The average national daily consumption for LPG was recorded at 22,942.93 kgs in 2022. Out of this consumption, Lusaka province accounted for 67.26 percent followed by the Copperbelt and Central provinces at 22.12 percent and 4.49 percent respectively. The least consumption was recorded in Muchinga Province at 0.04 percent.

In 2022, the average national daily consumption for petrol was 1,555,616.18 litres. Lusaka province accounted for 49.73 percent followed by the Copperbelt province at 19.11 percent. Muchinga and Western provinces accounted for the least consumption of petrol at 1.22 percent and 1.73 percent respectively.

(12)

2.4.3 Consumption by Economic Sector

This section discusses the comparison of consumption of selected petroleum products by economic sector for the period 2021 and 2022. For purposes of this report, only three broad economic sectors have been defined, namely; retail, mining and non-mining²².

2.4.4 Consumption of Diesel by Economic Sector

In the past two years, diesel consumption has consistently been the highest in the retail economic sector, compared to the other two sectors. However, in 2022, the consumption rate reduced by 3.6 percentage points, from 42.1 percent recorded in 2021 to 38.5 percent. The second highest consumption in 2022 was recorded in the mining sector at 33.2 percent compared to the 33.5 percent recorded in 2021. The least consumption was observed in the non-mining sector at 28.3 percent in 2022 compared to the 24.4 percent recorded in 2021. Figure 2-2 below shows the consumption of diesel by economic sector.



Figure 2-2: Consumption of diesel by economic sector

2.4.5 Consumption of Petrol by Economic Sector

Petrol consumption dominated the retail sector in the market for the past two years. The retail sector accounted for 95.9 percent of the consumption in 2022 which was a decline of 2.5 percentage points from 98.4 percent recorded in 2021. On the other hand, the non-mining sector recorded an increase of 2.5 percentage points from 1.5 percent in 2021 to 4.0 percent in 2022. In the mining sector there was no change recorded in 2022. The consumption of petrol by economic sector namely, mining, retail and non-mining sectors in 2022 is as shown in Figure 2-3.





²² Retail refers to the selling of petroleum product done at a retail site/filling station or shop (in the case of products such as lubricants). Mining refers to petroleum products delivered and consumed at the mines. The products that are not consumed in the retail and mining economic sectors are defined as non-mining.

(13)



2.4.6 Consumption of Kerosene by Economic Sector

In 2022, the consumption of kerosene continued to be dominated by the retail sector which accounted for 95.13 percent. Despite the dominance, the consumption rate declined by 1.4 percentage points from 96.50 percent in 2021 to 95.13 percent in 2022. Similarly, the mining sector recorded a decline of 3.37 percentage points in 2021 to 0.00 percent in 2022. On the other hand, the non-mining sector recorded an increase of 4.74 percentage points from 0.13 percent in 2021 to 4.87 percent in 2022. Figure 2-4 below shows the consumption of kerosene by economic sector in 2021 and 2022.



Figure 2-4: Kerosene consumption by economic sector, 2021-2022

2.4.7 Consumption of Liquefied Petroleum Gas by Economic Sector

In the year under review, the non-mining sector accounted for the highest consumption of LPG followed by retail sector, while the mining sector accounted for the least consumption. Specifically, the non-mining sector consumed 51.97 percent while the retail and mining sectors consumed 46.80 percent and 1.23 percent respectively. Figure 2-5 below shows the consumption of LPG by economic sector in 2021 and 2022.





2.5 MARKET SHARE OF OIL MARKETING COMPANIES

This section discusses the combined market share for OMCs in 2022 for white and non-white petroleum products²³. The sizes of OMCs are determined by their market share which is expressed as a percentage of the OMCs total sales to the sector/industry sales in a specified period.

(14)

²³ Gasoil, Unleaded petrol and Kerosene are referred to as white petroleum products.



2.5.1 Market Share for White Petroleum Products

In 2022, Puma Energy Zambia Plc, TotalEnergies Zambia Limited and Mount Meru Petroleum Zambia Limited continued to dominate the market for white petroleum products with an aggregated market share of 55.57 percent. This was however, 2.50 percentage points less than their combined market share of 58.07 percent recorded in 2021. The reduction in the combined market share for these three (3) OMCs was because of the increase in market shares by other OMCs such as Vivo Energy Zambia Limited, Oryx Energies Zambia Limited and Rubis Energy Zambia Limited whose market share increased from 5.74 percent, 4.87 percent and 4.45 percent in 2021 to 6.89 percent, 5.48 percent and 4.59 percent in 2022 respectively. Surya energies also came into the market and as at 2022 had a market share of 1.30 percent. The market shares for the OMCs are shown in Table 2-6 below.

OMC	2021	2022
Puma Energy Zambia Plc	18.98%	19.06%
TotalEnergies Zambia Limited	19.99%	18.40%
Mount Meru Petroleum Zambia Limited	19.10%	18.11%
VIvo Energy Zambia Limited	5.74%	6.89%
Oryx Energies Zambia Limited	4.87%	5.48%
Rubis Energy Zambia Limited	4.45%	4.59%
Spectra Oil Zambia	4.36%	3.59%
Petroda Zambia Limited	3.25%	3.02%
Lake Petroleum Limited	3.02%	2.84%
Eco Petroleum Limited	2.06%	1.84%
SGC Investments Limited	2.14%	1.77%
Oasis Oil Zambia Limited	1.50%	1.66%
Surya Energy Limited	0.00%	1.30%
Zamfuel Petroleum Limited	0.65%	1.22%
Karan Investments Limited	0.00%	1.08%
Korridor Zambia Fuel Limited	0.51%	1.00%
Dalbit Petroleum Limited	0.82%	0.97%
Others	8.57%	7.19%
Total	100.00%	100.00%

Table 2-6: Market share for white petroleum products, 2021-2022

2.5.2 Market Share for Jet A-1

In the year under review, only two (02) OMCs traded in jet A-1 compared to four (04) in 2021. Puma Energy Zambia Plc had a market share of 63.4 percent, representing a percentage point increase of 23.2 from 40.2 percent in 2021. The market share for TotalEnergies Zambia Limited reduced to 36.6 percent in 2022 from 57.5 percent in 2021, representing a reduction of 20.9 percentage points. Table 2-7 below shows the comparison of jet A-1 market share for 2021 and 2022.

Table 2-7: Market share for Jet A-1, 2021-2022

OMC	2021 (%)	2022 (%)
Puma Energy Zambia Plc	40.2	63.4
TotalEnergies Zambia Limited	57.5	36.6
Kapesika Energy and Petroleum	2.0	0.0
Mount Meru Petroleum Zambia Limited	0.4	0.0
Grand Total	100.0	100.0

(15)



2.5.3 Market Share for Lubricants

In 2022, Spectra Oil Corporation Limited continued dominating the market for lubricants in Zambia, with a market share of 32.47 percent. Puma Energy Zambia Plc occupied the second position with a market share of 13.61 percent. TotalEnergies Zambia Limited occupied the third position with a market share of 13.23 percent. Dana Oil, Fuchs Zambia Limited and Mount Meru Petroleum Zambia Limited continued to occupy the fourth, fifth and sixth positions, respectively, of the market share. The rest of the market share is summarised in Figure 2-6.

Figure 2-6: Market share for lubricants, 2022



2.5.4 Market Share for Liquefied Petroleum Gas

Afrox Zambia Limited continued to dominate the LPG market with a market share of 21.0 percent, in 2022 compared to 25.4 percent in 2021. Afrox Zambia Limited was followed by Mount Meru Petroleum Zambia Limited, OGAZ Zambia Limited and Oryx Gas Zambia Limited at 19.3 percent, 14.8 percent, and 13.9 percent market shares respectively. Table 2-8 shows the comparison of market shares for 2021 and 2022

Table	2-8:	Market	share	for LP	G. 202	1-2022
			••••••			

ОМС	2021 (%)	2022 (%)
Afrox Zambia Limited	25.4	21.0
Mount Meru Petroleum Zambia Limited	21.5	19.3
Ogaz Zambia Limited	17.6	14.8
Oryx Gas Zambia Limited	14.3	13.9
Falcon Gas Zambia Limited	0.0	8.3
Exclusive Brands Africa	6.3	6.3
Rubis Energy Zambia Limited	4.7	5.9
Minegases Company Limited	4.4	5.4
Chingases Company Limited	5.6	4.9
Oilbay Zambia	0.1	0.1
Grand Total	100.0	100.0



2.5.5 LPG Storage Facilities

The current energy usage in Zambia is dominated by traditional fuels such as charcoal or firewood especially in rural areas which has resulted in a massive deforestation and environmental degradation. This is a major concern to the Government which has responded by developing policies and regulatory frameworks that support the use of clean energy. The use of LPG promotes clean energy.

In 2022, the LPG bulk storage facilities in Zambia decreased to 2,544 MT from 2,611 MT in 2021. The reduction is attributed mainly to decommissioning of the facilities at INDENI refinery. Most of the bulk storage facilities were owned by INDENI refinery with the storage capacity of 1,600 MT, while the rest was under OMCs ownership. Table 2-9 shows the distribution of LPG bulk storage facilities by OMC in 2022.

No.	Name	Capacity (MT)	Location	
1	Afrox Zambia Limited	115	Ndola and Lusaka	
2	Oryx Gas Limited	72	Ndola	
3	MERU Gas Zambia Limited	132	Chibombo and Kitwe	
4	Rubis Energy Zambia Limited	40	Lusaka	
5	Exclusive Brands Africa Limited	90	Lusaka	
6	Ogaz/Puma Energy Plc	100	Lusaka	
7	Minegases Company Limited	125	Ndola and Chingola	
8	Chingases Company Limited	55	Lusaka	
9	Oxyzam Limited	22	Lusaka	
10	Ziko Gas Zambia	58	Lusaka	
11	Falcon Gas Zambia	100	Lusaka	
12	INDENI	1,600	Ndola	
13	Lake Gas Petroleum	35	Ndola	
	GRAND TOTAL	2,544		

Table 2-9 : OMCs LPG Bulk Storage facilities, 2022

2.5.6 Retail Sites Network

2.5.6.1 Number of Retail Service Stations Operated by OMCs

The retail service stations form part of the petroleum value chain that distribute finished petroleum products to the end users in the economy. In 2022, the country recorded an increase in the number of retail service stations from 460 in 2021 to 507, indicating a 10.22 percent increase. Mount Meru Petroleum Zambia Limited accounted for the largest number of retail sites with 73 followed by TotalEnergies Zambia Limited with 63 sites. Puma Energy Zambia Plc was next with 58 sites, while Vivo Energy Zambia Limited had 56 sites. Table 2-10 shows the number of filling stations in Zambia and Appendix 6 provides a detailed summary of retail sites by location.

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Series X

ОМС	Number of retail sites
Mount Meru Petroleum Zambia Limited	73
TotalEnergies Zambia Limited	63
Puma Energy Zambia Plc	58
Vivo Energy Zambia Limited	56
Rubis Energy Zambia Limited	39
Lake Petroleum Limited	30
Oryx Energies Zambia Limited	26
Petroda Zambia Limited	25
SGC Investments Limited	24
Karan Petroleum Zambia Limited	11
Oasis Oil Zambia Limited	11
Zamfuel Petroleum Limited	9
Eco Petroleum Limited	8
Harvest Group Limited	8
LBM Investments Limited	7
Hass Petroleum Zambia Limited	6
Spectra Oil Corporation Limited	5
Surya Energy Limited	5
Petrolink Limited	4
Simba Oil Company Limited	3
Endrone Petroleum Corporation Limited	2
Mel Petroleum	2
Oilbay Zambia Limited	2
Tribute Investments Limited	2
Zacks Hardware And Construction Ltd	3
Acm Petroleum Limited	1
Admire Energy Limited	1
Alfa Energy Limited	1
Alpha Enterprises Limited	1
Asharami Energy Resource Limited	1
Benzol Petroleum Zambia Limited	1
Boma Energy Limited	1
Collum Lunm Tian Petroleum Zambia Limited	1
Faraj Ali Fioull Limited	1
Hamdi Investments	1
Japawa Investments Limited	1
Luapula Oils Limited	1
Lushomo	1
Mon Fuel and Oil Investments Limited	1
Ngucha Energy Corporation Limited	1
Pure Petroleum Limited	1
Refuel Petroleum Corporation Limited	2
Simba Energy	1
Sino Petroleum Limited	1
Star Oil Limited	1
U-Fuel Zambia Limited	1
United Metro	1
Wada Chovu	1
Zhongkuang Zambia Services Limited Company	1
Grand Total	507

Table 2-10 : Number of Retail Service stations operated by OMCs as at 31st December, 2022

(18)
2.6 PRICING OF PETROLEUM PRODUCTS



Motor vehicle being refueled at filling station

One of the key functions of the ERB as outlined in section 4, of the Energy Regulation Act No. 12 of 2019, is to determine, regulate and review charges²⁴ and tariffs in the energy sector. Using an appropriate model, the ERB determines the price of petrol, diesel, kerosene and jet A-1. The adopted pricing model is aligned to the fuel supply chain in Zambia in order to ensure that the prices determined are cost reflective.

Since establishment of ERB in 1997, two pricing models have so far been applied in determining fuel prices in Zambia, that is, the CPM and the IPP model. The CPM operates in such a way that the price of petroleum products should cover all costs that are incurred in the supply chain from the source port to the final consumer. The IPP model aims at promoting maximum efficiency in the supply chain for petroleum products while ensuring that the domestic prices reflect the cost trends of petroleum products on the international market.

2.6.1 Zambia's Fuel Supply Chain

All the petroleum products consumed in Zambia are imported as the country has no known reserves of crude oil. As of 2022, the consumed petroleum products were imported as finished products. Most of the finished petroleum products are imported through Dar-es-salaam in Tanzania and Beira in Mozambique. The importation was carried out by Government contracted suppliers and OMCs until 30th September 2022²⁵. The major players in Zambia's fuel supply chain include the MoE, the ERB, TAZAMA, INDENI, TPPL, OMCs, Transporters and Dealers. These play different roles which range from procurement, regulation, transportation, distribution and retailing of petroleum products. Their specific roles are explained in Table 2-11.

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²⁴ Where charges include fees, rates, surcharges, levies, penalties, deposits, connection charges, use of system charges or any other charge made for the provision of any service, commodity or product that a licensee renders in the course of carrying out its licensed activity.

²⁵Subsequent to Government's pronounced reforms, petroleum products were imported as finished products only by Government of the Republic of Zambia (GRZ) suppliers and OMCs. During the fourth quarter of 2022, importation was now carried out by the private sector in line with Government's pronouncement made during the 2023 budget address, on 30th September, 2022.



Table 2-11: Roles of the players in the petroleum supply chain

No.	Petroleum Supply Chain Player	Role (before reforms)	Role (Expected after reforms)
1.0	Ministry of Energy	 i) Give policy guidance to the petroleum sub sector. ii) Float import tenders based on requirements of Petroleum products. iii) Opening of tender, evaluation and awarding of supply Contract. iv) Coordinate the determination of quantity requirements/projection for a specified period. v) Ensure that the quantities from the supplier are delivered. vi) Monitor and manage strategic reserves. vii) To procure petroleum products to meet market demand. 	 i) Give policy guidance to the petroleum sub sector. ii) Monitor and manage strategic reserves.
2.0	Energy Regulation Board	 i) Regulate the petroleum sub sector. ii) Determine, regulate and review tariffs and charges iii) Ensure compliance by Suppliers and OMCs to operational requirements as per licence conditions. iv) Facilitate fuel marking process and product quality monitoring. v) Project national demand of petroleum products in collaboration with MoE, OMCs and other stakeholders. 	 i) Regulate the petroleum sub sector. ii) Determine, regulate and review tariffs and charges iii) Ensure compliance by Suppliers and OMCs to operational requirements as per licence conditions. iv) Facilitate fuel marking process and product quality monitoring. v) Project national demand of petroleum products in collaboration with MoE, OMCs and other stakeholders.
3.0	TAZAMA Pipelines Limited	 i) Transport petroleum feedstock via pipeline to INDENI from Dar-es-salaam ii) Ensure receipt of imported products of Supplies in designated GRZ depots iii) Participate in procurement of petroleum products 	 i) To be responsible for transporting LSG ii) To continue offering hospitality for fuel importers at designated GRZ Depots.
4.0	INDENI Petroleum Refinery Limited	 i) Process petroleum feedstock to finished petroleum products ii) Participate in procurement of petroleum feedstock in collaboration with TAZAMA 	i) To Operationalise the company as an OMC;ii) To operationalize blending of biofuelsiii) To operate as a biofuels blending centre
5.0	TAZAMA Petroleum Products Limited	 i) Offer handling and storage facilities for petroleum products received in the country. ii) Offer storage services to OMCs. iii) Wholesale of petroleum products produced by INDENI from Ndola Fuel Terminal (NFT) and Government Depots to OMCs 	 i. Offer handling and storage facilities for petroleum products received in the country. ii. Offer storage services to OMCs. iii. Wholesale of petroleum products for OMCs in the market who would wish to utilize TPPL's wholesaling licence.
6.0	Oil Marketing Companies	 i) Importation of petroleum products (OMCs with import waivers). ii) Distribute petroleum products to Consumers, Retailers (Dealers) and Government. 	 i) Importation of petroleum products. ii) Distribute petroleum products to Consumers, Retailers (Dealers) and Government.
7.0	Petroleum Transporters	i) Transport petroleum products to OMCs, Retailers (Dealers) and Government.	i) Transport petroleum products to OMCs, Retailers (Dealers) and Government.
8.0	Retailers (Dealers)	i) Selling of petroleum products at filling stations to consumers.	i) Selling of petroleum products at filling stations to consumers.
9.0	Consumers	 Buy petroleum products at prices regulated by the ERB. 	i) Buy petroleum products at prices regulated by the ERB.



2.6.2 Determinants of Petroleum Prices

Global supply and demand are the major determinants of crude oil prices. On the demand side, economic growth is one of the biggest influencing factors affecting the price of crude oil. With increased demand for energy to transport goods and input materials for industrial production in growing economies, pressure is exerted on the price of petroleum products and crude oil. The world's transportation sector is totally dependent on petroleum products such as petrol and diesel. In addition, petroleum products are also highly demanded for heating, cooking, or generating electricity, globally.

On the supply side, the Organization of the Petroleum Exporting Countries (OPEC) has a significant influence on oil prices as OPEC includes countries with some of the world's largest oil reserves. OPEC sets production targets or quotas, for its members. Nonetheless, compliance of OPEC members with OPEC quotas is mixed because production decisions are eventually dependent individual members.

The other factors that affect the price of oil on the international market include; geopolitical events and severe weather that has the potential to disrupt the supply of crude oil and petroleum products to the market. This creates uncertainty for future supply or demand and leading to higher volatility in prices. Figure 2-7 depicts the factors that influence oil prices on the global market.



Figure 2-7: Global determinants of oil prices

In the case of Zambia which has no crude oil reserves and imports all its national demand of fuel, petroleum prices are mainly determined by the price of oil on the global market and the exchange rate between the Zambian Kwacha and the United States Dollar. Other factors include; changes in the cost-lines such as levies, duties and fees, margins for transporters, OMCs or dealers as well as fees such as the pumping fees.

(21)



2.6.3 Trends in the International Oil Prices in 2022

Figure 2-8 shows the trend in the international crude oil prices, namely West Texas Intermediate (WTI), Brent and Murban Crude during the period January to December, 2022.



Figure 2-8: Trends in international crude oil prices, January to December, 2022

During 2022, crude oil prices fluctuated between US\$122.71/bbl recorded in June, 2022 and US\$76.44/bbl in December, 2022. Generally crude oil prices were on an upward trajectory during the first half of the year but declined to as low as US\$76.44/bbl in December, 2022. The upward trajectory experienced in the first half of the year was due to supply concerns stemming from the combination of geopolitical tension between Russia and Ukraine with low global crude oil inventories. Russia's full-scale invasion of Ukraine came at the time when global crude oil inventory decreased. The lower inventory was the result of withdrawals from storage to meet the demand that resulted from rising economic activity after pandemic-related restrictions eased. As for European markets, these were also affected by a strong U.S. dollar that made imported crude oil more expensive.

With regards to the second half of the year, crude oil prices generally decreased due to concerns about a possible economic recession that reduced demand. This was due to the severe COVID-19 containment measures in China, being one of the major consumers of oil. In addition, there was an increase in crude oil supply from the U.S market stemming from an intervention to release Strategic Petroleum Reserve in a bid to ease global supply constraints. This increased global supply of crude oil, thus pushing prices downwards.

2.6.4 Trend in the exchange rate during 2022





The Kwacha generally appreciated from January to September, 2022. The appreciation was attributed to positive market sentiments stemming from an approval of the International Monetary Fund (IMF) credit facility.²⁶. Further, the appreciation was also supported by increased supply of foreign exchange into the market²⁷.

Nevertheless, the kwacha depreciated steeply against the US\$ beyond September, 2022. The depreciation was caused by foreign exchange demand pressures for the procurement of agricultural and petroleum products²⁸.

2.6.5 Trends in the International Oil Prices and the Exchange Rate

During the period January to November, 2022, the price of oil on the international market and the exchange rate between the kwacha and the United States dollar moved in the same direction. That is, an upward trajectory from January to February 2022 where, the kwacha depreciated against the United States Dollar as the price of oil increased; and a downward trajectory from March to October 2022 such that the kwacha appreciated against the United States dollar as the price of oil generally declined on the global market.

From November to December 2022, the prices of oil on the international market continued to decline while the kwacha steeply depreciated against the United States dollar. Figure 2-10 shows the trends in the international oil prices and the exchange rate.

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²⁶ Bank of Zambia – Monetary Policy Committee Statement November 2022

 ²⁷ Bank of Zambia – Monetary Policy Committee Statement August 2022
 ²⁸ Bank of Zambia – Monetary Policy Committee Statements, Nevember 2022

²⁸ Bank of Zambia – Monetary Policy Committee Statements November, 2022



Figure 2-10: Trend in international oil prices and the exchange rate, 2022

REGULATION BOARD

As depicted in Figure 2-10 above, the noted movements of the two fundamentals that influence the price of fuel in Zambia have a major role in the determination of domestic prices of fuel. In the event that the two fundamentals move in the same direction, either upward or downward, a similar pattern is expected to occur on the wholesale and retail prices on the domestic market. Further, where these two variables move in opposite directions, a negated effect takes effect on the domestic prices.

2.6.6 Petroleum Pricing Mechanism in Zambia

According to section 4 of the Energy Regulation Act No. 12 of 2019, the ERB is mandated to determine, regulate and review tariffs and charges in the energy sector. For the petroleum sub-sector, the ERB determines the wholesale and pump prices of petrol, diesel and kerosene. With regards to Jet A-1, the ERB determines the wholesale price and the Posted Airfield Price (PAP) at Kenneth Kaunda International Airport and other major airports.

Following the Government pronounced petroleum sub-sector reforms, in the fourth quarter of 2021; the ERB determines the prices of petroleum products using an IPP model.

The IPP model operates on the principle that the final price of petroleum products should be equal to the cost of the product at points of production plus the transportation cost to the point of sell and other attendant costs. The principle ensures that the final consumer pays a fair price for a product while promoting maximum efficiency in the supply chain for petroleum products.

Further, the IPP ensures that domestic prices reflect the cost trends of petroleum products on the international market. The cost elements in the model are divided into two groups of elements:

- i. Wholesale price build up; and
- ii. Pump Price build up.

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2.6.6.1 Wholesale Price Build-up

The cost elements that constitute the wholesale price build-up are presented in Table 2-12 while the details of these cost elements are provided in Appendix 7.



Table 2-12: Wholesale price build up

Cost element	Unit measure	Basis
Platts Arab Gulf	US\$/BBL	Platts Referencing
Conversion Factor		Industry Best Practice
FOB Price	US\$/MT	
Traders Margin	US\$/MT	Standard Cost
FOB & Traders margin	US\$/MT	
Ocean Freight	US\$/MT	Referenced to Worldscale Rates
C & F (Dar/Beira)		
Storage	\$/MT	Standard Cost
Ocean Insurance	0.15% of C &F	Standard Cost
Ocean losses	0.3% of C & F	Standard Cost
Wharfage	1.25% of C & F	Port Authority Charge
BPS Premium	\$/MT	BPS referencing
CIF (Dar/Beira)		
Transportation Fee	US\$/MT	standard cost
Transportation Losses	0.5% petrol & 0.3% diesel, 0.3% kerosene	Standard Cost
Importers Margin	US\$/MT	Standard cost
CIF (Lusaka)	\$/MT	
Storage losses	0.5% petrol & 0.3% diesel, 0.3% kerosene	Standard Cost
Wholesale Price to OMC	\$/MT	
Conversion factors		industry best practice
Wholesale Price to OMC	\$/M ³	
Exchange Rate	K to \$	Bank of Zambia
New Wholesale Price to OMC	K/M ³	

2.6.6.2 Pump Price Build-up

The cost lines that constitute the pump price build-up are depicted in Table 2-13

Table 2-13: Pump price build up

No	Details	Unit costs	Workings
1	Wholesale Price to OMC	K17.96, K16.84, & K18.28 per litre each for petrol, LSG and kerosene, respectively.	а
2	Terminal Fee	K0.063/litre	b
3	Marking Fee	K0.20/litre	С
4	Excise Duty (incl.) road levy	K2.07 for Petrol, K0.66 for LSG and K0 for Kerosene	d
5	Ex NFT Gate		E=(a+b+c+d)
6	Transport Cost	K0.52 for Petrol, K0.52 for LSG and K0.09 for Kerosene.	f
7	OMC Margin	K1.58/litre	g
8	Total (Excl VAT)		h=(e+f+g)
9	Dealer Margin	K1.07/litre	i
10	Price to Dealer		j= (h+i)
11	ERB Fees	0.7%	k
12	Strategic Reserves Fund	K0.15/litre for Petrol, Kerosene and LSG	1
13	Price before VAT		m=(j+k+l)
14	VAT	16%	n
15	Unform Pump Price	K/litre	o=(m+n)

25)



2.7 STRATEGIC RESERVE FUND

The Strategic Reserve Fund (SRF) was introduced by Government to finance construction and rehabilitation of petroleum infrastructure to respond to emergencies in the petroleum sub-sector as well as stabilize the fuel prices. The Government levies 15 ngwee per liter on petrol, diesel, kerosene, jet-A1, HFO and LPG that is sold in the country. In 2022, the ERB collected K311.97 million compared to K266.97 million collected in 2021, representing a 16.86 percent increase in collections in the SRF.

In line with the Energy Regulation Act No. 12 of 2019, which provides for the creation of the Energy Fund, SRF will in the future be administered under the Energy Fund. During 2022, the ERB was still in the process of developing regulations for administering the Energy Fund. The other functions of the fund will include the following:

- i. Ensuring stability of supply in the energy sector;
- ii. The development of the energy sector;
- iii. Ensuring the availability of strategic reserves; or
- iv. Any other purposes as may be prescribed by ERB

2.8 ANNUAL REVIEW OF PETROLEUM DOWNSTREAM MARGINS

The ERB is mandated by the Energy Regulation Act No. 12 of 2019 to regulate the margins of petroleum downstream players, namely, OMCs, Dealers²⁹ (Retailers) and Transporters, in the petroleum sub-sector.

In April, 2022, the ERB, with the Margins Committee reviewed the margins in line with the changes in the macro economic factors, that is, inflation and exchange rate as well as the cost of doing business in the petroleum sub-sector which were determined in December 2021. It is envisaged that the revised margins will be implemented during 2023.

2.9 PRICING FRAMEWORK FOR JET A-1

During the second quarter of 2022, the ERB fully implemented the pricing of Jet A-1 using the IPP model. The decision to implement the IPP model during the second quarter of 2022 was supported by the migration to the thirty (30) day pricing cycle, following the Government pronounced reforms for the petroleum sub-sector.

2.10 DOMESTIC AND REGIONAL FUEL PRICES

2.10.1 Domestic Fuel Pump Prices

In January, 2022, the ERB implemented the monthly pricing cycle of petroleum products. The revised pricing cycle implies that cost reflectivity of petroleum products' prices is much easily attained as the determined prices are reflective of movements in the pricing fundamentals as they are immediately admitted into the pricing framework.

During 2022, in line with the monthly fuel pricing cycle, the ERB adjusted fuel prices downwards four (4) times in February, May, August and September. The rest of the fuel price adjustments made during the year were upward. For the June and December, 2022 reviews, only petrol was adjusted upwards. Figure 2-11 shows the trend in the domestic fuel prices during 2022.



²⁹ Dealers are retail service station operators



Figure 2-11: January to December 2022 fuel pump price adjustment

2.10.2 Trends in Domestic Fuel Prices

Figure 2-12 shows the trend in the nominal pump prices of petrol, diesel and kerosene from 2000 to 2022.



Figure 2-12: Trends in nominal pump prices, 2000 - 2022

From 2000 to 2022, the retail prices of petrol, diesel and kerosene have significantly increased. The retail price of petrol and diesel continued to increase above the price of kerosene in the period under review.

2.10.3 Regional Fuel Prices

Fuel prices vary from country to country. This is on account of the differences in economic environments and distance from the sea, among others. The prices for petrol and diesel in the region increased in 2022, compared to 2021. Figures 2-13 and 2-14 show the price of petrol and diesel respectively as at 31st December in 2022 and 2021.

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As at 31st December, 2022, the price of petrol in the region, was highest in Malawi at US\$1.68/litre, followed by Kenya at US\$1.54/litre. Zimbabwe exhibited the third highest price in the region at US\$1.49/litre and then followed by Zambia at US\$1.43/litre. The lowest were recorded in Botswana, Namibia, Tanzania, South Africa and Mozambique.



Figure 2-14: Regional fuel pump prices as at 31st December, 2022 – Diesel

As at 31st December, 2022, the price of diesel in the region, was highest in Malawi at US\$1.85/litre, followed by Zimbabwe at US\$1.64/litre. Zambia exhibited the third highest price in the region at US\$1.51/litre and then followed by Tanzania at US\$1.44/litre. The lowest prices were recorded in Namibia, Botswana, Mozambique, Kenya and South Africa.

2.11 COMPLIANCE OF LICENSEES IN THE PETROLEUM SUB-SECTOR

2.11.1 Petroleum Product Quality Monitoring

The ERB conducts routine petroleum product sampling of fuel depots countrywide and randomly at service stations, twice every quarter to ascertain the quality of petroleum products distributed in Zambia. This is in line with Clause 31 (a) of the Energy Regulation Act No. 12 of 2019 that compels all licensees in the energy sector to meet the minimum standards relating to quality of products and services as may be specified or published by the ERB.

In the year 2022, the ERB collected a total of 295 samples, of petroleum products from Government and OMCs depots countrywide for testing against respective Zambian Petroleum Product Quality Standards, representing a 2.79 percent increase over the 287 samples collected in 2021. The overall results for the tests are shown in Table 2-14.

Product	No. of Sampl	les collected	% of collected samples that complied to quality standards		
	2021	2022	2021	2022	
Unleaded Petrol	105	116	96.2	97.4	
High sulphur diesel	120	0	100.0	-	
LSG	37	169	100.0	92.3	
Kerosene	8	2	100.0	100.0	
Jet A-1	17	8	100.0	100.0	
Total/Average	287	295	99.0	97.0	

Table 2-14: Test results for petroleum product samples collected in 2022

The overall petroleum quality compliance as at 31st December 2022 was 97.0 percent representing a 2.0 percentage point decrease, when compared to the product quality compliance rate of 99 percent as at 31st December 2021. This was mainly on account of the increased samples for LSG, following the discontinued sale and distribution of high Sulphur diesel on the Zambian market in the first quarter of 2022. The discontinued sale and distribution of high sulphur diesel was in line with the AFRI-4 (African Refiners Association) and SADC road maps, to migrate to low sulphur content in gasoil of 50ppm and below by 2020 and 2022 respectively. There were some observed non-compliant samples for LSG which could be attributed to failure to adhere to procedure by OMCs during the conversion of tanks from storage of high sulphur diesel to LSG. However, the recorded 97 percent product quality performance, complied with the standards and met the set ERB regulatory target of 95 percent compliance rate

Furthermore, following the discontinuation of the sales for high Sulphur diesel on the Zambian market, only LSG samples were collected and tested in 2022, which consequently increased the number of samples collected from 37 in 2021 to 169 in 2022.

2.11.2 Petroleum Infrastructure Compliance

Section 4 (v) of the Energy Regulation Act No. 12 of 2019 empowers the ERB to close energy facilities whose operations contravene the Energy Regulation Act, with regards to the safety and health of persons or consumers. In this regard, the ERB undertakes compliance audits of petroleum infrastructure. This is to ensure compliance with the Zambian petroleum standards and regulations.

The ERB inspected 482 petroleum facilities constituting of retail service stations, white petroleum product depots, LPG bulk storage facilities and Tazama Pipeline, during the initial compliance audits conducted in the first quarter of 2022. Out of the 482 inspected facilities, 323 acquired compliance rating below the set ERB regulatory target of 93.0 percent. The 323 facilities were re-inspected in the third and fourth quarters of 2022. The overall average compliance in 2022 increased to 94.8 percent, which was 1.8 percentage points above the regulatory target of 93.0 percent and 5.8 percentage points above the 89.0 percent compliance achieved in 2021. This is as presented in Table 2-15. Notably, INDENI was not inspected in 2022, as the facility was not operational.

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En all'ha	Average compliance		
Facility	2021	2022	
Retail service stations	86.3	94.3	
Fuel depots	87.8	95.0	
LPG depot/ filling plant	93.3	95.7	
INDENI refinery	N/A	N/A	
TAZAMA pipeline	N/A	94.5	
Overall average compliance	89.1	94.8	
Regulatory target	93.0	93.0	

Table 2-15: Results of petroleum infrastructure compliance monitoring

2.11.3 Environmental Impact Assessments

The ERB provides regulatory input and comments to the Zambia Environmental Management Agency (ZEMA) on environmental impact assessments (EIAs) and project briefs for energy projects in the country. The Energy Regulation Act No. 12 of 2019 mandates the ERB to work with ZEMA to develop measures to monitor the environmental impacts of energy-related operations. In 2022, the ERB reviewed and provided regulatory comments on all the EIAs received from ZEMA. A total of 202 EIA reports were evaluated by the ERB in 2022 compared to 167 in 2021, representing a 21.0 percent increase, as indicated in Table 2-16.

Table 2-16: EIAs reviewed and commented by the ERB for proposed energy projects in 2022

Cult another	No. of EIAs received from ZEMA and reviewed/commented by ERB		
Sub-sector	2021	2022	
Electricity	1	3	
Petroleum	165	197	
Renewable energy	1	2	
Total	167	202	

2.11.4 Key Performance Indicators for the Petroleum Sub-sector

The Energy Regulation Act No.12 of 2019 mandates the ERB to monitor the performances of licensees in the energy sector. The ERB uses the Key Performance Indicator (KPI) frameworks as one of its regulatory tools to monitor the efficiency and performance of enterprises

2.11.5 State Owned Enterprises

The ERB has developed a set of financial KPIs for TAZAMA, INDENI and TPPL. The KPIs are used to track the quarterly performance of the three (3) mentioned SOEs. The reports are meant to assess the performance of the enterprises and in informing the determination of tariffs, fees and other regulatory decisions.

With regards to the technical assessment, only TPPL's KPIs were monitored in 2022. This was because TAZAMA and INDENI were not operational during the period under review.

2.11.5.1 Technical KPIs - TAZAMA Petroleum Products Limited

TPPL's performance was monitored on four technical KPIs in 2022. The monitoring covered six bulk Government storage facilities namely: Ndola Fuel Terminal, Lusaka, Mpika, Solwezi, Mongu and Mansa depots. As shown in Table 2-17, TPPL achieved the technical KPI targets for Unaccountable Losses for kerosene, Petroleum Product Quality Incidents as well as Safety and Environment Incidents. Throughput volumes at all six government depots continued to be monitored for trend analysis. A trend of the throughput volumes over the last three years indicated a general decline in volumes from 901,544.19m³ in 2021 to 831,614.26m³ in 2022. The decline was due to a reduction in refinery output which resulted in a significant portion of fuel being imported directly by OMCs and delivered to their respective depots.

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Table 2-17: TPPL's Performance against KPIs

Indicator	Product Target		Actual performance (Total/ Average)		Comment on 2022
			2022	2021	performance
		Techni	cal KPIs		
Throughput (m ³)	All	-	831,614.26	901,554.19	Noted for comparison
	Diesel	0.30%	0.39%	0.28%	Not achieved
Unaccountable Losses	Petrol	0.50%	1.44%	1.77%	Not achieved
	Kerosene	0.30%	0.12%	0.13%	Achieved
No. of Petroleum Product Quality Incidents	-	-	-	-	Achieved
No. of Safety Health and Environmental incidents	-	-	-	-	Achieved

2.11.5.2 Financial KPIs – TAZAMA, INDENI and TPPL

During 2022, the ERB monitored the financial KPIs for TAZAMA, INDENI and TPPL. Table 2-18 shows the KPI performance of the three SOEs against the set KPI targets, during 2022 compared to 2021:

Table 2-18: TAZAMA, INDENI and TPPL's performance against financial KPIs

Indicator	Target	Actual perform	Comment on 2022	
		2022	2021	performance
	TAZAMA	Petroleum Products	Limited	-
Asset turnover ratio	2.00	0.26	0.46	Not Achieved
Current ratio	1.20	2.20	4.72	Achieved
Debtor days	30 days	0.00	0.00	Achieved
Creditor days	90 days	8.75	15.25	Achieved
	TA	ZAMA Pipelines Limito	ed	
Current ratio	1.20	0.19	1.10	Not Achieved
Debtor days	15 days	61.99	71.25	Not Achieved
INDENI Petroleum Refinery Company Limited				
Current ratio	1.00	0.33	0.79	Not Achieved
Debtor days	15 days	32.43	19.79	Not Achieved

During 2022, TPPL did not achieve the financial KPI target for asset turnover ratio greater than two (2), but achieved the KPI targets for current ratio, debtor days and creditor days. The KPI score for the asset turnover declined in 2022, compared to the year 2021. The reduction was mainly attributed to reduction in the throughput fees as OMCs continued to trade more among each other than uplifting from Government depots.

Further, both TAZAMA and INDENI did not achieve their KPI targets for the current ratio and trade debtor days. TAZAMA did not achieve its KPI target for trade debtor days due to delayed settlements of invoices for services rendered during the period under review. INDENI did not achieve its KPI target for both trade debtor days and the current ratio due to reduced activity for the company arising from lack of feedstock for processing. The KPI assessment for INDENI was based on the income generated from other activities such as laboratory analysis fees, terminal handling fees, rental income and weighbridge.

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2.12 GOVERNMENT OWNED STORAGE DEPOTS FOR WHITE PETROLEUM PRODUCTS



Fuel Tank offloading at Mpika depot

In order to ensure security of supply of petroleum products Government has continued to construct fuel depots. During 2022, the MoE successfully commissioned the Chipata fuel depot in Eastern Province. The depot was commissioned on 19th August, 2022.

In that regard, as at 31st December 2022, the country had seven (7) operational depots in Lusaka, Ndola, Mpika, Mongu, Solwezi, Mansa and Chipata. Meanwhile, works had advanced at the upcoming fuel depot in Lusaka. It is expected that the number of operational depots will increase to eight (8) once the New Lusaka depot is commissioned. Table 2-19 shows the status, capacity and estimated costs of establishing the Chipata and New Lusaka fuel depots as at 31st December, 2022.

No.	Fuel Storage Depot	Status	Estimated Cost US\$' million
	New Lusaka Fuel Depot	 Construction works had reached advanced completion stages during the period under review. Progress on the development of the depot was at 99% completion by close of December 2022. The depot will have a capacity of 102 million litres with the following breakdown: 60 million litres Diesel; 40 million litres Petrol; and 2 million litres Kerosene. 	124
	Chipata Fuel Depot	 Construction of Chipata fuel depot was completed. The depot was commissioned on 19th August, 2022. The depot has a capacity of 7.08 million litres with the following breakdown: 4 million litres Diesel; 2 million litres Petrol; 0.50 million litres kerosene; and 0.58 million litres Jet A-1. 	37

Table 2-19: Status of the construction of GRZ fuel depots as at 31	st December, 2022
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2.13 DEVELOPMENT OF TECHNICAL STANDARDS, GUIDELINES AND FRAMEWORKS

Section 4(h) of the Energy Regulation No. 12 of 2019, mandates the ERB in collaboration with Zambia Bureau of Standards (ZABS) to design technical standards, with regards to quality, safety and reliability of supply of energy products and services. Further, section 4(m) of the aforementioned Act mandates the ERB to develop codes of practices and guidelines. During the period under review, in the petroleum sub-sector, the ERB revised the LPG Standard series (ZS 429 1 - 4) and developed the Guidelines on Siting of Petroleum infrastructure, as listed in Table 2-20. The ERB also commenced the process of developing the regulations on Siting of petroleum infrastructure.

Type of document developed and the sub-sector	Name of document	Status as of 31 st December 2022
	Standards	
Petroleum sub-sector	DZS 429: Liquefied Petroleum Gas Standards (Parts 1 to 4) (revision)	The revision was drafted and public comments were incorporated in the drafts in 2022
	Guidelines	
Petroleum sub-sector	Guidelines for Siting of Retail Service Stations	The Guidelines were developed and published in 2022
	Regulations	
Petroleum sub-sector	Regulations for Siting of Filling Stations	The ERB commenced the process of converting the Guidelines for Siting of filling Stations into a statutory instrument for effective enforceability

Table 2-20: Development and review of technical standards, frameworks and guidelines

2.14 FUEL MARKING PROGRAMME

The Fuel Marking programme, in Zambia began in 2018 and continues to be implemented in line with the provisions of Statutory Instrument (SI) No. 69 of 2017. The programme entails addition of a biochemical marker to all LSG , petrol and kerosene uplifts/ imports destined for domestic consumption prior to distribution on the Zambian market. Marking of fuel is undertaken from designated operational Government and selected OMC depots.

In 2022, a total of 1,886,717.55 m³ of fuel was marked compared to 1,868,667.80 m³ in 2021, representing a 0.97 percent increase in the marked fuel quantities.

During the period under review, routine field sampling and testing of petroleum products were undertaken at operational service stations and known consumer sites (including mine sites) countrywide in line the provisions of SI No. 69 of 2017. In this regard, a total of 5,904 samples were collected and tested, representing a 24.35 percent increase, when compared to 4,748 samples collected in 2021. The increase in the number of samples collected in 2022 was attributed to an increase in the total number of ERB licensed petroleum infrastructure. Figure 2-15 shows the total number of samples collected and tested per province

33)



Figure 2-15: Total number of samples collected and tested per province

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The results of the field sampling and testing revealed a slight decline in the pass rate from an overall compliance rate of 98.57 percent in 2021 to 98.05 percent in 2022. The North-Western Province recorded the lowest compliance rate at 96.31 percent followed by Muchinga Province that recorded a compliance of 96.95 percent. Four (04) out of the ten (10) provinces recorded compliance levels higher than the set KPI target of 99 percent. Table 2-21 shows the results of the fuel marking sampling and testing exercise by province.

Table 2-21: Results	of the fuel	marking	exercise	by province
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	2021 sampling ar	nd testing results	2022 sampling and testing results		
Province	No. of samples collected	Pass rate (%)	No. of samples collected	Pass rate (%)	
Central	343	99.71	461	98.92	
Copperbelt	1,177	96.60	1,640	97.20	
Eastern	197	100	303	99.01	
Lusaka	1,950	99.18	2,090	98.47	
North-Western	221	96.83	352	96.31	
Southern	380	99.47	454	98.02	
Western	100	100	147	99.32	
Northern	135	100	201	99.50	
Muchinga	149	98.66	131	96.95	
Luapula	96	100	125	99.20	
Total	4,748	98.57	5,904	98.05	

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2.15 CHALLENGES IN THE PETROLEUM SUB-SECTOR

2.15.1 Lack of Supply of Petroleum Feedstock

In 2022, there was no supply of petroleum feedstock to INDENI and TAZAMA following Government's pronounced reforms to restructure the Petroleum sub-sector. The country mostly relied on importation of finished petroleum products to meet market demand. On the full implementation of the Government reforms in the petroleum sub-sector, the dead stock in the pipeline will be the final consignment to be pumped and processed as a petroleum feedstock consignment.

2.15.2 Concentration of Retail Sites in Urban Areas

During 2022, it was noted that there was increased concentration of development of retail sites in urban areas. Majority of OMCs prefer to set up retail sites in urban areas with little expansion in rural sites. A deliberate policy to encourage development in rural retail sites is necessary to extend the expansion of operations of OMCs in remote parts of the country.

2.16 OUTLOOK FOR THE PETROLEUM SUB-SECTOR

2.16.1 Conversion of TAZAMA Pipeline to a Finished Petroleum Products Pipeline

Following Government's pronouncement to restructure the petroleum sub-sector, TAZAMA is expected to commence pumping LSG in the first quarter 2023, in line with the reforms. With regards to INDENI, the company is expected to commence operating as an OMC as well as a biofuels blending plant.

35)



2.16.2 Extension of Import Duty Waiver

During the period under review, Government extended the suspension of import duty on petrol and diesel. Government amended the Customs and Duty rate in chapter 27 of the customs and exercise Act cap 322 from 25.00 percent to free rate on importation of petrol and diesel. This implies that OMCs are no longer required to obtain import permits from the MoE. The amended Act is expected to come into operation on 1st January, 2023.

2.16.3 Enhanced National Petroleum Storage Capacity

As at 31st December, 2022, the construction of the New Lusaka Fuel Depot was at advanced stage. It is expected that the fuel depot will be commissioned during 2023. With this development the total number of GRZ storage depots will increase from seven (7) to eight (8), consequently increasing storage capacity

(36)



3.0 ELECTRICITY SUB-SECTOR

This section covers the performance, developments, constraints and challenges as well as the outlook of the electricity sub-sector. The Zambian electricity sub-sector includes a public utility company, ZESCO, and several Independent Power Producer (IPPs). ZESCO has Power Purchase Agreements (PPAs) with IPPs in Zambia and is involved in generation, transmission, distribution and supply. The sector also comprises key players such as Traders, Distribution Network Service Providers (DNSPs) and Transmission Network Service Providers (TNSPs), that mainly supply electricity to bulk consumers (the mines).



ZESCO Substation

3.1 ZAMBIA'S INSTALLED ELECTRICITY GENERATION CAPACITY

With the construction and commissioning of KGL power project, the national installed electricity capacity increased to 3,777.3MW in 2022, from 3,318.4MW in 2021. From the total electricity generation installed capacity of 3,777.3MW, 5.5MW was attributed to mini-grids and 3,771.8MW is on-grid generation capacity which also includes CEC's standby emergency generators with combined capacity of 80MW.

In 2022, Zambia's national installed capacity continued to be dominated by hydro generation accounting for 83.8 percent while thermal was at 8.7 percent, HFO at 2.9 percent, solar at 2.4 percent and diesel at 2.2 percent. Figure 3-1 shows the proportion of electricity installed capacity by technology as at 31st December, 2022.

37)





Figure 3-1: Installed electricity generation by technology – 2022

3.2 HYDROLOGICAL SITUATION IN ZAMBIA



Kariba Dam

Zambia has two main river basins, namely; the Zambezi and the Congo river basins, which are hydrologically divided into six main catchments. The Zambezi river basin comprises the upper Zambezi, Kafue and Luangwa catchments while the Congo river basin comprises the Chambeshi, Luapula and the Tanganyika catchments in the northern part of the country as depicted in Figure 3-2.

(38)







Source: Water Resources Management Authority

3.2.1 Rainfall Performance in 2021/2022 Season in Zambia

Zambia receives moderate rainfall ranging from an annual average of approximately 700 mm in the south of the country to 1400 mm per year in the north. In 2021/22 rainy season, Zambia generally recorded normal to above normal rainfall and Table 3-1 shows the total rainfall at meteorological stations across the country as monitored by Zambia Meteorological Department (ZMD). Figure 3-3 shows spatial distribution on how total rainfall has changed from 2017/18 to 2022/23 using merged data sets with satellite data as complied by ZMD. The map shows an increase in seasonal rainfall totals from 2017/18 to 2022/23. The total seasonal rainfall over Lusaka Province, parts of Central and Muchinga Provinces including the North-Western, parts of Southern Province have increased by more than 50 percent.

Table 0-1. Meteorological stations seasonal total railian in 2021/22 season								
Station ID	Latitude	Longitude	Seasonal Totals (mm)					
Chipata	-13.57	32.58	916.60					
Choma	-16.95	27.07	454.90					
Isoka	-10.27	32.68	1,219.6					
Kabompo	-13.60	24.21	1,100.4					
Kabwe	-14.42	28.48	846.00					
Kabwe Agro	-14.41	28.5	752.94					
Kaoma	-14.8	24.8	907.25					
Kasama	-10.22	31.13	1,364.70					
Kasempa	-13.45	25.83	1,465.84					
Kawambwa	-9.79	29.08	1,209.30					
Livingstone	-17.82	25.82	826.70					
Lundazi	-12.29	33.18	740.10					
Lusaka	-15.42	28.32	592.20					

Table 3-1: Meteorological stations' seasonal total rainfall in 2021/22 season

39)



Station ID	Latitude	Longitude	Seasonal Totals (mm)
Magoye	-16.13	27.63	951.60
Mansa	-11.10	28.85	1,173.20
Mbala	-8.87	31.33	2,389.20
Mfuwe	-13.27	31.93	713.10
Misamfu	-10.18	31.22	1,143.50
Mongu	-15.25	23.15	1,025.30
Mpika	-11.85	31.45	1,202.20
Msekera	-13.65	32.57	1,174.40
Mount Makulu	-15.55	28.25	659.70
Mumbwa	-15.08	27.19	781.40
Mwinilunga	-11.75	24.43	1,516.90
Ndola	-13	28.65	1,342.70
Petauke	-14.25	31.28	711.30
Senanga	-16.12	23.27	871.50
Serenje	-13.23	30.22	1,196.90
Sesheke	-17.47	24.3	762.10
Solwezi	-12.17	26.37	1,143.70
Zambezi	-13.57	23	1,109.60

Figure 3-3: Change in percentage from 2017/18 to 2022/23 of total rainfall



Change in % over 2017 - 2023 for Oct - Apr

Source: Zambia Meteorological Department

Table 3-2 highlights the end of year levels in large reservoirs and compares the design operational levels to actual levels for 2021/22 season as monitored by Zambezi River Authority (ZRA) and other key stakeholders for power generation in Zambia.

(40)



Main Water	Dam Design Operational Levels [m]		Year 2021 Actual Dam Levels [m]		Year 2022 Actual Dam Levels [m]	
Reservoir	Min. Dam Level	Max. Dam Level	Start Level [Jan]	End Level [Dec]	Start Level [1 Jan 22]	End Level [1 Jan 23]
Kafue Gorge	974.00	976.60	976.37	976.11	976.24	974.27
Kariba North Bank	475.50	487.71	478.44	478.22	478.35	475.61
Victoria Falls	881.50	883.20	882.20	881.80	881.86	881.81
Itezhi- Tezhi	1,006.00	1,030.50	1019.13	1023.36	1021.92	1019.30
Kafue Gorge Lower	530.00	579.75	-	561.70	562.00	560.90

Table 3-2: Large reservoir water levels – 2021 and 2022

Figures 3-4 to 3-6 depicts the graphical representation of the dam levels for 2022. Typically, the Zambian rainfall season runs from October to April with April to May being the peak dam collection period as illustrated by the Rule Curve (R/C).



Figure 3-4: Trend analysis of water levels at Kafue Gorge, 2022

The main water reservoir at Kafue Gorge is designed to operate between levels of 974.0 minimum and 976.6m maximum for hydropower generation. In 2022, the dam level at the end of the year was 976.2m, whereas in 2021 it closed at 976.1 equivalents to 87.16 percent and 87.15 percent of usable storage, respectively.

(41)

Source: ZESCO Hydrology Report



Figure 3-5: Trend analysis of water levels at Kariba North Bank, 2022

Source: Zambezi River Authority website

For optimum power generation, the Kariba dam is designed to operate between minimum level of 475.50m and maximum level 487.71m. In 2022, the dam level at the end of the year was 475.61m equivalent to about 20.6 percent of usable storage, while in 2021, the dam level closed at 476.22m equivalent to 20.65 percent of usable storage.



Figure 3-6: Trend analysis of water levels at Victoria Falls, 2022

The operating minimum and maximum dam levels at Victoria Falls are designed to be 881.5m and 883.2m respectively. In 2021 and 2022, the dam level closed at approximately 881.8m which was equivalent to 17.7 percent usable storage.

(42)





ITT dam was designed to serve as a primary water storage facility for Kafue Gorge power station. For optimum hydro power generation, the main water reservoir at ITT is designed to operate between minimum and maximum levels of 1,006.0m and 1,030.5m respectively. In 2022, the dam level at the end of the year was 1,019.3m equivalent to 70.6 percent of usable storage, while, in 2021, the dam level closed at 1,023.4m equivalent to 70.9 percent of usable storage.





KGL is designed to operate between levels of 530.0m minimum level and 579.8m maximum for optimum hydro power generation. At the end of 2022, the dam level was 560.9m equivalent to 96.7 percent of usable storage while in 2021, the dam level closed at 561.7m equivalent to 96.9 percent of usable storage.

3.3 NATIONAL ELECTRICITY GENERATION

In 2022, Zambia's total electricity generation grew by 10 percent from 17,635.05GWh in 2021 to 19,399.12GWh in 2022. The growth is attributed to the increased generation from KGL power station following the commissioning of three additional electricity generation units each rated at 150MW. Figure 3-9 shows the annual electricity generation from ZESCO's power plants and from the IPPs from 2017 to 2022.

(43)



Further, as shown in Figure 3-9, there has been a marginal rise in the portion of electricity generated by IPPs. This is attributed to the commencement of electricity generation by KGL in 2021.

3.3.1 Electricity Generation from Large Hydro Power Plants³⁰ Owned by ZESCO



ZESCO sub-station transformer

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ZESCO owns and operates five large hydro power plants which include: Kariba North Bank (KNB), Kafue Gorge Upper (KGU), KGL, Kariba North Bank Extention (KNBE) and Victoria Falls Power Station (VFS). Generation from ZESCO's large hydro power plants declined by 6 percent from 12,204.96GWh in 2021 to 11,454.60GWh in 2022.

(44

³⁰ Hydropower plants are traditionally broken down into categories depending upon their size based on the World Bank. The smallest plants, with capacities of between 1 and 100 kW are called micro hydropower plants. Between 100 kW and 1 MW a plant is described as a mini hydropower plant. Small hydropower plants are generally those with capacities of between 1 and 10 MW, but this upper limit can vary from country to country and in some cases may be as high as 30 MW. Plants with capacities larger than 10 MW (or up to 30 MW depending on jurisdiction) are classed as large hydropower plants.



KNBE is a peaking power plant designed to only operate during peak demand periods. However, in 2022, the plant operated beyond its intended purpose, thus recording increased generation by more than double from 731.40GWh in 2021 to 1,501.20GWh in 2022 representing 105 percent. Meanwhile, the Utility also recorded reduced generation from VFS of 56 percent from 1,570.62GWh in 2021 to 685.42GWh in 2022. Figure 3-10 shows ZESCO's trend in Electricity generation from large hydro power plants.



Figure 3-10: Trend in electricity generation from large hydro power plants owned by ZESCO

3.3.2 Electricity Generation from Mini-Hydro Power Plants Owned by ZESCO

ZESCO recorded a reduction in the electricity generated from mini-hydro power plants by 27 percent from 220.57GWh in 2021 to 160.81GWh in 2022. Lunzua and Shiwang'andu Mini-hydros recorded declines in generation by 42 and 77 percent respectively. Figure 3-11 shows the trend in electricity generation from mini-hydro power plants from 2017 to 2022.





(45)



3.3.3 Electricity generation from Diesel Power Plants Owned by ZESCO

ZESCO uses diesel generators for supply of power in Shang'ombo, Chama and Lundazi as these are not yet connected to the national grid. Electricity generation from diesel generators rose by 64.67 percent from 1.50 GWh in 2021 to 2.47 GWh in 2022. The increase can be attributed to the increased generation from the Lundazi diesel plant which more than doubled its generation sent out. Figure 3-12 provides a trend of electricity generation from 2017 to 2022.





3.3.4 Electricity generation from Independent Power Producers

The IPPs' contribution to the electricity supply has continued to rise following the commissioning of additional plants in the sub-sector. Electricity generation from the IPPs went up by 72.67 percent from 3,638.0GWh in 2021 to 6,280.0GWh in 2022. This is attributed to increased generation by MCL from 1,296.6GWh to 2,164.7GWh, representing 67 percent. Additionally, the commissioning of three generating units at KGL resulted in an increase from 893.3GWh to 2,966.7GWh, representing 232 percent rise. However, ITPC and LHPC recorded reductions in electricity generation of 9 percent and 30 percent, from 829.1GWh and 354.1GWh in 2021 to 757.8GWh and 247.8GWh in 2022 respectively. Figure 3-13 shows the trend in electricity generation from IPPs.

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3.4 DOMESTIC AND REGIONAL POWER TRADING

3.4.1 Power Purchase and Supply Agreements

As part of its regulatory mandate the ERB facilitates for domestic and regional power trade through grant of approval of Power Supply/Purchase Agreements (PSA/PPA). In the year 2022, the ERB granted the following approvals of PPA/PSAs, shown in Table 3-3:

Table 3-3: ERB approved PPA/PSAs

No	Contracting parties	Contracted capacity (MW)	Duration (Years)
1.	ZESCO and Botswana Corporation (Pty) Limited	80	3
2.	Endeva Power Zambia and Milla Eco Lodge	0.0015	3
3.	ZESCO and Zimbabwe Electricity Transmission and Distribution Company (ZETDC)	100	5
4.	ZESCO and Copperbelt Energy Corporation Plc (CEC)	380	13
5.	ZESCO and Northwestern Energy Corporation Limited (NWEC)	20	15
6.	ZESCO and Namibian Power Corporation (Pty) Limited	80	5
7.	ZESCO and Botswana Power Company, (non-firm supply)	200	2
8.	CEC and Mimbula Minerals	26	10

3.4.2 Trade on the Southern African Power Pool

ZESCO is part of an interconnected network of regional electricity utilities in Southern Africa. The Southern African Power Pool (SAPP) is an electricity market that provides a platform for electricity trade among member Utilities in the Southern African region. During 2022, the Day Ahead Market (DAM) continued to dominate trade on the SAPP market. Figure 3-14 shows the total market trade on the SAPP market during the year 2022:

(47)



3.4.3 ZESCO's Electricity Imports and Exports

Figure 3-15 shows ZESCO's imports and exports of electricity to fulfil bilateral regional PSAs as well as trade on the SAPP market.



Figure 3-15: ZESCO's imports and exports

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During 2022, there was a slight increase in the electricity exports to 2,923GWh from 2,150GWh in 2021 representing a rise of 36 percent. Meanwhile there was no marginal increase in the electricity imports as depicted by Figure 3-15 imports were maintained at 18GWh.

(48)



3.4.4 Trade by GreenCo Power Services Limited

GreenCo Power Services Limited (GPSL) is an intermediary off-taker and service provider that purchases power from renewable IPPs and sells to other utilities and on the SAPP market. The enterprise holds a Trading of Electricity License that was the first of its kind issued by the ERB.

In 2022, GPSL commenced trading on the SAPP Day-Ahead Market. GPSL signed a PPA with LHPC to purchase excess capacity of at least 5 MW of energy generated from LHPC's hydro power plants. Consequent to this, GPSL traded 6,404MWh on the SAPP market.

GPSL intends to grow its portfolio of agreements with renewable energy IPPs, and facilitate development of additional renewable energy projects in Zambia by being a credit worthy off-taker of renewable energy power in Zambia.

3.5 ELECTRICITY CONSUMPTION

3.5.1 Analysis of National Electricity Consumption by Economic Sector

During the period under review, the total electricity consumed was 13,777.9GWh which was a 7.4 percent increase from 12,831.4GWh consumed in 2021. This increase in total electricity consumed over this period was mainly due to increased demand from the Transport and Mining economic sub-sectors. Table 3-4 below shows a comparison of electricity consumption between 2021 and 2022 by economic sector.

Electricity consumption (GWh)	2021	2022	% Change
Transport	31.8	36.9	16.1%
Mining (Quarries)	6,551.3	7,355.1	12.3%
Finance and Property	835.4	908.3	8.7%
Trade	82.8	87.8	6.0%
Manufacturing	375.4	384.6	2.4%
Domestic (Including Households)	4,477.3	4,548.5	1.6%
Agriculture	293.7	286.5	-2.5%
Energy and Water	113.7	106.8	-6.1%
Others	60.5	56.2	-7.1%
Construction	9.4	7.3	-22.2%
Total national consumption	12,831.4	13,777.9	7.4%

Table 3-4: Comparison of national electricity consumption by economic sector, 2021 and 2022

During the period under review, the Mining sector accounted for the largest electricity consumption share at 53.4 percent while the Domestic sector was second at 33.0 percent. The third highest consumption was reported in Finance and Property sector which accounted for 6.6 percent. In this regard, the top three sectors accounted for 93.0 percent of the total national consumption. Table 3-5 below shows the shares of national electricity consumption by economic sector.

(49)

Electricity consumption (GWh)	2021	% Share	2022	% Share
Mining (Quarries)	6,551.3	51.1%	7,355.1	53.4%
Domestic (Including Households)	4,477.3	34.9%	4,548.5	33.0%
Finance and Property	835.4	6.5%	908.3	6.6%
Manufacturing	375.4	2.9%	384.6	2.8%
Agriculture	293.7	2.3%	286.5	2.1%
Energy and Water	113.7	0.9%	106.8	0.8%
Trade	82.8	0.6%	87.8	0.6%
Others	60.5	0.5%	56.2	0.4%
Transport	31.8	0.2%	36.9	0.3%
Construction	9.4	0.1%	7.3	0.1%
Total national consumption	12,831.4	100.0%	13,777.9	100.0%

Table 3-5: Share of national electricity consumption by economic sector, 2021 and 2022

3.6 OPERATIONAL PERFORMANCE OF ELECTRICITY ENTITIES

This section discusses the performance of individual entities in the electricity sub-sector during the year 2022.

3.6.1 Key Performance Indicators for State and Non-State Owned Enterprises

The Energy Regulation Act and Electricity Act, both of 2019, mandate the ERB to monitor the efficiency and performance of licensees in the provision of energy products and services to energy consumers. To this end, the ERB in consultation with the SOEs and Non-State Owned Enterprises (NSOEs) developed KPI frameworks meant to monitor and measure the technical and operational performance for both SOEs and NSOEs. In 2022, the SOEs and NSOEs continued to implement the frameworks under the following key technical and commercial areas, presented in Table 3-6:

Table 3-6: Approved KPIs for SOEs and NSOEs

Approved KPIs for SOEs - ZESCO	Approved KPIs for NSOEs			
 i). New customer connections; ii). Post-paid meter reading; iii). Safety; iv). Quality of service; v). Power generation; vi). System losses; vii). Financial performance; viii). Power Generation; ix). Power Quality; x). Staff Productivity; and xi). Customer Service. 	 i). Quality of Service Supply; iii). System Losses; iv). Customer service; v). Service restoration; vi). Financial performance: vii). Infrastructure Compliance; and viii). Safety. 			

3.6.2 ZESCO Limited

ZESCO is a state owned electricity utility responsible for the generation, transmission, distribution and supply of electricity in Zambia. As part of its regulatory monitoring mandate, the ERB utilizes KPIs to monitor and assess the performance of licensed enterprises. In that regard, the ERB and ZESCO agreed on a three-year KPI framework for the period 2020 - 2022.

3.6.2.1 ZESCO's performance on the KPI framework

The overall performance of ZESCO on the KPI framework over the last three years has been below the minimum set target of 75 percent. ZESCO scored 35.1 percent in 2020, 46.3 percent in 2021 and 46.9 percent in 2022. Figure 3-16 shows the annual average score of the Utility on the framework.

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Figure 3-16: ZESCO's annual average performance in 2020 – 2022



The KPI framework had 11 thematic areas, namely; new customer connections, customer metering, financial performance, efficiency, system losses, staff productivity, quality of service, power generation, safety, customer service and power quality. Table 3-7 shows ZESCO's performance under each sub-indicator:

No.	Thematic area/ Indicator	ERB agreed Weight (%)	Individual Average performance 2020 (%)	Individual Average performance 2021 (%)	Individual Average performance 2022 (%)
1	New Customer Connections	10	1.3	0.0	0.8
2	Customer Metering	5	3.1	4.4	5.0
3	Financial performance	10	4.0	3.5	3.9
4	Efficiency	15	5.6	5.6	6.3
5	System Losses	7.5	2.5	3.9	2.5
6	Staff Productivity	10	7.5	8.0	7.5
7	Quality of service	20	0.0	10.0	11.3
8	Power generation	5	5.0	5.0	5.0
9	Safety	10	2.5	2.5	2.5
10	Customer Service	5	2.0	2.5	1.0
11	Power Quality	2.5	1.6	0.9	1.3
Actual Score		100	35.1	46.3	46.9
Benc	hmark minimum score		7	5	

Table 3-7: Breakdown of ZES	CO's performance or	n the KPI framework	2020 to 2022
Table 0-7. Dieakdowii of 220	oo s periornance or		, 2020 10 2022

As highlighted in Table 3-7, for the period 2020 to 2022, ZESCO only met staff productivity and power generation targets. ZESCO cited non-cost reflective tariffs and connection charges as major causes of poor performance on customer connections, financial performance, quality of service and customer complaints KPI. Further, ZESCO had challenges in collecting payments from Government agencies, export customers and mining firms as evidenced by the rising Trade receivable (debtor) days.

3.6.2.2 Technical Performance - ZESCO

In 2022, the ERB conducted country-wide technical audits of ZESCO's electricity generation, transmission and distribution infrastructure. The audits were undertaken in line with ERB's mandate to monitor the efficiency and performance of licensees, having regard to the purpose for which ZESCO was licensed as provided for in the Energy Regulation Act No. 12 of 2019. The audits were conducted in order to determine the Utility's electricity infrastructure compliance levels with the requirements stipulated in the various licence conditions, standards, codes of practice, guidelines and any other applicable directives and regulations. The compliance audits were also undertaken in line with the strategic objectives of the ERB's 8th Strategic Business Plan (SBP).

(51)



During the period under review, the overall average compliance level for ZESCO was found to be 79.0 percent compared to 87.0 percent in 2021 representing a decline of eight (8) percentage points. This was below the ERB set target of 93.0 percent. The failure to meet ERB set target was attributed to non-resolution of 2021 non-compliances despite ZESCO's commitment to close all outstanding anomalies from previous audits. Table 3-8 depicts ZESCO's performance over the years from 2017 to 2022.

Type of Facility/Substation	2017 % Compliance	2018 % Compliance	2019 % Compliance	2020 % Compliance	2021 % Compliance	2022 % Compliance
Large Hydro Power Stations	95.3	95.0	93.0	95.0	96.0	95.0
Transmission Substations>33kV	79.1	79.3	82.0	86.0	90.0	91.0
Distribution Substations≤33kV	74.9	73.3	74.0	78.0	73.0	74.0
Mini Hydro Power Stations	82.6	68.5	94.0	98.0	95.0	91.0
Diesel generation stations	64.0	67.1	64.0	81.0	81.0	79.0
ZESCO Overall Average Compliance	79.2	76.7	81.0	80.0	87.0	79.0
ERB SBP Compliance Target for ESI	85.0	87.0	89.0	91.0	93.0	93.0

Table 3-8: ZESCO's infrastructure percentage compliance, 2017-2022

3.6.3 Rural Electrification Authority

The Rural Electrification Authority (REA) was established to facilitate increased access to electricity in rural areas through the Rural Electrification Act No. 20 of 2003. REA is the implementing body of the Rural Electrification Master Plan (REMP). The REMP has an ambitious target of achieving a rural electrification rate of 51 percent by the year 2030. In that regard, REA aims to accelerate access to electricity in rural areas through grid extension projects, solar home systems, solar mini-grids, mini-hydro and other renewable energy sources. In 2022, REA reported to have undertaken the following projects as highlighted in Table 3-9.

Table 3-9: Rural electrification projects undertaken in 2022

No.	Name of Project	Province	District	Type of Technology					
Rene	Renewable energy projects								
1.	Chaba	Northern	Chilubi	Solar Mini-Grid					
2.	Kasanjiku Phase - Lot 2	North-Western	Mwinilunga	Grid Extension					
3. Kasanjiku Phase - Lot 3		North-Western	h-Western Mwinilunga						
Grid	development projects								
4.	Salamano	Mufulira	Copperbelt	Grid Intensification					
5.	Kanongesha	North-Western	Mwinilunga	Grid Intensification					
6.	Ming'omba	Copperbelt	Chililabombwe	Grid Intensification					
7.	Mutenda/Muchinshi	Copperbelt	Chingola	Grid Intensification					
8.	Bulaimu	Muchinga	Nakonde	Grid Intensification					

3.6.3.1 REA Projects under IAEREP and ESAP

Under the Increased Access to Electricity and Renewable Energy Production (IAEREP) Project, REA facilitated for the awarding of three grant beneficiaries to implement renewable energy demonstration projects in Zambia.

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The grant beneficiaries are expected to implement a total of 194 Solar Mini-grids at an approximate cost of £44.8 million. The cost of implementing the projects is a contribution from both the EU grant and the private sector. REA, as one of the implementing agencies of the Energy Sector Monitoring & Evaluation Plan (ESM&P) 2020, engaged a consultant to develop a Monitoring and Evaluation Framework for the demonstration Projects.

Under the Electricity Services Access Project (ESAP), the Authority achieved a total of 56,341 subsidy connections against a target of 39,992 by end of the year 2022. Table 3-10 summarises the connections completed in the period under review.

	······································				
S/N	Electrification category	Number of connections	Female-headed/ owned	Male-headed/owned	
1.	Metered residential	47,616	14,428	33,188	
2.	Metered commercial	8,303	1,774	6,529	
3.	Unclassified Connections	422	-	-	
Total		56,341	16,202	39,717	

Table 3-10: Summary of connections as at 31^{st} December 2022

3.6.3.2 Challenges faced by the Rural Electrification Authority

During the period under review, the Authority faced the following challenges which impacted the smooth operation of the Authority.

- i. Reduced Productivity as a result of the continued effect of the COVID-19 pandemic;
- ii. Delays in completion of projects under Force Account project implementation method which was as a result of the new Emolument Commission Guidelines which stipulated that all temporal or permanent employments by any Government Institution must be approved by the Commission;
- iii. Delay in commencement of project implementation due to delays in approvals of Contracts; and
- iv. Delay in supply of project materials as there was a continued lock down around the globe which was attributed to the COVID-19 Pandemic.

3.6.4 Copperbelt Energy Corporation Plc



CEC Transmission Lines - Riverside

Copperbelt Energy Corporation (CEC) is a NSOE involved in power transmission and distribution to large mining customers on the Copperbelt. CEC also exports power to the Democratic Republic of Congo (DRC) through a 220kV interconnector. Further, CEC generates electricity using diesel powered Gas Turbine Alternators (GTAs)

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with a combined installed capacity of 80MW, located in Luanshya (Maclaren), Mufulira (Kankoyo), Chingola (Luano) and Chililabombwe (Bancroft). In 2022, CEC signed a PPA with ZESCO for the period of 13 years, to supply power to its customers. The company has also entered into PPAs with LHPC and Dangote Industries Zambia Limited (Dangote).

In 2022, CEC's power purchases with ZESCO, LHPC and Dangote were as depicted in Table 3-11.

Table 3-11: CEC's power purchases in 2022

Source	Energy Purchases in MWh
ZESCO	1,655,538.45
LHPC	232,213.00
Dangote	64,306.71
Total Annual Purchases	1,952,058.16

CEC's mining customers on the Copperbelt include Mopani Copper Mines Plc (MCM), China Nonferrous Metal Mining Corporation Limited (CNMC) and NFC Africa Mining Plc (NFCA), among others, and Table 3-12 presents their energy sales in 2022.

Table 3-12: CEC energy sales in 2022

Customer Name	Energy sales (MWh)
MCM	1,039,867.6
CNMC - Luanshya Copper Mines Plc	342,134.2
NFCA - Chisenga	179,424.4
NFCA - Luela	102,565.9
Chambishi Metals Plc	2,717.1
Chambishi Cosak	1,596.9
Lubambe Copper Mine Limited	174,603.7
Chibuluma Copper Mine Plc	9,952.7
Mimbula Minerals Limited	72.7
Macrolink Resources Zambia Limited	13.7
China Copper Mines Limited	20,665.0
Nkana Mining and Mineral Processing Limited	191.6
Sinohydro Zambia Limited	62.4
Dangote Industries Zambia Limited	18,851.5
China Civil Engineering Construction Corporation (Zambia) Limited	117.8
Huayi Investment Limited	128.4
Total Sales	1,893,056.3

In 2022, CEC increased its investment in power generation and embarked on an expansion of its 1MWp grid tied solar power plant to 33MWp at Riverside solar farm in Kitwe. The expansion of the solar project was scheduled to be completed and commissioned in the first quarter of 2023.
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3.6.4.1 Technical Performance - CEC

In 2022, the ERB conducted its annual technical compliance audits of CEC's electricity infrastructure and the compliance levels for the GTAs was found to be 98.7 percent compared to 98.3 percent in 2021 as depicted in Figure 3-17. This was above the ERB set target of 93.0 percent.





In 2022, the average compliance level for CEC's transmission and distribution electricity infrastructure was found to be 98.0 percent compared to 97.1 percent in 2021 as presented in Figures 3-18 and 3-19 respectively.





(55)



Table 3-13 depicts CEC's performance from 2017 to 2022.

Table 3-13: CEC's infrastructure percentage compliance, 2017-2022									
Type of Facility/ Substation	2017 % Compliance	2018 % Compliance	2019 % Compliance	2020 % Compliance	2021 % Compliance	2022 % Compliance			
CEC Transmission - Chililabombwe	100.0	99.0	96.2	96.6	96.2	100.0			
CEC Transmission - Chingola	98.7	97.1	93.0	95.6	95.1	100.0			
CEC Transmission - 96.3 g		97.0	94.9	96.2	99.1	99.1			
CEC Transmission - Kitwe		94.9	89.6	93.6	98.2	97.0			
CEC Transmission - Luanshya	CEC Transmission - 99.6 98.0		96.1	97.0	98.1	96.2			
CEC Transmission - Mufulira	CEC Transmission - 100.0 97.9		98.1	96.0	98.1	100.0			
CEC Transmission - Ndola	99.4	96.0	94.5	96.8	98.1	100.0			
CEC Gas Turbine Alternators (GTAs) 80MW	100.0	100.0	98.0	100.0	98.3	98.7			
ERB SBP Compliance Target for ESI	85.0	87.0	89.0	91.0	93.0	93.0			

Figure 3-19: CEC's performance of the distribution infrastructure

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3.6.4.2 Challenges Faced by CEC in 2022

The challenges faced by CEC during 2022 included theft and vandalism on electrical infrastructure as well as cases of land encroachment. In addition, capital expenditure on the construction of the 33MWp solar power plant was higher than the budgeted due to high duty on the importation of some components, which did not qualify for the zero rate tax incentives on some selected solar equipment in place.

(56)



3.6.5 Lunsemfwa Hydro Power Company Limited

Lunsemfwa Hydro Power Company (LHPC) is an IPP located in Kabwe District of Central Province which owns and operates two power plants namely; Mulungushi (32MW) and Lunsemfwa (24MW) hydro power stations with a combined installed generation capacity of 56MW. In 2022, the total combined generation was 236,922.6MWh.

In 2022, the total electricity sales to CEC and the SAPP Markets were 232,213.0MWh and 6,499.0MWh respectively at an average available capacity of 35.0MW compared to the sales of 347,240.5MWh at an average available capacity of 42.9MW in 2021. There were no sales to ZESCO during the period under review. Further LHPC wheeled a total of 275,103.4MWh³¹ of energy to customers through its transmission network.

3.6.5.1 Technical Performance - LHPC

In 2022, the ERB conducted technical compliance audits of LHPC's electricity infrastructure covering the generation power stations, 66kV Line A and B infrastructure at Converter 66/33/11kV Substation, Transformer T5 and its accessories at 88kV Kabwe Step Down Substation.

The average LHPC compliance level was found to be 95.3 percent compared to 90.5 percent recorded in 2021. This was above the ERB compliance target of 93 percent. Table 3-14 depicts the percentage compliance of audited infrastructure from 2017 to 2022.

-	<u> </u>					
Type of Facility/ Substation	2017 % Compliance	2018 % Compliance	2019 % Compliance	2020 % Compliance	2021 % Compliance	2022 % Compliance
Converter 66/33/11KV	80.9	94.0	93.0	86.0	92.7	96.3
Kabwe Step Down 66/88kV	83.0	100.0	88.0	93.0	94.8	96.4
Mulungushi Power Station	80.8	93.0	93.0	96.0	89.3	96.2
Lunsemfwa Power 89.7		90.0	93.0	96.0	89.1	92.9
LHPC Overall Average Compliance	83.6	94.3	91.8	92.8	90.5	95.3
ERB SBP Compliance Target for ESI	85.0	87.0	89.0	91.0	93.0	93.0

Table 3-14: LHPC's percentage compliance rate, 2017-2022

3.6.5.2 Challenges Faced by Lunsemfwa in 2022

LHPC faced the following challenges among others:

- i. Reduced income due to lack of sales to ZESCO;
- ii. Low water levels causing intermittent generation of power;
- iii. Low transmission capacity;
- iv. Theft of copper conductors;
- v. Operational inefficiency due to manual operations of intake gates; and
- vi. Water energy-food nexus.

³¹ Includes power wheeled on behalf of ZESCO for consumers based in Kabwe



3.6.6 Maamba Collieries Limited



Maamba power plant

MCL owns and operates Zambia's largest coal mining concession and coal-fired Thermal Power Plant. As one of the largest IPPs in the country, the 300MW power plant at Maamba has two generating units each with rated capacity of 150MW. From its total available capacity, 267.6MW is contracted to ZESCO and the balance is used for the plant's auxiliary consumption. MCL also operates a 46km long 330kV double circuit transmission line for power evacuation. In 2022, MCL's total generation sent out was 2,164.2GWh.

3.6.6.1 Technical Performance - MCL

In 2022, the ERB conducted technical compliance audit of MCL's electricity generation infrastructure and the overall average compliance was found to be 98.9 percent compared to 98.3 percent in 2021 as depicted in the Table 3-15 below. This compliance was above the ERB target of 93.0 percent.

Type of Facility/ Substation	2018 % Compliance	2019 % Compliance	2020 % Compliance	2021 % Compliance	2022 % Compliance
MCL Thermal Power station	94.7	95.4	97.0	96.4	97.8
330kV switchyard	94.7	95.4	98.0	100.0	100.0
MCL Overall Average Compliance Level	94.7	95.4	97.5	98.3	98.9
ERB SBP Compliance Target for ESI	87.0	89.0	91.0	93.0	93.0

Table 3-15: MCL's percentage compliance rate, 2018-2022

3.6.7 Northwestern Energy Corporation Limited

NWEC is an electricity distribution company that purchases electricity in bulk from ZESCO and sells to the mining townships of Kabitaka, Kalumbila and Lumwana. The Company has a distribution license to supply the electricity within the mining township of Kabitaka and Lumwana and in Kalumbila district. As of December 2022, the Utility had 3,194 customers with a demand of up to 20MW.

In 2022, the Utility supplied 45.87GWh of electricity to its territorial area of supply. The Company has plans of expanding its customer base especially in Kalumbila. Therefore, the Company has embarked on the construction of a new sub-station in the eastern part of the Kalumbila township. To support this development, the Utility submitted an application to the ERB for approval of its proposed standard connection charges. As of December, 2022 NWEC's application was still under review.

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3.6.7.1 Technical Performance - NWEC

In 2022, the ERB conducted technical compliance audits of NWEC's electricity distribution and supply infrastructure and the average compliance was found to be 87.7 percent compared to 97.9 percent in 2021, representing a decline of 10.2 percent. This was below the ERB compliance target of 93.0 percent and was attributed to significant drop in compliance at Kalumbila. Table 3-16 depicts NWEC's performance from 2017 to 2022.

Type of Facility/ Substation	pe of Facility/ 2017 % Substation Compliance		2019 % Compliance	2020 % Compliance	2021 % Compliance	2022 % Compliance
Kansanshi (Kabitaka)	75.0	88.0	78.1	88.5	100.0	100.0
Lumwana	65.0	83.0	94.2	82.3	93.7	88.6
Kalumbila	80.0	87.0	92.0	81.5	100.0	74.4
NWEC Overall Average Compliance	73.3	86.0	88.1	84.1	97.9	87.7
ERB SBP Compliance Target for ESI	85.0	87.0	89.0	91.0	93.0	93.0

Table 3-16: NWEC's percentage compliance rate, 2017-2022

Figure 3-20 shows the graphical representation of the compliance levels of NWEC's electricity infrastructure for 2022 compared to 2021.



Figure 3-20: Compliance levels for NWEC's electricity infrastructure for 2022 compared to 2021

3.6.7.2 Challenges Faced by NWEC in 2022

During the period under review, NWEC faced the following challenges among others:

- i. Difficulties in accessing project funding and high interest rates; and
- ii. Increased operational expenses due to rising maintenance costs.

3.6.8 Itezhi Tezhi Power Corporation

ITPC is an IPP that generates and supplies power to ZESCO. It has an installed capacity of 120MW with a composition of two (2) by 60MW units. The annual available capacity based on the PPA with ZESCO is 119.0MW. In 2022, ITPC supplied a total of 766.3GWh of electricity, compared to a total of 829.1GWh in 2021.

(59)



3.6.8.1 Technical Performance - ITPC

In 2022, the ERB conducted the technical compliance audits on the electricity infrastructure for ITPC and the average compliance level was determined to be 95.0 percent compared to 93.2 percent in 2021. This was above the ERB compliance target of 93 percent as depicted in the Table 3-17.

Type of Facility/ Substation	2017 % Compliance	2018 % Compliance	2019 % Compliance	2020 % Compliance	2021 % Compliance	2022 % Compliance
ITPC Hydro Electric Power Stations	85.2	94.9	93.0	95.0	92.0	97.3
220kV Switch Yard	0012	98.0	94.0	0010	94.3	92.7
ITPC Overall Average Compliance Level	85.2	96.5	93.5	95.0	93.2	95.0
ERB SBP Compliance Target for ESI	85.0	87.0	89.0	91.0	93.0	93.0

Table 3-17: ITPC's percentage compliance rate, 2017-2022

3.6.9 Zengamina Power Company Limited

Zengamina Power Company Limited (ZPL) is a privately developed, vertically integrated mini-grid utility company that supplies power to the Ikelenge District of North-Western Province. ZPL has an installed run-off-river hydro power generation capacity of 750kW. In 2022, ZPL energy generation sent out was 1.78GWh as shown in Figure 3-21.



Figure 3-21: Monthly generation sent out by ZPL, 2022

Figure 3-21 shows that the ZPL recorded its peak generation in July and the lowest in May, 2022.

3.6.9.1 Technical Performance - ZPL

In 2022, the ERB conducted technical inspections on the electricity infrastructure for ZPL. In that regard, the overall compliance level remained the same as that of 2021 at 92.0 percent which was below the ERB compliance target of 93.0 percent.

Notwithstanding the below target score, as mentioned earlier, ZPL resolved some of the outstanding noncompliances that were reported during the 2021 compliance inspections.

3.6.9.2 Challenges Faced by Zengamina in 2022

During the period under review ZPL reported the following challenges:

- i. Resistance by customers regarding the increase in tariffs;
- ii. Recovery of post-paid arrears owed by customers migrated to pre-paid metering;
- iii. High failure rate of prepaid meters; and
- iv. High system losses of approximately 31 percent.

3.6.9.2.1 Prospects for Zengamina

The following were the prospects for ZPL beyond 2022:

- i. Upgrade of its 33kV network; and
- ii. To invest in Solar PV and Battery Energy Storage System.

3.6.10 Dangote Industries Zambia Limited

Dangote Cement Industries Zambia Limited (Dangote) operates a captive thermal (coal fired) power plant with an installed generation capacity of 30MW. The plant mainly supplies power to its cement production facility and the excess capacity of at least 8MW is sold to CEC via a PPA. Table 3-18 shows Dangote's energy statistics in 2022.

Table 3-18: Dangote's energy statistics in 2022.

Description	Energy (MWh)
Auxiliary consumption	19,947
Consumption by the cement plant	81,557
Power exported to CEC	68,195
Total Electricity Generation	148,733

3.6.10.1 Technical Performance - Dangote

In 2022, the ERB conducted technical compliance audits on the electricity infrastructure for Dangote. The overall compliance level was found to be 91.8 percent compared to 96.0 percent in 2021 representing a decline of 4.2 percentage points. This was below the ERB compliance target of 93.0 percent and was attributed to unresolved 2021 non-compliances. Figure 3-22 depicts Dangote's technical compliance levels from 2016 to 2022.



Figure 3-22: Compliance levels for Dangote's electricity infrastructure from 2016 to 2022

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3.6.10.2 Challenges faced by Dangote in 2022

Dangote reported that it faced the following challenges in 2022 which adversely impacted the company's operations:

- i. Fluctuation in the exchange rate;
- ii. Instability in the national electricity grid; and
- iii. Increase in the cost of diesel affecting coal prices, as coal is a substitute product.

3.6.11 Zambia-China Economic and Trade Cooperation Zone Development Limited

Zambia-China Economic and Trade Cooperation Zone Development Limited (ZCCZ) is a DNSP which distributes and supplies electricity within the ZCCZ multi-facility economic zone in Chambishi area of Kalulushi District.

3.6.11.1 Technical Performance - ZCCZ

In 2022, the ERB conducted technical compliance audits on the electricity infrastructure for ZCCZ and the overall compliance level was found to be 96.5 percent compared to 98.1 percent in 2021, representing a decline of 1.6 percentage points. This was above the ERB compliance target of 93.0 percent. Table 3-19 depicts ZCCZ's compliance levels from 2020 to 2022.

Substation	Transformer Rating (MVA)	2020 (%)	2021 (%)	2022 (%)
ZCCZ main 66/10 kV	2 x 40	90.7	98.1	94.9
CCS 66/10 kV	3 x 40	87.2	98.1	98.1
Average compliance	-	89.0	98.1	96.5
ERB compliance target	-	91.0	93.0	93.0

Table 3-19: ZCCZ's distribution infrastructure compliance levels, 2020 -2022

3.6.12 Ndola Energy Company Limited

Ndola Energy Company Limited (NECL) is an IPP with a 15-year PPA with ZESCO Limited. NECL operates a power plant fired with HFO using 12 generators. The plant is sub-divided into two (2) sections namely Phase I (Plant A) and Phase II (Plant B).

In 2022, NECL was not audited on technical performance parameters as the plant was not operational from October 2021, due to lack of HFO.

3.7 OPERATIONAL PERFORMANCE OF THE INTERCONNECTED POWER SYSTEM

System Operation of the Interconnected Power System (IPS) is provided for under Chapter 4 of the Electricity (Grid Code) Regulation, Statutory Instrument No. 79 of 2013 to ensure coordinated operation of the IPS to achieve a high level of system reliability, safety and security. The Power Quality and Reliability Zambian Standard ZS 387 Part 2 under Clause B.5.1 define major supply interruptions as:

- i. Any single event that lead to loss of supply to 1,000 consumers or large end-user consumer; and
- ii. Forced interruption index greater than five (5) system minutes.

Where;

System minutes = Energy not supplied in MWh/ Power at Peak

In 2022, the System Operator reported 167 abnormal network conditions compared to 115 recorded in 2021. Table 3-20 shows the number of disturbances recorded in the period under review per quarter.



Table 3-20: System disturbances reported per quarter

Period	No.of disturbances
Quarter 1	85
Quarter 2	25
Quarter 3	27
Quarter 4	30
Total	167

Appendix 8 presents the details of the major system interruptions as defined in the Power Quality Standard and Grid Code.

3.8 ZESCO NETWORK EXPANSION

ZESCO has over the years undertaken a number of network expansion and reinforcement projects and in 2022 ZESCO continued to implement major network expansion projects. Some of the major projects implemented included the following:

- i. Kafue Gorge rehabilitation and upgrade of control systems at the power station;
- ii. Victoria Falls rehabilitation, upgrade of water intakes trash rack cleaner and improvement of Unit cooling system at the power station;
- iii. Kariba North Bank rehabilitation and upgrade of lower layer of control system;
- iv. Reinforcement of metering systems on ZESCO-CEC interface points;
- v. Acquisition of the Energy Trading Software;
- vi. Reinforcement of the Kabwe Step Down 330/88kV transformer;
- vii. Upgrade and establishment of Supervisory Control and Data Acquisition (SCADA) in Livingstone, Kasama, Chingola, Kabwe, Ndola and Kitwe;
- viii. Migration of Maximum Demand customers to the Advanced Metering Infrastructure platform (AMI); and
- ix. Implementation of Lusaka Transmission and Distribution Reinforcement Project (LTDRP).

3.9 Network Constraints

During the period under review, the IPS performance was satisfactory, despite experiencing some network constraints in the following critical locations as depicted in Table 3-21:

Table 3-21: Network constraints, 2022

No.	Constraint	Location of Constraint	Available load (MW)	Impact on the Network/IPS
1.	 Terminal equipment at Kabwe Step Down limited to 1,200 Amps on each line; Average loading on the Three Leopards Hill to Kabwe lines is currently limited at 1,237MW 	Leopards Hill to Kabwe Step Down sub-station Three 330kV Transmission Lines	1,954.8	• Failure to evacuate all the available load through this corridor
2.	 Loading on the line is determined by joint SAPP ZESCO ZESA CEC SNEL working group which controls how much power can be transmitted through CEC to SNEL interconnector Limited by N-1 criteria (1 x 330kV Leopards Hill - Kabwe) 	CEC to SNEL 220kV Luano - Karavia 220kV Michelo - Karavia 220kV Michelo - Kasumbelasa Karavia	229	Limited power flow on the IPS



No.	Constraint	Location of Constraint	Available load (MW)	Impact on the Network/IPS
 Loadir by join SNEL bow m 	 Loading on the line is determined by joint SAPP ZESCO ZESA CEC SNEL working group which controls how much power can be transmitted 	Kariba South to Kariba North Two 330kV Transmission lines	645	 Limited power inflow to Kariba North from Kariba South on this interconnector
	 Average of the second se	Kariba North to Kariba South Two 330kV Transmission lines	436	 Limited power outflow to Kariba South from Kariba North on this interconnector

3.9.1 System Status and Power Deficit in 2022

In this section, we review the system status for 2022 by discussing generation, demand, deficit and system losses. Table 3-22 depicts the all-time peak demand, against recommended peak generation for 2022 and compares it to that of 2021.

Table 3-22: All-time peak demand, against recommended peak generation, 2021 - 2022

All-time Peak Demand (MW)	Recommended Peak Generation	Date	Time
2,374.5	2,375.5	14 th June, 2022	18:30
2,238.0	2,358.8	17 th November, 2021	19:50

During the period under review, generation reduced between August and September and increased in October. However, in October 2022 the transmission losses regrettably increased to about 5.9 percent compared to the yearly average of 5.6 percent with a peak losses recorded in December at 6.2 percent. Figure 3-23 depicts average system losses for 2022.





In 2022, Zambia recorded a Level 1 deficit of up to 231MW. It was assumed that a level 1 deficit is one with support of about 100MW from the mines and availability of the two machines at MCL. The deficit was allocated to ZESCO's distribution regions based on the average demand for each region.



3.10 POWER QUALITY MANAGEMENT SYSTEM

In 2022, the ERB continued to enforce Power Quality and Reliability Standard, ZS 387 Parts 1 to 4, in order to facilitate for a technically and economically efficient Zambian IPS. This is done in accordance with the Power Quality Management System (PQMS) developed in 2015 and augmented by Power Quality Directives (PQDs) issued to the licensees. The PQDs require licensees to install Power Quality Recorders (PQRs) at sufficient locations in their respective networks to adequately monitor power supply quality and reliability and to report system performance as prescribed in ZS 387. Additionally, the ERB set a minimum regulatory target of 73 percent compliance to standards in 2022 by all electricity enterprises on the IPS.

Table 3-23 shows the progress achieved on installation of PQRs by licensees on the IPS as at 31st December 2022

PQR recorders installed / Site monitoring	ZESCO	CEC	NECL	MCL	LHPC	ITPC	BPC	Total in IPS
No. of sites required to be monitored/ or agreed targets	161	172	3	2	11	2	1	352
No. of sites actually monitored	109	164	3	2	7	2	1	288
% sites monitored	68%	95%	100%	100%	64%	100%	100%	82%

Table 3-23: Progress on installation of PQR by licensees on the IPS as at 31st December 2022

3.10.1 Power Quality Performance

Out of the planned 352 sites that needed to be monitored for Power Quality by the licensees, 288 sites were monitored in 2022 representing 82 percent sample size compared to 75.6 percent sample size monitored in 2021. The ERB evaluated the Power Quality performance of the monitored sites and the overall average compliance for the IPS was 75 percent compared to 71 percent. This was above the regulatory target of 73 percent. The improved compliance was partly attributed to the regulatory engagements which were held with the licensees during 2022. Table 3-24 shows the summary of Power Quality performance for 2022 compared to 2021.

Table 3-24: Summary of Power Quality Performance of 2022 compared to 2021

Period of monitoring	Average percentage compliance against ZS 387 requirements	
Quarter 1 of 2022	75	
Quarter 2 of 2022	75	
Quarter 3 of 2022	75	
Quarter 4 of 2022	75	
Average compliance for 2022	75	
Average compliance for 2021	71	
Regulatory Target	73	

3.11 IMPLEMENTATION OF LOW POWER FACTOR SURCHARGE MECHANISM

The Electricity (Grid Code) Regulations SI 79, 2013 under Clause 2.2.1 provides that distributors and end-use customers shall take all reasonable steps to ensure that the power factor at the point of supply is at all times 0.92 lagging or better, unless otherwise agreed to in an existing contract between the participants.

In 2022, the ERB approved the implementation of a low power factor surcharge mechanism for Maximum Demand (MD) customers operating below the stipulated 0.92 lagging. This measure was aimed at reducing reactive power as part of demand side management. ZESCO commenced enforcement in October 2022.

The adopted and approved surcharge model is as presented in Table 3-25 below.

Power Factor Band	Surcharge applicable	Surcharge computation
0.76 < pf < 0.92	1.5% for every 0.01 less than 0.92	1.5% x $\frac{(0.92 - P.factual)}{0.01}$ x Pre-tax Bill
0 – 0.76	3% for every 0.01 less than 0.76 plus 1.5% for every 0.01 less than 0.92	$[(1.5\% \text{ x } \frac{(0.92-0.76)}{0.01}) + (3\% \text{ x } \frac{(0.76-P.\text{factual})}{0.01})] \text{ x Pre-tax Bill}$

Table 3-25: Adopted and approved surcharge model

Where;

- i. p.f.actual = Average Power Factor for the billing period (kW/kVA);
- ii. 0.92 is the target power factor in accordance with clause 2.2.1 of the Network Chapter 1 of the Grid Code; and
- iii. Pre-tax bill is the total customer bill computed at specific point of supply before taxes

3.11.1 Electricity (Grid Code) Regulations, SI 79 of 2013 and Zambian Distribution Grid Code

In 2022, the Grid Code Technical Committee (GCTC) and Distribution Grid Code Review Panel (DGCRP) as established by the ERB revised the Electricity (Grid Code) Regulations, SI 79 of 2013 and the Zambian Distribution Grid Code and submitted them to the ERB for onward approval by the Board and the Minister responsible for Energy, respectively. The revised draft Codes incorporate the connection requirements for Variable Renewable Energy Sources (VRES) to the Zambian grid.

3.11.2 Implementation of Wiring of Premises Standard – ZS 791

The ERB constituted the Expert Working Group to spearhead the implementation of the ZS 791 – Wiring of Premises Code of Practice in Zambia. The standard aims at improving the safety of persons, livestock, and property by ensuring proper design, selection, erection, inspection, and testing of electrical installations in various premises. It is anticipated that the successful implementation of the ZS 791 standard will significantly reduce the number of safety incidents and accidents related to electrical installations in Zambia.

In 2022, the Expert Working Group submitted draft Application Guides for easy implementation and use of the Standard. The Guides were subjected to wider stakeholder and public consultations before submission to the Board.

Going forward, the ERB shall continue engaging key stakeholders like Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA) in developing comprehensive Training Modules and a Skills Award Program focused on the ZS 791 standard for wiring of premises.

3.12 COST OF SERVICE STUDY

The ERB concluded the Cost of Service Study (CoSS) in December 2021. The main aim of the study was to determine the Zambian power system's full cost of electricity supply and in turn determine the appropriate tariff levels that would enable the power utility companies improve their service and meet the growing demand. The study report was submitted to Government in January, 2022. The Government reviewed the reports and issued a White Paper which contained the final positions and guidance on the findings and recommendations of the study. Salient features of the White Paper are summarized in Appendix 9.



3.13 CHALLENGES IN THE ELECTRICITY SUB-SECTOR

During 2022 the country faced another phase of load shedding arising from deficit in electricity generation capacity which was exacerbated by the declining water levels at the main electricity generation station namely, the KNB power station. The Electricity Sub-Sector has suffered from lack of adequate investment to meet the growing demand for electricity due to non-cost reflective tariffs that have also led to the deterioration of ZESCO's financial position.

To facilitate for resolution of the challenges in the sector the ERB completed the CoSS in 2021 aimed at determining benchmark cost reflective tariffs for the electricity sub-sector. Further, the ERB is developing the Multi-year tariff regulations aimed at ensuring an appropriate tariff migration path from the existing tariffs to cost reflective tariffs over a pre-defined period of 2023 to 2027. In addition, the MYTF regulations will also provide for regulations for automatic cost pass-through and automatic adjustments to ensure that unusual fluctuations in exchange rates, inflation or other economic factors are taken into account promptly in the electricity tariffs.

3.14 OUTLOOK FOR THE ELECTRICITY SUB-SECTOR

Generally, the outlook of the electricity industry in Zambia is poised for growth both in the short and long-term. The key prospects for the electricity sub-sector include the following:

3.14.1 Development of Multi-Year Tariff Framework

The ERB with the technical assistance of the EU through the IAEREP is developing the MYTF for Zambia's electricity sector. During quarter four (4) of 2022, the consultant submitted the final MYTF Rules and Regulations to the Study Technical Team for consideration. It is expected that these will be implemented by the fourth quarter of 2023. The main objectives of the MYTF framework for Zambia include the following among others:

- i. To ensure licensees' financial and economic viability;
- ii. To ensure reasonable tariff stability and smoothed changes over time consistent with the socio-economic objectives of the Government;
- iii. To provide efficiency incentives without leading to unintended consequences of regulation on performance;
- iv. To provide a systematic and predictable basis for revenue/tariff setting; and
- v. To ensure smooth transition between multi-year tariff control periods.

3.14.2 Open Access

To facilitate increased power trade, the ERB is in the process of developing Open Access Regulations and new Market Design and Structure. The Electricity Act of 2019 defines Open Access as "the availability of spare transmission or distribution capacity to any qualifying participant on nondiscriminatory terms and conditions". Phase I of the study was concluded in December 2021 and comprised of Open Access Market Structure and Market Design. Phase II of the study commenced in July, 2022 and comprises of Transmission & Distribution Pricing Methodology and Rules, Guidelines and Regulations for an Open Access Market. It is envisaged that the study will be completed by December, 2023.



3.14.3 Kafue Gorge Lower Hydro Power Station

KGL hydro power station is a hydroelectric power project located in southern Zambia, approximately 90 kilometers south-west of the capital city, Lusaka. The power station is owned and operated by the Kafue Gorge Lower Development Corporation Limited (KGLDC). The power plant is situated on the Kafue River, downstream of the existing KGU hydro power station.

The project was initiated in response to the growing demand for electricity in Zambia, as well as the need to diversify the country's energy mix and reduce its reliance on fossil fuels. KGL hydro power station is expected to contribute significantly to the country's energy generation capacity, with a planned installed capacity of 750 MW, consisting of five (5) generation units of 150MW each. At December, 2022 four (4) out of the five (5) units were commissioned and operational. The remaining 150MW generation unit is expected to be commissioned in early 2023..

3.14.4 CEC Riverside 33MWp Solar Expansion Plan

CEC is constructing a 33MWp solar power plant expansion project at Riverside Solar Park in Kitwe. As of December, 2022 the project was 80 percent complete and is expected to be completed and commissioned in quarter one (1) of 2023. According to CEC, upon completion the Company's solar energy generating capacity will increase to 34MWp with average annual energy output of 56.5GWh. The project is part of CEC's broader renewables agenda, enabling it to contribute to the global energy transition and the country's efforts to diversify its power sources and make available reliable, sustainable and affordable electricity.



4.0 RENEWABLE ENERGY SUB-SECTOR

This section presents the status on the development and overall performance of the renewable energy subsector in Zambia. The section further elaborates the challenges and the prospects for the sub-sector.



Solar photovoltic plant and wind mills

There has been growing demand for climate friendly sources of energy globally. In Zambia, there has been a rising number of renewable energy players in the sector as evidenced by the rapid increase in the number of licensed installers, manufacturers and retailers of renewable energy equipment, in the recent past. Further, there has been an increased absorption of grid connected renewable energy generation in the country.

4.1 STATUS ON RENEWABLE ENERGY IN ZAMBIA

Zambia's renewable energy sector focuses on harnessing naturally occurring non-depletable sources of energy which include solar, wind, biomass, hydro and geothermal. Harnessing these forms of energy is essential towards enhancing the country's energy mix and ensuring transition towards reliable, sustainable and affordable energy.

Within the current regulatory framework and to guarantee safe, healthy and reliable operations, the ERB has licensed grid connected and off-grid photovoltaic (PV) plants. Grid connected PV plants include Bangweulu 54MW jointly owned by Neon and Industrial Development Corporation (IDC), Ngonye 34MW jointly owned by Enel and IDC. The other grid connected power plant is the CEC 1MW Solar Power Plant located within Riverside, Kitwe. In addition to this 1MW solar power plant, a 33MW solar plant was still under construction by CEC during 2022.

The ERB has further licensed enterprises engaged in the manufacture, supply, installation and maintenance of renewable energy generating equipment.

Commissioned in 2021 and in the process of licensing is Surya Biofuels, a bioethanol production plant located in Chibombo District with a production capacity of approximately 3 million litres of biofuels per year. The bioethanol produced will be for purposes of blending within the fuel supply chain.

In order to reduce charcoal energy consumption and increase the utilization of Alternative Technologies and/or Fuels (ATFs) and ultimately reduce deforestation directly attributable to charcoal production, the United States



Agency for International Development (USAID) Zambia partnered with various stakeholders under a project called, Alternatives to Charcoal (A2C). With continued support from USAID's five-year Alternatives to Charcoal Project, the ERB in 2022, developed standards for bioethanol and gel as well as associated appliances for cooking purposes.

4.1.1 Licensed Entities in the Renewable Energy Sub-Sector in Zambia

The renewable energy sub-sector in Zambia has evolved over the years with the number of licensed entities growing as at the end of 2022. These include the PV solar plants (grid-tied power plant and off-grid), those engaged in bioenergy technologies, as well as those trading in renewable energy generating equipment.

4.2 PERFORMANCE OF ENTITIES IN RENEWABLE ENERGY - GRID CONNECTED PLANTS

In 2022 the ERB undertook an assessment of the performance of the grid connected solar photovoltaic (PV) plants with focus on the enterprises' adherence to contractual energy dispatch to the grid, its performance guarantee which ensures that faster degrading solar modules are replaced, as well as the health of the PV systems. Through this process, the performance models generated can be applied to new systems, enable correct investment decisions and better regulatory framework and government policies.

4.2.1 Bangweulu Power Company Limited



Bangweulu Solar plant

Bangweulu Power Company Limited (BPC) is an IPP that operates a grid connected 54.3 MWp solar PV power plant in the Lusaka South Multi-Facility Economic Zone (LSMFEZ). The plant is connected to the grid at the LSMFEZ 330/132/33kV substation located adjacent to the PV plant, at 33kV nominal voltage and has a total of 453,600 modules arranged in 12 blocks.

The power is evacuated under the terms and conditions of the PPA signed between ZESCO (buyer) and Bangweulu (seller).

Technical Performance

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In 2022, Bangweulu solar PV plant delivered a total of 84,537.42MWh compared to 89,190MWh of the energy, delivered in 2021, representing a decline of 5.21 percent.

Besides an assessment of the energy delivered, assessment of the PV plant's performance was extended to performance ratio, capacity factor and plant availability which were at 79.4, 20.3 and 99.9 percent respectively.

4.2.2 Ngonye Power Company Limited

Ngonye Power Company Limited (NPCL) is an IPP that operates a 34MWp solar PV plant that is connected to the grid at the LSMFEZ 330/132/33kV substation located in close proximity to the PV plant at 33kV nominal voltage. The plant has a total of 104,580 solar tracking modules. NPCL has a 25-year PPA with ZESCO to supply power to the grid under terms and conditions of the PPA.

Technical Performance

In 2022, NPCL delivered a total of 58,548.5MWh to the grid compared to 58,424.2MWh in 2021, representing a marginal increase of 0.2 percent.

Apart from an assessment of the energy delivered, assessment of the PV plant's performance was extended to performance ratio, capacity factor and plant availability which were at 80.1, 19.7 and 95.8 percent respectively.



4.2.3 CEC Solar Power Plant

CECs 5MVA 0.8/11kV transformer

CEC owns and operates a 1MW solar grid connected PV power plant located in Kitwe, on the Copperbelt province.

Technical Performance

In 2022, the ERB conducted technical audits to ascertain compliance of the solar PV to licence conditions, standards, codes and guidelines. The plant's performance was generally very satisfactory.

4.3 OPERATIONAL PERFORMANCE OF MINI-GRIDS

A mini-grid is an aggregation of loads, with one or more energy sources operating as a single system providing energy.

The mini-grids under discussion in this section hold a Standard Licence to Generate, Distribute and Supply Electricity to an off grid area. Technical inspections for licensing purposes are undertaken prior to issuance of a license while compliance audits are undertaken once a year thereafter. In view of the 'light handed' concept for mini-grids, compliance rating does not apply, though, a status of either "Pass" or "Fail" is assigned, for it to operate or not.



Overall, existing mini-grids have complied to set standards regarding their operations and have adhered to the licence conditions. In general, mini-grids provide reliable energy to various communities through an innovative approach. Prior to development of mini-grids, key considerations such as site selection and load analysis are undertaken with key stakeholders to ensure viability of projects.

Tariff structures vary, depending on affordability, willingness to pay and energy usage. This allows customers to plan their consumption in advance and eliminates the chance of bills being higher than anticipated.

The ERB enforces compliance to ensure that licensees control risks that would otherwise affect power quality and reliability of supply. The compliance audits are also a way of ensuring efficiency and improvements in the licensees' performance with regards quality and reliable service delivery.

4.3.1 Solar Mini-grids

4.3.1.1 Engie Power Corner Limited



Engie Power Corner

Engie Power Corner Limited (EPCL) owns and operates a 28.35kWp mini-grid in Chitandika Village of Chipata District in Eastern Province.

4.3.1.2 Solera Power Vending Machine

Under Solera Power Vending Machine, the existing solar off-grids are eight in total, with installed generation capacities being; 0.01MW, 0.015MW, 0.024MW, 0.025MW, 0.024MW, 0.024MW, 0.015 and 0.024MW. The sites are all located within the Eastern Province of Zambia. Table 4-1 shows the solar off grid sites for Solera by location.

No.	Name of site	Capacity (MW)	Location
1.	Solera Power Vending Machine	0.0125	Luangwa
2.	Kacholola	0.015	Nyimba
3.	Ken Site	0.02412	Katete
4.	Taferansoni	0.025	Chadiza
5.	Madzi – Atuba	0.02412	Chipangali
6.	Kapasa	0.02412	Chipangali
7.	Chanyalubwe	0.02412	Lumezi
8.	Chikomeni	0.015075	Lundazi





4.3.1.3 Chibwika Mini-grid

The site is located approximately 50km west of Mwinilunga Central Business District (CBD) in North-Western Province close to the Chibwika Local Court. The solar mini-grid has a maximum capacity of 32.4kWp with a total of 120 solar modules, rated at 270W each.

4.3.1.4 Standard Micro-grid Zambia

Standard Micro Grid (SMG) owns and operates a 14kWp Mugurameno mini-grid in Chief Chiawa area of Chirundu district. During the year 2022 the mini-grid supplied electricity to the surrounding community in Mugurameno.

Challenges faced by Standard Micro-grid during 2022

SMG reported the following as being the challenges for the mini-grid:

- i. Low customer ability due to season or low incomes in rural areas;
- ii. Power and cable theft continue to impact the Company's operating costs.
- iii. Grant financiers are extremely slow at releasing funds for projects which makes running a business very challenging because it is unclear when payments will be made, if they get made at all.

4.3.2 Mini-hydro Power Plants

Zambia has seven mini-hydro power stations, located within Central, Luapula, Muchinga, Northern, Eastern and North-Western Provinces. These are Lusiwasi Lower - 12MW and Upper - 15MW, Chishimba Falls - 6MW, Musonda Falls - 10MW, Shiwanga'andu - 1MW, Zengamina - 0.75MW, Kasanjiku - 0.64MW and Lunzua - 14.8MW mini-hydros. The aggregate generation capacity is 45.2MW, contributing to approximately 1.52 percent of the national installed capacity.

4.4 PROJECTS UNDER RENEWABLE ENERGY SUB-SECTOR IN ZAMBIA

4.4.1 Implementation of the Global Energy Transfer Feed - in Tariff (GET FiT) Programme

Global Energy Transfer–Feed-in Tariff (GET FiT) is a Programme that was designed to facilitate private sector investment in independent small and medium-scale renewable energy-independent power projects. The main objective of the Programme is to assist African countries in pursuing a climate resilient low carbon development path resulting in growth, poverty reduction, and climate change mitigation.

In Zambia, GET FiT was launched as an implementing programme for the Government's RE FiT Strategy. The Programme aims to diversify Zambia's generation mix by promoting the development of solar and small hydro power plants of up to 20MW.

The procurement and support of 200MW renewable energy capacity are at the core of the Programme. This was divided into two procurement segments of 100MW solar PV and 100MW small hydro. Further, the Programme aims to improve institutional capacity and enable a transparent regulatory framework for private sector participation. The Programme is still on-going.

4.4.2 USAID's Alternatives to Charcoal Project

4.4.2.1 Development of Standards for Bioethanol and Gel for Cooking Purposes

The National Energy Policy has prioritized the promotion of sustainable exploitation of biomass and alternative energy to wood fuel resources in-order to increase socio-economic development. The specific objectives include:

- Promotion of efficient and sustainable exploitation of biomass for household utilization;
- Promotion of the use of alternatives to wood fuel;



- Promotion of biofuels in the national fuel mix; and
- To ensure that the use of biofuels for the energy market is given priority without compromising food security.

In-order to achieve some of these objectives, USAID Zambia partnered with various stakeholders under a project called, **Alternatives to Charcoal (A2C)** to reduce charcoal energy consumption and increase the utilization of Alternative Technologies and/or Fuels (ATFs) so as to reduce deforestation directly attributable to charcoal production. The contract was awarded in January 2021 and holds a performance period of five years till 2026. The geographical focus is urban and peri-urban areas.

The following are the objectives of the project:

Objective 1: Identify and remove market barriers to enable an increase in the household use of alternative technologies and fuels (ATFs) by 38 percent.

Objective 2: Support the GRZ and the private sector to improve the business enabling environment for low emission ATFs, and support improved enforcement and regulation of charcoal production.

Objective 3: Change social behavior to increase consumer use of ATFs and increase public perception of the negative impact of charcoal production on forests.

Objective 4: Support alternative livelihoods in charcoal producing communities, improve community forest management and build the capacity of the FD to enforce and regulate the charcoal sector.

Objective 5: Integrate adaptive management throughout, including Pause, Reflect and Pivot workshops.

Owing to market trends, the ERB through the Renewable Energy Unit and in consultation with ZABS and other stakeholders, developed standards for bioethanol and gel for cooking and their associated appliances, which included:

- 1. DZS 1236 Denatured Hydrous Ethanol for Use as Cooking and Appliance Fuel Specification;
- 2. DZS 1237 Non-Pressurized Ethanol Cooking Appliances Using Liquid Fuel Specification;
- 3. DZS 1238 Ethanol Gel for Cooking and Other Gel Gurning Appliances; and
- 4. DZS 1239 Ethanol-Gel Fueled Appliances.

4.5 CHALLENGES IN THE RENEWABLE ENERGY SUB-SECTOR

In Zambia, grid extension initiatives have faced numerous challenges due to; sparse population; low income levels impacting on affordability, and lack of potential economic activities to entice energy consumption. Therefore, the rural community has resorted to alternative sources of energy such as wood fuel and diesel which have negative effects on the environment.

While there has been growing demand for clean energy products and services globally, the sub-sector in Zambia has not been without any challenges. To that end, challenges range from technological, social, financial, and economic. The following are main challenges that the sub-sector has continued to face:

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- i. The ever changing renewable energy technologies require continuous development and revision of standards, codes and guidelines;
- ii. Weather conditions and time of day affect the generation of energy (energy storage needed);
- iii. The absence of a clear electronic Waste Management Policy continues to pose risk to the environment. This is due to the fact that renewable energy technologies are potential electronic waste; and
- iv. Growing markets face challenges with the quality of renewable energy products imported in the country.

Financial Challenges

- i. High tariffs pose a risk on the affordability of the consumers who have seasonal income;
- ii. The sparse population in Zambia continues to challenge the development of mini-grids due to the fragmented supply of renewable energy products in the country as a result of the profit-oriented nature of most investors who focus on investing along the line of rail;
- iii. Most mini-grids are located in rural areas which are characterised by deprivation hence unable to afford electricity tariffs charged by mini-grid operators. This threatens the viability and sustainability of mini-grids unless subsidies or viability gap funding is provided; and
- iv. The lack of tailor-made financial products for small players in the renewable energy sub-sector as financial institutions are biased towards big entities, resulting in less favourable platforms for Small and Medium Enterprises (SMEs) to invest.

Social Challenges

- i. Minimal engagement with the community on the utilisation of cleaner fuels;
- ii. Slow uptake as a result of challenges in communities socially accepting new technologies because of lower cost of traditional methods when compared with new technologies;
- iii. Social concerns regarding the safety of liquid and gaseous biofuels and social waste management; and
- v. The general public seemingly prefer grid power to mini-grid power.

4.6 OUTLOOK FOR THE RENEWABLE ENERGY SUB-SECTOR

In light of the growing demand of renewable energy services and products presently, there is a bright outlook for the sub-sector. Interventions by the Zambian Government are in place to meet the target of 50 percent electricity access across the nation by 2030. The National Energy Policy of 2019 proposes to increase exploitation of renewable energy in order to diversify the energy mix.

In order to diversify the energy mix, the following renewable energy projects are expected to be actualized beyond 2022:

- i. CEC's solar PV power plant and a 11kV power evacuation line to connect to the grid through Kitwe 66/11kV substation³²; and
- ii. Construction of 60 solar mini-grids by EPCL to be located in Eastern, Luapula, Northern and North-Western Provinces of Zambia.

In addition, in order to promote an enabling environment for investment in the sub-sector, the ERB will continue to facilitate integration of renewable energy into the national grid through development and revision of regulatory frameworks.

³² This is in addition to the 33 MWp solar power plant expansion project at Riverside Solar Park in Kitwe, discussed under section 3.15, which is also expected to be commissioned in 2023.



5.0 LICENSING IN THE ENERGY SECTOR

The Energy Regulation Act No. 12 of 2019 mandates the ERB to issue licences to energy enterprises in Zambia. The ERB issues various types of licences in the energy sector. To this effect, this section highlights the number and types of licenses that were issued during 2022.

5.1 TYPES OF LICENSES ISSUED IN THE ENERGY SECTOR

Table 5-1 shows the types of licenses issued in the energy sector.

Table 5-1: Licence types issued by the ERB in each sub-sector

Petroleum licences	Validity (years)
Wholesale Oil Marketing	1.5
Road Transportation of Petroleum Products	03
Transportation of LPG in Bulk and in Cylinders	03
Blending and Packaging of Lubricants	05
Bulk Distribution, Import and Export of LPG (Combined Licence)	05
Distribution, Import and Export of Petroleum Products	05
Importation of Lubricants	05
Importation of Petroleum Feedstock	05
Retail of LPG in Cylinders	05
Retail of Petroleum Products	05
Terminal Storage of Petroleum Products	10
Refining of Crude Oil	15
Pipeline Transportation of Crude Oil	30

Electricity licences	Validity (years)
Embedded Generation of Electricity	05
Generation of Electricity for Own Use	05
Supply of Electricity	05
System Operator Licence for the Operation of the Zambian Interconnected Power System	05
Distribution of Electricity	15
Generate, Distribute and Supply Electricity (Off -Grid)	20
Trading of Electricity	20
Generation of Electricity	30
Transmission of Electricity	30

Renewable energy licences	Validity (years)
Blending of Bio-fuels	05
Manufacture, Wholesale Importation and Installation of Solar Energy Systems	05
Production, Storage, Marketing and Transportation of Renewable Energy	05
Transportation and Marketing of Coal	05



5.2 CONSTRUCTION PERMITS

A construction permit is issued to a developer intending to put up an energy facility, installation or common carrier in accordance with section 22 of the Energy Regulation Act of 2019. The permit as issued by the ERB is valid for two (2) years and is applicable to construction, rehabilitation and modification of energy infrastructure.

Appendix 10 presents the procedure for submitting a construction permit application whereas the requirements are presented in Appendix 11, *Construction Permit Checklist.*

The assessment of the application is based on the technical and financial reviews as provided for by SI 42 of 2021, Energy Regulation (General) Regulations. Upon successful assessment of the application, the applicant is then communicated to accordingly.

5.3 LICENCES AND CONSTRUCTION PERMITS ISSUED

In 2022, the ERB issued licences and Construction Permits to various applicants in the energy sector as highlighted in the subsequent sections.

5.3.1 Provisional Licences

A Provisional licence is issued to an applicant who meets all licensing requirements and has paid the assessment fees. This is to enable the applicant to commence operations while the application is undergoing gazetting before issuance of a standard licence. Gazette Notices are published in the National Government Gazette for a period of 14 days for public comments/objections. A provisional licence issued by the ERB is valid for two (2) months.

In 2022, a total of 261 provisional licences were issued by the ERB compared to 203³³ in 2021, representing 28.6 percent increase. Table 5-2 presents a summary of provisional licences issued in 2022:

Table 5-2: Provisional	licences issue	d, 2021 - 2022
------------------------	----------------	----------------

S/N	Provisional Licence	2021	2022
1	Distribute, Import and Export of LPG	04	03
2	Distribute, Import and Export Petroleum Products	97	108
3	Distribution, Importation, Blending and Packaging of Lubricants	21	30
4	Electricity Supply	03	00
5	Electricity Trading	01	00
6	Generate, Distribute and Supply Electricity (Off-Grid Electricity Licence)	01	02
7	Generation of Electricity	01	00
8	Generation of Electricity for own use	00	02
9	Manufacture, Supply, Installation and Maintenance of Energy Generating Equipment	22	40
10	Retail of LPG	01	01
11	Retail of Petroleum Products	07	15
12	Road Transportation of Petroleum Products	45	60
	Total Issued	203	261

³³ In the 2021 report the total number of issued provisional licences reported (279) included 19 inclusions of retail sites and 57 construction permit licences



5.3.2 Construction Permits

In 2022, a total of 98 Construction Permits were issued for various energy infrastructure including service stations, mini grids and consumer facilities compared to 57 issued in 2021. Table 5-3 shows the number of construction permits issued during 2022.

Table 5-3: Number of construction permits issued

Sub-sector	Construction permits issued
Electricity	02
Petroleum	96
Total	98

5.3.3 Standard Licences

In 2022, a total of 361 Standard Licences were issued compared to 117 issued in 2021, as depicted in Table 5-4.

Table 5-4: Standard licences issued, 2021 - 2022

S/N	Type of Licences	2021	2022
1.	Distribute, Import and Export of Petroleum Products	38	157
2.	Distribute, Import and Export of LPG	04	08
3.	Retail of LPG	00	03
4.	Electricity Generation	01	01
5.	Generation, Distribution and Supply of Electricity for an Off-Grid Electricity System	01	01
6.	Electricity Generation for Own Use	01	02
7.	Electricity Supply	01	03
8.	Electricity Trading	01	01
9.	Distribution, Importation, Blending and Packaging of Lubricants	17	32
10.	Manufacture, Supply, Installation and Maintenance of Energy Generating Equipment	23	44
11.	Retail of Petroleum Products	05	23
12.	Road Transportation of Petroleum Products	24	86
	Total Issued	117	361

5.4 COMPLIANCE MONITORING AND ENFORCEMENTS

In accordance with Section 4(c) of the Energy Regulation Act, the ERB continued to monitor performance of licensed enterprises in order to ensure compliance to set standards, licence conditions, Board orders and guidelines. In 2022, the ERB carried out enforcement hearings aimed at fostering compliance to licence conditions against erring licensees. In this regard, a total of 69 licensees were summoned for various breaches. The action taken for each breach is summarized in Appendix 12.





6.0 CONSUMER AND PUBLIC AFFAIRS

The ERB is mandated to safeguard the interest of energy consumers through deliberate regulatory interventions which include complaints handling, information dissemination and engagement activities. In this regard, this section will provide statistics on the consumer interventions undertaken during the year 2022.

6.1 STAKEHOLDER ENGAGEMENTS

6.1.1 Consumer Awareness Activities

In 2022, the ERB enhanced stakeholder engagements through information dissemination by using various platforms such as town hall meetings, exhibitions, shows/fairs, workshops, public hearings, and expositions. In order to maximise on the target audiences, the Mobile Office was deployed to conduct sensitisations in high human traffic areas such as taxi ranks, shopping malls, markets, bus stations and traditional ceremonies, among other locations.

During the period under review, a total of 91 consumer awareness activities were conducted compared to 40 in 2021, representing an increase of 127 percent. The increase in the awareness activities were attributed to the need to sensitise the public on the energy reforms that were being undertaken. Specific to these were the petroleum sub-sector reforms which included the monthly fuel pricing and the revision in the electricity tariffs. The activities were conducted through town hall meetings and the mobile office. Table 6-1 depicts the number of consumer awareness activities conducted in 2021 and 2022.

Table 6-1 : Consumer awareness activities - 2022 and 2021

Type of Engagement	2022	2021
Town hall Meetings	43	12
Mobile Office	48	28
Total Consumer Awareness programmes	91	40

6.1.2 Media Engagements

In 2022, the ERB utilised various communication tools such as radio programmes, press statements, newspaper articles, responses to press queries, adverts, and television to reach its target audiences.

A total of 403 media engagements were undertaken compared to 163 in 2021, translating into an increase of 147.24 percent. Out of the 403 media engagements undertaken, 88 included press queries, newspaper articles and statements, while 315 comprised adverts, radio, and television programmes. The programmes were regarding various regulatory and energy matters such as pricing of petroleum products, consumer protection and review of the electricity connection charges.

The recorded increase in media engagements was attributable to the proactive and robust information dissemination driven initiatives through radio and television presence. These platforms were the key channels for information dissemination and stakeholder engagement. Table 6-2 highlights the media interactions undertaken during the year 2022 on a quarterly basis.



Devied	Madia Engenerate	No. of A	ctivities
Period	Media Engagements	2022	2021
Overlag 1	Media Engagements	22	22
Quarter 1	TV/Radio Program	22	00
	Media Engagements	23	51
Quarter 2	TV/Radio Program	23	00
Overster 0	Media Engagements	24	24
Quarter 3	TV/Radio Program	201	46
Overster 4	Media Engagements	19	07
Quarter 4	TV/Radio Program	69	13
Total		403	163

Table 6 -2: Media activities undertaken in 2022 against 2021

6.1.2.1 Annual Media Workshop

The ERB conducted a Media Workshop in March 2022, which attracted 25 personnel from both the print and electronic media, aimed at enhancing journalists' knowledge and understanding of energy regulation issues. Further, the training was meant to dispel common energy regulation misconceptions such as fuel quality *vis a vis* grading of service stations. The training focused on pricing of fuel, safe wiring of premises, wayleave code of practice and grading of service stations among others.

6.1.3 Digital Platforms

Mainstream media is the priority communication channel to effectively deliver a clear and consistent narrative that articulates ERB's mandatory roles and responsibilities. To complement this, the ERB's Communication and Visibility Strategy (CVS) also emphasises increased use of digital platforms.

In 2022, the ERB continued to use social media to actively engage with the public and stakeholders. In this regard, Facebook, LinkedIn and Twitter platforms provided an interactive two-way communication channel with targeted audiences for effective engagements.

6.2 PUBLICATIONS

To ensure a smooth and consistent flow of information to its stakeholders and the public, the ERB continued disseminating information on key developments in the energy sector through various publications. In 2022, key publications issued included: the 2021 Annual Report, 2021 Energy Sector Report, bi-annual Corporate Newsletters, the Statistical Bulletins, monthly Staff Bulletins and brochures³⁴.

6.3 CONSUMER COMPLAINTS

To enhance consumer protection, the Energy Regulation Act and the Electricity Act, both of 2019, mandate the ERB to receive, investigate and determine complaints which may arise from the provision of products and services in the energy sector. In the period under review, the ERB continued to receive and determine complaints from the energy sector.

6.3.1 Complaints' Handling

During the year, the ERB handled 471 complaints and facilitated resolution of 278, representing a resolution rate of 59.02 percent. In comparison with complaints handled in 2021, a 16.75 percentage points increase was recorded, and this was attributed to increased public sensitisation and awareness activities undertaken during the year. Further, the number of complaints resolved under the electricity sub-sector increased,

³⁴ Some of these stated publications are available on the ERB website (www.erb.org.zm)



following commitment by the service provider, ZESCO, to dismantle the delayed service connections within the financial year. By the close of 2022, there was significant progress recorded in this regard. Appendix 14 provides the complaints handling procedure

As at 31st December, 2022, the number of outstanding complaints was 193 and out of this number, 179 were from the electricity sub-sector and 14 from the petroleum sub-sector. Table 6-3 gives a summary of the complaints handled in 2022 and 2021.

	Sub-Sector	Received	Resolved	Pending	Resolution Rate (%)
	Electricity	600	241	359	40.17
0001	Petroleum	32	26	6	81.25
2021	Renewable Energy	2	1	1	50.00
	TOTAL	634	268	366	42.27
	Electricity	428	249	179	58.17
0000	Petroleum	43	29	14	67.44
2022	Renewable Energy	-	-	-	-
	TOTAL	471	278	193	59.02

Table 6-3: Complaints received and resolved by the ERB in 2022

6.3.2 Complaints' Meetings

To secure resolution of complaints, the ERB holds Complaints Meetings to address complaints that remain unresolved by the licensees, beyond specified service level agreement time frames. In that regard, the ERB Complaints Committee convenes meetings which accord licensees and consumers an opportunity to submit verbal or written evidence in support of their respective positions after a grievance/dispute.

In light of the above, a total of 23 Complaints Meetings were held in 2022, out of which 13 were under the electricity sub-sector while 10 were from the petroleum sub-sector. Arising from the meetings, 181 complaints were heard and 98 were resolved as of December 31st, 2022. Table 6-4 highlights the complaints discussed and resolved during 2022.

Table 6-4: Total complaints heard and resolved in 2022

Sub-sector	Complaints discussed	Complaints resolved
Electricity	171	93
Petroleum	10	5
Total	181	98

Further, in 2022, the ERB undertook enforcement action for complaints that remained unresolved, beyond agreed time frames as depicted in Appendix 12.

6.3.3 Platforms Used to Lodge Complaints

To facilitate accessibility and enhanced complaints lodging by complainants, the ERB utilised various platforms and tools. Among these were the Toll-Free Line (TFL), land line, Management Information System (MIS) on-line portal, letters, e-mails, and Mobile Office. Further complaints were also lodged physically at the ERB Offices.



6.4 OUTLOOK ON CONSUMER AFFAIRS

During 2022, the ERB conducted trainings and orientations for the established Consumer Councils (CCs) in Chipata and Solwezi. In that regard, it is projected that consumer protection and public awareness will be strengthened through timely complaints resolution and information dissemination, beyond 2022.

The petroleum sub-sector underwent reforms which among others included Governments handing over the procurement of petroleum products to the private sector, TAZAMA being converted to a finished products pipeline and reconfiguration of INDENI to an OMC and a biofuels blending facility. In order to enhance public awareness and appreciation of the reforms as well as other new developments taking place in the sub-sector, the ERB will embark on increased stakeholder engagements and sensitisation through various communication tools and channels, beyond 2022.

The outlook under the electricity sub-sector regarding delayed service connections is to move towards zero outstanding complaints beyond specified time frames as the country gradually migrates to cost reflectivity of connection charges. It is therefore expected that ZESCO will expedite connections for new customers to the grid, following the approved new connection charges to be effected in 2023.





Appendix 1: Volumes of imports of petroleum feedstock processed at INDENI, 2010 - 2021

Appendix 2: TAZAMA throughput, 2017 - 2021







Appendix 4: INDENI refinery production, 2016 - 2021

Appendix 5: Total national consumption of petroleum products in kilograms and litres

Product	2020	2021	2022
Avgas (L)	589,064.35	881,672.79	1,188,438.00
Gasoil (L)	1,086,683,287.32	1,214,524,979.99	1,267,159,950.92
Heavy Fuel Oil (Kgs)	45,023,049.78	15,384,942.00	17,454,848.00
Jet A-1 (Kgs)	20,846,980.00	27,744,562.00	39,194,544.00
Kerosene (L)	9,380,212.64	3,171,055.73	1,041,301.24
LPG (Kgs)	7,945,041.77	7,981,100.11	8,374,167.68
Unleaded petrol (L)	452,574,783.80	528,881,823.65	567,799,904.49
Grand Total	1,623,042,419.66	1,798,570,136.27	1,902,213,154.33

BOARD BECULATION

Appendix 6: Retail sites network by location

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OMC	Central	Copperbelt	Eastern	Luapula	Lusaka	Muchinga	Northern	Northwesten	Southern	Western	Grand Total
Acm Petroleum Limited											
Admire Energy Limited					-						-
Alfa Energy Limited											┭-
Alpha Enterprises Limited						+					-
Asharami Energy Resource Limited					-						
Benzol Petroleum Zambia Limited											-
Boma Energy Limited		1									-
Collum Lunm Tian Petroleum Zambia Limited					+-						-
Eco Petroleum Limited		ю		.		-	2	-			8
Endrone Petroleum Corporation Limited							0				CN
Faraj Ali Fioull Limited		+									
Hamdi Investments		1									+
Harvest Group Limited					8						8
Hass Petroleum Zambia Limited		e			2						9
Japawa Investments Limited						-					-
Karan Petroleum Zambia Limited	0	2			4			-	N		11
Lake Petroleum Limited	5	10			11	-		-	2		30
LBM Investments Limited		2		-		-	က				7
Luapula Oils Limited				-							-
Lushomo	-										-
Mel Petroleum						-					N
Mon Fuel and Oil Investments Limited								-			-
Mount Meru Petroleum Zambia Limited	10	10	က	7	28	-	-	9	6	က	73
Ngucha Energy Corporation Limited					-						-
Oasis Oil Zambia Limited	0		9		ю						11

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OMC	Central	Copperbelt	Eastern	Luapula	Lusaka	Muchinga	Northern	Northwesten	Southern	Western	Grand Total
Oilbay Zambia Limited	+			F							0
Oryx Energies Zambia Limited	+	7	2		11				ю	Ŧ	26
Petroda Zambia Limited		9			17			-			25
Petrolink Limited	+	-						2			4
Puma Energy Zambia Plc	ю	14	5		23	-	-	2	5	З	58
Pure Petroleum Limited	+										
Refuel Petroleum Corporation Limited									+	t	2
Rubis Energy Zambia Limited	5	14	က		10				9	+-	30
SGC Investments Limited	-	11	2		7		2				24
Simba Energy						-					
Simba Oil Company Limited	-				2						m
Sino Petroleum Limited					-						+
Spectra Oil Corporation Limited	+				4						5
Star Oil Limited		+									£
Surya Energy Limited		-			4						5
TotalEnergies Zambia Limited	7	19		-	26	2	-	2	က		63
Tribute Investments Limited								2			0
U-Fuel Zambia Limited	+										-
United Metro		+									t
Vivo Energy Zambia Limited	-	11		-	32		2	2	5		56
Wada Chovu		t									F
Zacks Hardware And Construction Limited	-					-	-				v
Zamfuel Petroleum Limited	2		2		S				2		o
Zhongkuang Zambia Services Limited Company		-									
Grand Total	48	121	25	10	201	12	15	22	41	12	507

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Appendix 7: Detailed explanation of wholesale price build up cost elements

i. Platts FOB Average

Platts is the globally accepted publication for pricing of petroleum products. Supply contracts for petroleum products between oil companies are based on the Platts publication. The publication is proprietary and the petroleum price information is sent on a daily basis only to those who have subscribed. The Platts Free on Board (FOB) price for petrol, diesel and kerosene/jet A-1 are derived from the monthly average Platts quotation on the Arabian Gulf Market. Platts Arab Gulf market is very liquid and representative of most sourcing areas. It is the reference used on most quotations for regional imports.

For monthly fuel price reviews using the IPP, the ERB covers a 30 day window using month minus 1 or M-1. Meaning the recommended prices for the current month are based on the prices that prevailed one month ago. In the case of Zambia the Platts reference prices are for the period 25th day of the previous month to the 24th day of the month in which the price review is being carried out.

ii. Conversion factor

The conversion factors used to convert US\$/bbl to \$/MT for petrol, diesel and kerosene are 8.42, 7.50 and 7.56 respectively.

iii. Trader's Margin

The trader's margin is the margin that suppliers of OMCs in Dar-es-Salaam, Beira and other supply ports or sources charge the OMCs for supplying petroleum products to them.

iv. Storage

The storage cost is the cost for storing petroleum products in Dar-es-salaam, Beira and or other ports.

v. Wharfage

The Harbour Authority levies a statutory charge on the importation of petroleum products at various ports in countries with ocean fronts. At present, the ERB has adopted a standard cost of 1.25% of the CIF cost which is currently charged at ports of importation.

vi. BPS Premium (Cash Premiums)

The Bulk Petroleum Supply (BPS) premium is a cash premium that is charged by oil traders for the petroleum products at the various ports. The cash premiums are an additional cost for the products and have been moving in tandem with the supply and demand shift in the market.

Presently the BPS premiums used in the market is referenced to the Tanzanian BPS platform and this is the source adopted by the ERB. The BPS premium includes <u>freight</u>, insurance and ocean losses.

vii. Freight

Freight covers the amount paid by the supplier to the transporter of the petroleum products from the point of origin (Dubai/Oman) to Dar-es-salaam. The freight charge is calculated based on the mode of transportation and the distance between the pickup place and the destination.

The freight is normally based on Worldscale rates for the current year, from Arab Gulf to East Africa (i.e. Dar es Salaam and Beira). Just like Platts, the Worldscale publication is also proprietary and is the globally accepted standard publication for determination of freight charges for petroleum products.



viii. Insurance

<u>Insurance</u> covers the cost of insuring the finished petroleum products from the Middle East to the ports in Africa i.e. Dar-es-Salaam, Beira etc. The insurance rate adopted in the model is the standard cost in line with prevailing rates in petroleum insurance contracts.

ix. Ocean Loss

The 0.3% <u>ocean loss</u> is based on international best practice. This is the normally acceptable loss incurred in the loading and offloading of petroleum products from a vessel.

x. Transportation Fees

These are the transportation charges for delivering a volume of product from Ocean ports to inland fuel depots. The rate adopted in the pricing is a standard cost and is sufficient for covering the transport cost for each product.

xi. Transportation Losses

These are transportation losses as prescribed by international norms. A loss level of 0.5% is allowed for petrol, 0.3% for diesel and 0.3% for kerosene.

xii. Importers Margin

This is a margin set in for the importation of petroleum products into the country. This is a standard cost and offers reasonable return to companies providing a service of supplying petroleum products into the country.

xiii. Storage Losses

The storage losses cover the product losses for handling and storage and are set as prescribed by international norms. A loss level of 0.5% is allowed for petrol, 0.3% for diesel and 0.3% for kerosene.

xiv. Conversion factor

The conversion factors used to convert metric tonnes (MT) to cubic meter (M³) for petrol, diesel and kerosene are 0.74, 0.84 and 0.8 respectively.

xv. Exchange Rate

The exchange rate applied in the formula is the monthly average Interbank Commercial Selling Rate as published by the Bank of Zambia (BOZ). The applied rate is the monthly average rate within the month in which the price review is being carried out.

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Appendix 8: Major system disturbances recorded in 2022

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		a	uarter 1 of 202	2 Abnormal Network Conditions/ System Disturbances Recorded		
No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
÷.	2- Jan 2022	8:27:00 AM	Lusiwasi	G4 taken out on emergency at 08:27hrs due to worn out shaft bearing. Synchronised at 16:28hrs.	2- Jan 2022	4:28:00 PM
5	2- Jan 2022	11:32:00 AM	Serenje	66kV Mkushi Central Line tripped at 11:32hrs on DI, Zone 1, all phases, FL=40.43Km. 4MW lost. Restored at 12:26hrs.	2- Jan 2022	12:26:00 PM
ю.	2- Jan 2022	5:56:00 PM	Victoria Falls	A station machines tripped at 17:56hrs due to loss of 400V AC supply caused by tripping of 33kV Linda line on O/C. Synchronised A1, A2, A3 and A4 at 19:05hrs, 19:10hrs, 22:03hrs and A4 at 22:20hrs respectively.	2- Jan 2022	7:05:00 PM
4.	3- Jan 2022	2:54:00 PM	Mukuni	330/220kV T1 &T2 tripped at 14:54hrs on LV side on E/F due to a cut jumper on isolator 103 on 220kV Mukuni line at V/Falls end on yellow phase, however line did not trip from either side. Restored at 19:58hrs.	3- Jan 2022	7:58:00 PM
ப்	3- Jan 2022	2:54:00 PM	Victoria Falls	Units tripped, B1 tripped on O/F. Restored at 16:43hrs, B2 on turbine digital device overspeed. Restored at 15:43hrs, B3 on electrical protection O/F. Restored at 16:42hrs, B6 turbine digital device overspeed. Restored at 15:29hrs, C8 on O/F. Restored at 15:33hrs, A station on O/F. Restored at 17:26hrs. While B4, C7 & C10 islanded.	3- Jan 2022	5:26:00 PM
.0	3- Jan 2022	3:02:00 PM	Kansanshi	330kV Lumwana line tripped at 15:02hrs on both ends. At Kansanshi on Diff & Diff Intertrip, ABC. At Lumwana on O/V. Restored at 15:15hrs.	3- Jan 2022	3:15:00 PM
7.	3- Jan 2022	2:54:00 PM	Sesheke	220kV Zambezi tripped on Manpower end only at 14:54hrs, Sync at 15:23hrs.	3- Jan 2022	3:23:00 PM
ö.	3- Jan 2022	6:27:00 PM	Senanga	66kV Mongu tripped & A/R at 18:27hrs, on DI zone 1, B & C. 66/11kV TxT2 tripped on both HV & LV CB's on Diff. Restored at 06:10hrson 04/12/21 after IR test.	4- Jan 2022	6:10:00 AM
ō	4- Jan 2022	9:18:00 PM	SNEL	System Disturbance experienced a system disturbance at 21:18hrs due to loss of 96MW load in SNEL network. The cause for the loss of load was not established due to communication challenges with SNEL by both CEC and ZESCO. IPS normalized at 21:28hrs.	4- Jan 2022	9:28:00 PM

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		đ	Nuarter 1 of 202	2 Abnormal Network Conditions/ System Disturbances Recorded		
No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
10.	6- Jan 2022	10:01:00 AM	Kaoma	66/33kV 5MVA T2 tripped at 10:01hrs on Main PRV and tap changer PRV due to water ingress in the Tx Marshalling Kiosks. Restored at 15:42 after tests and replacing gasket for the Marshalling Kiosks.	6- Jan 2022	3:42:00 PM
11.	6- Jan 2022	5:11:00 PM	Kabwe SD	330/88kV, 71MVA T2A tripped at 17:11hrs on both sides on buchholz trip and L/out 1&2 operated. Kabwe Town – Tripped and A/R on DI, Zone 1. Critical loads swung to T1A. Restored on 07/01/2022 at 02:40hrs after conducting IR test and checking the buchholz. Delay due to adverse weather.	7- Jan 2022	2:40:00 AM
12.	7- Jan 2022	2:08:00 PM	Kafue town	88/33kV Tx T3 and T4 taken out at 14:08hrs on emergency to enable distribution clears hot spot on 33kV bus bar and 33kv Munali feeder. Restored at 14:54hrs. Both transformers restored at 14:15hrs.	7- Jan 2022	2:54:00 PM
13.	8- Jan 2022	2:13:00 PM	Kabwe	330kV Pensulo line tripped at 14:13hrs at both ends and L/out at both ends: At Kabwe S/S on diff trip, IT, all phases FL=308.9km. At Pensulo S/S on diff trip, Zone 5, FL=51.3km. Restored at 14:20hrs load lost 51.5MW	8- Jan 2022	2:20:00 PM
14.	10- Jan 2022	12:28:00 PM	KNB	330kV K/West line tripped and L/out at 12:28hrs on Diff and DI Zone 1 FL= 66km and at K/West tripped and A/R on Diff and DI Zone 1 B-phase FL=37.58km. Restored at 13:18hrs.	10- Jan 2022	1:18:00 PM
15.	11- Jan 2022	10:36:00 AM	Kabwe SD	88kV Kabwe Town line tripped at 10:36hrs on main protection. Restored at 15:14hrs after mending cut jumper.	11- Jan 2022	3:14:00 PM
16.	16- Jan 2022	4:45:00 AM	SNEL	System disturbance experienced on 16/01/22 at 04:45hrs due to loss of 95MW load in the SNEL network. Disturbance characterised by power swings and frequency and voltage fluctuations. IPS Normalized at 04:50hrs.	16- Jan 2022	4:50:00 AM
17.	16- Jan 2022	8:20:00 PM	SNEL	System disturbance experienced on 16/01/22 at 20:20hrs due to loss of 90MW load due to tripping of Converter #1 in the SNEL network. Disturbance characterised by power swings and frequency and voltage fluctuations. IPS Normalized at 20:25hrs.	16- Jan 2022	8:25:00 PM

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ENERGY SECTOR REPORT 2022
		Ø	Nuarter 1 of 202	2 Abnormal Network Conditions/ System Disturbances Recorded		
No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
18.	18- Jan 2022	10:28:00 PM	Kansanshi	330kV Lumwana line tripped at 22:28hrs at both end on Diff at both ends following a system disturbance emanating from Lumwana mine. Restored at 22:37hrs.	18- Jan 2022	10:37:00 PM
19.	18- Jan 2022	6:50:00 PM	Kabwe Step Down	330kV Pensulo line tripped at both ends at 18:50hrs. A/R at Pensulo and L/out at KSD. Indications: KSD on Diff & DI zone1 B-ph FL=192.2km, Pensulo Diff FL=0.685km. Restored at 18:51hrs.	18- Jan 2022	6:51:00 PM
20.	18- Jan 2022	10:28:00 PM	Lumwana Mine	System Disturbance experienced on 18/01/2022 at 22:28hrs characterized by high voltages and loss of load following tripping of 18MW sag mills and 16MW ball mills on rotor E/F at Lumwana Mine. IPS stabilized at 22:37hrs	18- Jan 2022	10:37:00 PM
21.	20- Jan 2022	6:55:00 PM	KNBPS	Unit 1 failed to synchronize at 18:55hrs due to major fault indication on the governor system. Instigations done and found faulty proximity speed sensor. Resolved at 20:52hrs after replacing the proximity speed sensor	20- Jan 2022	8:52:00 PM
22.	21- Jan 2022	8:13:00 AM	ITPC	G1 and G2 tripped at 08:13hrs on Unit plant flood alarm. Investigation revealed false alarm from water level sensor. G1 synchronized at 09:57hrs, G2 synchronized at 09:57hrs.	21- Jan 2022	9:57:00 AM
23.	25- Jan 2022	2:05:00 AM	BPC/ESCOM	IPS Experienced major system disturbance on 25/01/2022 at 02:05hrs after A/R of 400kV Matimba – Phokoje (BPC – Eskom) resulting in Insukamini - Phokoje line tripping on U/F. Disturbance characterised by power swings and voltage and frequency fluctuations. IPS stabilized at 02:18hrs	25- Jan 2022	2:18:00 AM
24.	25- Jan 2022	12:57:00 PM	SNEL	IPS Experienced a system disturbance on 25/01/22 at 12:57hrs following the tripping of all three 220kV interconnectors between CEC & SNEL. All three 220kV lines between CEC & SNEL restored by 13:43hrs.	25- Jan 2022	1:43:00 PM
25.	25- Jan 2022	9:11:00 PM	SNEL	IPS Experienced a system disturbance on 25/01/22 at 21:11hrs characterized by high voltages, frequency rise and tie line power swings due to loss of 112.66MW load in the SNEL network. IPS normalized at 21:18hrs.	25- Jan 2022	9:18:00 PM

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ENERGY SECTOR REPORT 2022

		9	Nuarter 1 of 202	2 Abnormal Network Conditions/ System Disturbances Recorded		
No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
26.	26- Jan 2022	3:43:00 AM	KGL	G2 tripped at 03:43hrs on mechanical shutdown (shaft seal water flow low indication). Restored at 06:26hrs after flushing the shaft seal strainer for cooling water system.	26- Jan 2022	6:26:00 AM
27.	26- Jan 2022	12:21:00 AM	SNEL	IPS ZESCO Experienced a Major system disturbance on 26/01/22 at 00:21hrs characterized by loss of interconnectors, high voltages, tie line power swings and frequency excursions and lost 560MW of load on ZESCO & CEC networks. IPS Normalised by 00:59hrs	26- Jan 2022	12:59:00 AM
28.	26- Jan 2022	10:18:00 AM	BPC/ESCOM	IPS Experienced a system disturbance on 26/01/22 at 10:18hrs characterized by a voltage drop, frequency fluctuations and tie line power swings following the tripping of 400kV Insukamini – Phokoje line. (ZESCO went off parallel with ESKOM). IPS normalized at 11:28hrs.	26- Jan 2022	11:28:00 AM
29.	30- Jan 2022	8:44:00 AM	Musonda Falls	Unit 6 shutdown at 08:44hrs due to operational failure of the governor. Restored at 12:29hrs after resetting the interface for opening percentage and output power regulation. Generation lost 2.23MW.	30- Jan 2022	12:29:00 PM
30.	31- Jan 2022	4:59:00 AM	Kabwe Step Down	330kV Pensulo line tripped at 4:59hrs at both ends: A/R at KSD end on differential protection, DIT, FL=277km and. L/Out at Pensulo end on differential protection, IT, FL= -8.356m and. Restored at 05:01hrs. Tripping was attributed to adverse weather.	31- Jan 2022	5:01:00 AM
31.	31- Jan 2022	5:01:00 PM	KGL	G2 tripped at 17:01hrs on head cover water level too high. Synchronised at 19:20hrs after disconnecting the output for high water level on faulty float switch sensor for head cover water leakage.	31- Jan 2022	7:20:00 PM
32.	31- Jan 2022	9:08:00 PM	Lusaka west	132/33kV T2A & T2B tripped at 21:08hrs on HV side on O/C and E/F. LV side on T2A was invalid while LV side of T2B went invalid immediately after the tripping. Found conductors on 33kV Kanyama line lying on the ground due to a fallen pole and yellow phase conductor off the termination at the cable take off due to a melted clamp. CB was also in closed state. Txs restored at 22:39hrs and 22:38hrs, respectively. Distribution loaded at 23:40hrs after isolating 33kV Kanyama line.	31- Jan 2022	11:40:00 PM

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		0	Quarter 1 of 202	2 Abnormal Network Conditions/ System Disturbances Recorded		
No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
33.	3- Feb 2022	4:32:00 PM	Victoria Falls	220kV Sesheke line tripped at 16:32hrs from both ends. At V/Falls on DI, Zone 1, ABC, FL = 95.64km At Sesheke on DI, Zone 1, ABC. Restored at 16:57hrs.	3- Feb 2022	4:57:00 PM
34.	6- Feb 2022	3:11:00 PM	KFGL	G2 tripped at 15:11hrs due to surge shaft guard gate inadvertently closing. Investigations done but cause not established. Unit restored at 17:54hrs	6- Feb 2022	5:54:00 PM
35.	7- Feb 2022	8:16:00 PM	KFGL	G2 taken out at 20:16hrs to investigate the DC E/F alarm. Restored at 02:24hrs after steaming water ingress in GIS and sealed it off using silicon.	8- Feb 2022	2:24:00 AM
36.	9- Feb 2022	8:28:00 AM	SNEL	System disturbance experience on 09/02/2022 at 08:28hrs characterized by high voltage and power swing following tripping of 120kV Kabobi-Likasi line in the SNEL network. IPS normalized at 08:40hrs.	9- Feb 2022	8:40:00 AM
37.	9- Feb 2022	1:36:00 PM	SNEL	System disturbance experience on 09/02/2022 at 13:36hrs characterized by high voltage and power swing following tripping of 220kV CEC SNEL interconnector on U/V protection. Cause attributed to lightning and thunderstorms in Congo which also tripped 220kV Kolwezi-Busanga line. IPS normalized at 13:44hrs.	9- Feb 2022	1:44:00 PM
38.	10- Feb 2022	8:49:00 AM	Leopards Hill	132kV Roma line 1 & 2 taken out at 08:49hrs to facilitate clearing of hotspots on the 132kV bus bars at Leopards Hill substation. 132kV Roma load transferred to Lusaka West. Restored at 15:37hrs.	10- Feb 2022	3:37:00 PM
39.	10- Feb 2022	5:28:00 PM	SNEL	System disturbance experience on 10/02/2022 at 17:28hrs due to loss of 249.4MW load in the SNEL network. IPS Normalised at 17:34hrs.	10- Feb 2022	5:34:00 PM
40.	10- Feb 2022	2:33:00 PM	BPC/ESCOM	System disturbance experience at 14:33hrs following the tripping of 400kV lnsukamini-Phokoje line on Direct transfer trip after 400kV Matimba-Phokoje line tripped. ZESCO went off parallel with Eskom and took over frequency control. Restored Insukamini-Phokoje line at 15:22hrs and back in parallel with Eskom. IPS Normalised at 15:22hrs.	10- Feb 2022	3:22:00 PM

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		G	Nuarter 1 of 202	2 Abnormal Network Conditions/ System Disturbances Recorded		
No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
41.	11- Feb 2022	9:00:00 AM	KGL	Generator G1 tripped at 09:00hrs on reverse power protection indication due to inadvertent closure of MIV. Restored at 09:54hrs.	11- Feb 2022	9:54:00 AM
42.	11- Feb 2022	12:00:00 PM	Nambala	220kV ITPC line 1 tripped at 12:00hrs on DI Zone 1, B phase, FL = 43.3km and line differential. Restored at 12:34hrs. ITPC G1 tripped at 12:00hrs on O/V. Restored at 12:39hrs.	11- Feb 2022	12:39:00 PM
43.	11- Feb 2022	5:14:00 PM	SNEL	System disturbance experience on 11/02/2022 at 17:14hrs due to loss of 100MW load in the SNEL network. IPS Normalised at 17:18hrs.	11- Feb 2022	5:18:00 PM
44.	13- Feb 2022	3:27:00 PM	Michelo	220kV Karavia line 1 taken out on emergency at 15:27hrs due to sustained spring charge alarms. Restored at 17:43hrs on Bypass due to defective CB charging coil.	13- Feb 2022	5:43:00 PM
45.	15- Feb 2022	3:10:00 AM	Kafue Town	88/33kV T3 tripped at 03:10hrs on HV and LV side on main protection. Isolated for further investigation. Findings; 33kV Munali feeder protection and control found burnt. Restored at 18:39hrs after IR test results were satisfactory. Protection also confirmed that LV backup protection operated and not main protection. This also inter-tripped the HV side.	15- Feb 2022	6:39:00 PM
46.	15- Feb 2022	12:47:00 PM	Nampower	IPS experienced power swings at 12:47hrs on 15/02/2022 on the tie lines and interconnector. This was accompanied by frequency excursions in the ZESCO system. This resulted from loss of 165MW after tripping of a transformer at Gerus substation in the Nampower network. IPS Normalised by 13:55hrs	15- Feb 2022	1:55:00 PM
47.	16- Feb 2022	4:26:00 PM	System Disturbance	IPS experienced a major disturbance on 16/02/2022 at 16:26hrs characterised by loss of load (total=831.5MW),high frequency(52.53Hz), loss of generation(300MW), high voltages(Kitwe 367kV) and power swings. 400kV Insukamini- Phokoje line tripped and ZESCO ESKOM went off parallel. The disturbance is suspected to have emanated from CEC Kitwe CSS where a 66kV Dropper conductor for Luangwa line snapped off from the clamp due to loose connection and touched both the 66kV MBB and RBB. IPS Normalized at 17:36hrs.	16- Feb 2022	5:36:00 PM

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		đ	uarter 1 of 202	2 Abnormal Network Conditions/ System Disturbances Recorded		
Vo	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
48.	17- Feb 2022	6:02:00 AM	Kariba North Bank	Gen 2 taken out on emergency on at 06:02hrs due to "main Tx oil temp high" alarm. Replaced with G3. Investigations revealed failure of terminal block for common supply to cooling fans. Terminal block replaced and G2 restored at 16:00hrs.	7- Feb 2022	4:00:00 PM
49.	17- Feb 2022	4:23:00 PM	SNEL	IPS experienced a disturbance on 17/02/2022 at 16:23hrs characterised by high voltage and power swings. The disturbance is suspected to have emanated from SNEL network where there was a report of tripping of 120kV Likasi- Fungulume line 2 due to lightning strike. IPS Normalized at 16:32hrs.	7- Feb 2022	4:32:00 PM
50.	21- Feb 2022	4:12:00 PM	Lusaka West	132/33kV T2A & T2B tripped on the LV side only at 16:12hrs on Directional E/F. , Restored at 19:20hrs after isolating the burnt resistors	:1- Feb 2022	7:20:00 PM
51.	22- Feb 2022	12:43:00 PM	Kabwe Step Down	330kV Kitwe line 3 taken out on emergency at 12:43hrs due to mis- alignment of isolator 606 R-ph observed during swinging in readiness for outage of 330kV KSD - L/Hill line 2. Restored at 16:34hrs	:2- Feb 2022	4:34:00 PM
52.	23- Feb 2022	1:28:00 PM	Kitwe	330/220/11 kV Tx T8AB Bank taken out on emergency at 13:28hrs to clear hot spot on isolator 819B. Restored at 19:49hrs after re-aligning contact on blue 2 phase.	:3- Feb 2022	7:49:00 PM
53.	24- Feb 2022	3:30:00 PM	Lusaka West	330kV K/West line tripped at 15:30hrs on both ends. Indications NCC: Lusaka West – Diff, DI, Zone 1, B phase. Restored at 15:48hrs Kafue West – line diff trip, all phases. S/S: Lusaka West – Diff, DI, Zone 1, B phase, FL= 7.04km. K/ West – indications not given Load lost = 100MW at Kalumbila Mine on U/V due to dip on the 33kV voltage from 33.62kV from 31.48kV.	:4- Feb 2022	3:48:00 PM
54.	24- Feb 2022	10:39:00 AM	Converter	66kV Mulungushi line A taken out on emergency at 10:39hrs for works to inspect the red phase VT at converter Substation. Restored at 06:50hrs on 25/02/22 after decommissioning faulty 66kV Red phase VT and installing new one.	:5- Feb 2022	6:50:00 AM
55.	27- Feb 2022	3:10:00 PM	SNEL	IPS experienced a system disturbance on 27/02/2022 at 15:10hrs characterized by power swings & high voltage. This was due to loss of load in SNEL network [156MW] following the tripping of 220kV Lubumbashi-Likasi line, attributed to adverse weather. IPS normalized at 15:23hrs	:7- Feb 2022	3:23:00 PM

	Restoration Time	2:49:00 PM	8:20:00 PM	9:10:00 PM	7:30:00 PM	3:25:00 PM	1:31:00 PM	7:00:00 PM	10:00:00 AM	3:10:00 PM
	Restoration Date	1- Mar 2022	1- Mar 2022	1- Mar 2022	2- Mar 2022	2- Mar 2022	3- Mar 2022	3- Mar 2022	4- Mar 2022	5- Mar 2022
2 Abnormal Network Conditions/ System Disturbances Recorded	Event	330/220/11kV TXT9 and 330kV RBB taken out at 9:14hrs to clear hot spots on RBB Isolator 916 and 220kV Isolator 973. Restored RBB at 14:48hrs and TXT9 at 14:49hrs after changing the male and female contacts on the yellow phase of 220kV isolator 9T3 and aligning contacts on blue phase of 330kV isolator 916 and tightening contact terminations on 11kV isolator 9X4.	330kV Lumwana line tripped and l/out at 20:05hrs at both ends on; @ Kansanshi end on line diff and O/V and @ Lumwana end on O/V. Restored at 20:20hrs. Lost load of 60MW. This tripping was due to loss of 42MW at Kansanshi mine attributed to adverse weather.	System disturbance Experienced on 01/01/2022 at 21:03hrs due to tripping of 220kV line 63 in SNEL network. The disturbance was characterised by power swings and voltage and frequency fluctuations. IPS Normalised by 21:10hrs	System disturbance Experienced on 02/01/2022 at 19:18hrs following the tripping and A/R of 220kV Luano-Karavia line and 220kV Michelo-Karavia line 2 on Dl. The disturbance was characterised by power swings and voltage and frequency fluctuations. IPS Normalised by 19:30hrs	66kV Mkushi Central line taken out on emergency at 11:00hrs to replace stay wires at Ndabala area. Restored at 15:25hrs.	330kV Msoro line tripped at 13:21hrs on both ends. A/R at Msoro on Diff, DI, Zone 1, Blue phase, FL=120.2km. Locked out at Pensulo on Diff, DI, no Zone, FL=38.33km. Restored at 13:31hrs.	G4 tripped at 13:25hrs on O/C & O/speed. Restored at 19:00hrs.	66kV LHPC line B tripped at 22:15hrs on DI, zone 1, all phases, FL=0.761km. Failed to close the breaker due to low hydraulic oil in the spring charging mechanism. Restored on 04/03/2022 at 10:00hrs after replenishing hydraulic oil in the spring charging mechanism by LHPC.	66kV Mkushi line tripped at 13:46hrs on DI, Zone 1, all phases, FL=1km. 2.2MW load lost. Restored at 15:10hrs.
uarter 1 of 202	Station/ Area	Luano	Kansanshi	SNEL	SNEL	Serenje	Pensulo	Lusiwasi	Converter	СНРС
Ø	Outage Time	9:14:00 AM	8:05:00 PM	9:03:00 PM	7:18:00 PM	11:00:00 AM	1:21:00 PM	1:25:00 PM	10:15:00 PM	1:46:00 PM
	Date	1- Mar 2022	1- Mar 2022	1- Mar 2022	2- Mar 2022	2- Mar 2022	3- Mar 2022	3- Mar 2022	3- Mar 2022	5- Mar 2022
	No.	56.	57.	58.	20.	60.	61.	62.	63.	64.

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	Restoration Time	6:42:00 PM	5:15:00 PM	6:20:00 PM	6:34:00 AM	7:10:00 PM	3:17:00 PM	7:06:00 PM	10:03:00 AM
	Restoration Date	5- Mar 2022	5- Mar 2022	5- Mar 2022	6- Mar 2022	6- Mar 2022	8- Mar 2022	8- Mar 2022	9- Mar 2022
2 Abnormal Network Conditions/ System Disturbances Recorded	Event	330kV Kalumbila lines 1 and 2 tripped on both ends at 17:53hrs. At Nambala end line 1 on Diff, DI, Zone 1, red phase, FL=309km. Line 2 on Diff, DI, Zone 1, red phase, no FL. At Kalumbila end line 1 on Diff, DI, Zone 1, red Phase, FL=37.7km. Line 2 A/R on Diff, DI, Zone 1, red phase, FL=37.7km. and line 2 at 18:42hrs.	System disturbance experienced on 05/03/2022 at 17:04hrs due to tripping and auto reclosing of 220kV Luano-Michelo line 2 and 220kV Luano-Karavia line on main protection. Disturbance characterised by power swings and frequency and voltage fluctuations. IPS normalised at 17:15hrs.	System disturbance experienced on 05/03/2022 at 18:07hrs due to tripping of Snel interconnectors all three on DOP and lost 253.96MW. Disturbance characterised by power swings and frequency and voltage fluctuations. IPS normalised at 18:20hrs.	66kV Kalabo line tripped at 02:42hrs on backup protection. Tripped and locked out on attempt to restore at 02:47hrs on DI, Zone 2, and Yellow phase. Restored at 06:34hrs.	220kV ITPC line tripped on both ends at 18:31hrs. At Nambala end on Diff, DI, Zone 1, all phases, FL=11.5km. At ITPC end on Diff, DI, Zone 1, blue phase, FL=103km. Restored at 18:56hrs. At ITPC G1 and G2 went to speed no load. Synchronised at 19:04hrs and 19:10hrs respectively.	330kV Kalumbila line 1 tripped and L/out at 14:59hrs at both ends. NCC- Diff and DI zone 1 B-ph. S/S- Diff and DI zone 1 B-ph FL=94.4km. 330kV Kalumbila line 2 tripped and L/out at 14:59hrs at both ends. NCC- Diff and DI zone 1 B-ph. S/S- Diff and DI zone 1 B-ph FL=146km. Restored at 15:15hrs and 15:17hrs respectively.	66/11kV 10MVA TxT1 tripped at 18:06hrs on HV side. Indications: NCC - HV O/C and LV OC&EF. S/S - HV O/C. Restored at 19:06hrs after isolating 11kV FTC feeder.	Gen 2 taken out on emergency at 09:12hrs due to clogged screens. Restored at 10:03hrs after cleaning.
uarter 1 of 202	Station/ Area	Nambala	SNEL	SNEL	Mongu	Nambala	Nambala	Mbala	Musonda P/S
đ	Outage Time	5:53:00 PM	5:04:00 PM	MG 00:70:9	2:42:00 AM	6:31:00 PM	2:59:00 PM	6:06:00 PM	9:12:00 AM
	Date	5- Mar 2022	5- Mar 2022	5- Mar 2022	6- Mar 2022	6- Mar 2022	8- Mar 2022	8- Mar 2022	9- Mar 2022
	No.	65.	66.	67.	68.	69.	70.	71.	72.

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No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
73.	9- Mar 2022	9:06:00 PM	Mbala	66/11kV TxT1 taken out on emergency at 21:06hrs due to a hot spot on 66kV CB 1TO. Restored at 22:35hrs after tightening loose connection on B-ph between CB 1TO and isolator 1T7.	3/9/2022	10:35:00 PM
74.	9- Mar 2022	8:31:00 PM	SNEL	NCC – ZESCO experienced a system disturbance on 09/03/2022 at 20:31hrs characterized by voltage fluctuations and power swings. Cause of disturbance is external to ZESCO and suspected to have emanated from SNEL network. IPS stabilized at 20:48hrs. ZESCO Eskom back in parallel at 20:48hrs, Nampower Converter restored at 21:20hrs and SNEL interconnector at 21:07hrs.	3/9/2022	9:07:00 PM
75.	13- Mar 2022	4:24:00 PM	KGU	Gen # 6 tripped at 16:24hrs on low spherical valve pressure. Restored at 02:39hrs on 14/03/2022 after cleaning seal pilot valve, cleaned & changed damaged o ring in pilot valve, and cleaned supply line to bypass pilot valve spool B (i.e. filter & orifice).	14- Mar 2022	2:39:00 AM
76.	16- Mar 2022	8:49:00 AM	MCL	Gen 2 tripped at 08:49hrs. No indications. Suspected protection relay malfunction. Restored at 14:16hrs.	16- Mar 2022	2:16:00 PM
77.	21- Mar 2022	8:25:00 AM	Luano	330/220/11kV TxT7AB taken out at 08:25hrs on Emergency to remove the live Brid trapped in 11kV cage on tertiary winding of TxT7B. Restored at 09:55hrs	21- Mar 2022	9:55:00 AM
78.	25- Mar 2022	19:43:00 PM	Kansanshi	330kV Lumwana line tripped at 19:43hrs, result into System experiencing high voltages as monitored at Kitwe (318.5KV - 328KV). Indications; NCC: TC Protection trip. S/S: DI Zone 1,all phases FL=12.95km. Restored at 20:06hrs	25- Mar 2022	20:06 PM
79.	26- Mar 2022	8:07 AM	Lumwana	330kV Kalumbila line tripped at 08:07hrs on Overpower protection (DOP). Line restored at 08:21hrs after disabling DOP protection	26- Mar 2022	8:21 AM
80.	26- Mar 2022	8:07 AM	Nambala	330kV Kalumbila lines 1 & 2 tripped at 10:08hrs on O/V on both lines. Restored line 1 at 10:44hrs, line 2 at 10:30hrs.	26- Mar 2022	10:44 AM
81.	26- Mar 2022	22:23 PM	KGL	G1 tripped at 22:23hrs on Station Tx. Differential protection during Auxiliary changeover from 330/33kV DT. Aux supply successfully swung to St. Tx #2. Restored at 23:48hrs after isolating StationTx.1 from the 3.3kV side.	26- Mar 2022	23:48 PM

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		0	Nuarter 1 of 202	2 Abnormal Network Conditions/ System Disturbances Recorded		
No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoratio Time
82.	28- Mar 2022	12:41 PM	SNEL	IPS experienced system disturbance on 28/03/2022 at 12:41 hrs characterized by power swings and high voltage following the tripping of Converters 1&2 at Kolwezi in SNEL network. IPS normalized at 12:46 hrs	28- Mar 2022	12:46 PM
83.	28- Mar 2022	9:28 AM	Leopards Hill	132kV Mphanshya line tripped on 28/03/2022 at 09:28hrs at both ends. Indications: Mphanshya S/S – Diff B-ph, NCC - Diff B-ph Leopards Hill S/S –Diff ABC, NCC–Diff B-ph Investigation revealed termination failure on B-ph at cable take off. Line isolated and earthed at 11:42hrs. Restored on 29/03/2022 at 16:04hrs after erecting 5X wooden poles and stringing B-phase line conductor.	29- Mar 2022	16:04 PM
84.	29- Mar 2022	11:23 AM	System Disturbance	IPS experienced system disturbance on 29/03/2022 at 11:23hrs characterized by power swings, voltage fluctuations and loss of load. The disturbance is suspected to have emanated from the CEC network where there was report of tripping of 66/11kV TX's T1B,T4 &T5 on O/C at Bancroft S/S in Chililabombwe. IPS stabilized at 11:26hrs and ZESCO loads restored by 11:38hrs.	29- Mar 2022	11:26 AM
85.	29- Mar 2022	11:47 AM	SNEL	IPS experienced system disturbance on 29/03/2022 at 11:47hrs characterized by power swings and high voltage following the tripping of Converters 1&2 at Kolwezi in SNEL network. IPS normalized at 12:00hrs	29- Mar 2022	12:00 PM

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		G	uarter 2 of 2022 AI	onormal Network Conditions/ System Disturbances Recorded		
No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
86.	1- Apr 2022	8:33:00 AM	KNBPS	Gen. G4 tripped at 08:33hrs on turbine pit water level too high. Findings; - Float switch for standby pump #1 was defective (stiff) so failed to kick in. Restored at 12:00hrs after changing float switch for pump #1 and cleaned suction for pump #2.	1- Apr 2022	12:00:00 PM
87.	3- Apr 2022	1:58:00 PM	Kabwe Step Down	330kV Pensulo line tripped at 13:58hrs on both ends. At Kabwe on Diff, DI Zone 1, all phases, FL=287.9km. At Pensulo on Diff, DI, Zone 1, all phases. Restored at 14:08hrs.	3- Apr 2022	2:08:00 PM
88.	6- Apr 2022	6:02:00 PM	Lumwana	330kV Kansanshi line tripped and L/Out at 18:02hrs on E/F. Restored at 18:09hrs.	6- Apr 2022	6:09:00 PM
89.	6- Apr 2022	8:39:00 PM	Kalumbila	330kV Nambala line 1 tripped at 20:39hrs on both ends. At Kalumbila; Line Differential At Nambala; Line Differential and DI Zone1, ABC, FL=304.4km. Restored at 20:49hrs.	6- Apr 2022	8:49:00 PM
90.	12- Apr 2022	1:11:00 PM	KGL PS	G3 tripped at 13:11hrs on shaft seal water flow low. Investigation revealed that the flow meter for the shaft seal water malfunctioned. Restored at 16:11hrs.	12- Apr 2022	4:11:00 PM
91.	14- Apr 2022	1:06:00 PM	SNEL	System disturbance experienced on 14/04/2022 at 13:06hrs due to tripping of 220kV Michelo-Karavia lines 1 and 2 and 220kV Luano-Karavia line on DOP. IPS normalised at 13:26hrs	14- Apr 2022	1:26:00 PM
92.	15- Apr 2022	9:20:00 AM	Pensulo	330kV Kabwe line tripped at 09:20hrs on directional E/F and O/C. This was due to a DC E/F on Auxiliary Relay. Restored at 09:57hrs.	15- Apr 2022	9:57:00 AM
93.	16- Apr 2022	5:20:00 PM	V/Falls	C-Station tripped at 17:20hrs on Diff due to a cut conductor on red phase of tension tower. Report of lightning strike and broken insulators. Heavy rains in the area. Synchronised C7 at 12:00hrs, C9 at 12:00hrs, C10 at 12:17hrs and C8 at 13:01hrs on 17/04/2022.	17- Apr 2022	12:17:00 PM
94.	16- Apr 2022	4:40:00 PM	V/Falls	220kV Sesheke line tripped on both ends at 16:40hrs. At V/Falls on DI, Zone 1, all phases, FL=79.79km. At Sesheke end on DI, Zone 1, all phases, no FL. Load lost 160.6MW. Restored at 17:00hrs and Nampower synchronized at the same time.	16- Apr 2022	5:00:00 PM

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	Restoration Time	5:32:00 AM	2:18:00 PM	8:19:00 PM	9:58:00 PM	3:14:00 PM	6:24:00 PM	2:20:00 PM	12:53:00 PM	6:21:00 PM
	Restoration Date	19- Apr 2022	26- Apr 2022	27- Apr 2022	2- May 2022	3- May 2022	16- May 2022	21- May 2022	23- May 2022	27- May 2022
Abnormal Network Conditions/ System Disturbances Recorded	Event	System disturbance experienced on 19/04/2022 at 05:24hrs due to tripping of 220kV Michelo-Karavia lines 1 and 2 and 220kV Luano-Karavia line on DOP caused by. SNEL interconnector lost 284.58MW. IPS normalised at 05:32hrs	132/33kV TXT2 tripped on both sides at 13:32hrs. LDCC gave alternative supply. Indications: NCC - Pressure Relief Tripp. S/S - Pressure Relief Valve. Restored at 14:18hrs.	G1 tripped at 02:46hrs on mechanical fault shutdown alarm and 'turbine bearing water in oil alarm' which was caused by a leaking water pipe from shaft seal leading to water ingress into the oil sump tank for the turbine bearing. Synchronised at 20:19hrs after draining oil from turbine sump, flushing and putting fresh oil.	G4 Tripped at 20:57hrs on Unit Leakage Water Too High after pump in service failed to cope with the rising level and standby pump failed to start due to stuck float switch. Standby pump started manually to bring down the level, float switch repositioned. Unit declared available at 21:58hrs.	System Disturbance experienced at 15:02 hrs following the tripping of Kankoyo - 66kV Mufulira line 1 in CEC network, report of blue phase diverter jumper dropper conductor snapped. This was characterised by loss of 190MV on CEC, Lumwana, Kansanshi, ZESCO Distribution networks. IPS normalised at 15:14hrs	System Disturbance experienced on 16/05/2022 at 18:17hrs following the tripping of SNEL interconnector on DOP after loss of Converter 1&2 at Kolwezi in the SNEL network. IPS normalised at 18:24hrs.	System disturbance experienced at 14:00hrs on 21/05/2022 characterized by high frequency and high voltage. Disturbance attributed to Eskom carrying out stage 4 load management (4000MW). IPS normalised at 14:20hrs.	G1 tripped at 09:14hrs on "turbine guide bearing High Limit ". Restored at 12:53hrs after disconnecting suspected temperature-probe #7. Faulty probe to be rectify during Mtce. Gen lost 150MW.	330/88kV TxT2 tripped at 18:06hrs on O/C. Restored at 18:21hrs
Quarter 2 of 2022 /	Station/ Area	SNEL	Coventry	E	KNBPS	System Disturbance	SNEL	ESKOM	KGL	KSD
	Outage Time	5:24:00 AM	1:32:00 PM	2:46:00 AM	8:57:00 PM	3:02:00 PM	6:17:00 PM	2:00:00 PM	9:14:00 AM	6:06:00 PM
	Date	19- Apr 2022	26- Apr 2022	27- Apr 2022	2- May 2022	3- May 2022	16- May 2022	21- May 2022	23- May 2022	27- May 2022
	No.	95.	96.	97.	98.	<u>9</u> 9.	100.	101.	102.	103.

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No.DateOttoge TimeStation AreaEvent AreaBeat Area			Ø	uarter 2 of 2022 A	bnormal Network Conditions/ System Disturbances Recorded		
10. 29. May 2022 2.0000 PM SNEL Statem Disturtance on 2905/2022 at 14.00% totolog the tropond 20. May 2022 2.0000 PM 10. 31. May 2022 10.36:00 PM SNEL Settem Disturtance on 31.05/2022 at 10.26% totolog the tropond 20. May 2022 208:00 PM 200:00 PM	No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
10531-May 202210:56:00 AMSNEILSNEIL Instructance on 31/05:2022 at 10:36th of the troping of SNEIL Instructance of the Authority floctuations. IPS nomilied at swings and voitage and recuency floctuations. IPS nomilied at swings and voitage and recuency floctuations. IPS nomilied at swings and voitage and lose of load (Total How Neisen). IPS nomilied at the Neisen and SNEIL Instructance of the address characteriated by power swings and voitage and lose of load (Total How Neisen). IPS nomilied at 	104.	29- May 2022	2:00:00 PM	SNEL	System Disturbance on 29/05/2022 at 14:00hrs following the loss of 106MW in the SNEL network. Disturbance characterised by power swings and voltage and frequency fluctuations. IPS normalised at 14:08hrs.	29- May 2022	2:08:00 PM
10. 5-Jun 2022 6:46:00 AM System Disturbance on 05/06/2022 at 06:46 hrst charactered by high voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of lead (Total=146 MV). Disturbance is suspected at voltage and loss of lead (Total=146 MV). Disturbance is suspected to voltage and loss of load (Total=146 MV). Disturbance is suspected to voltage and loss of load (Total=146 MV). Disturbance is suspected at voltage and loss of load (Total=146 MV). Disturbance is suspected at voltage and v	105.	31- May 2022	10:36:00 AM	SNEL	System Disturbance on 31/05/2022 at 10:36hrs following the tripping of SNEL interconnectors on DOP after tripping of Converter 1&2 at Kolwezi in the SNEL network. Disturbance characterised by power swings and voltage and frequency fluctuations. IPS normalised at 10:58hrs	31- May 2022	10:58:00 AM
107.8. Jun 20221:13:00 AMSNELSystem Disturbance on 03/06/2022 at 01:13 hredue to tripping of 120kV bower swings and voltage and frequency fluctuations. IPS normalised t 001:18 hrs.1:18:00 AM108.17- Jun 20226:33:00 PMU/WestInvestige and requency fluctuations. IPS normalised t 132/33111K/ T2B tripped at 18:35 hrs on both HV & LV side on Diff.1:18:00 AM108.17- Jun 20226:33:00 PMU/West1:23/33111K/ T2B tripped at 18:35 hrs on both HV & LV side on Diff.1:18:00 AM108.17- Jun 20226:33:00 PMU/West1:32/33111K/ T2B tripped at 18:35 hrs on both HV & LV side on Diff.1:18:00 AM108.17- Jun 20226:33:00 PMU/West2:3/33111K/ T2B tripped at 18:35 hrs on both HV & LV side on Diff.1:18:00 AM109.2:3- Jun 20224:19:00 PMNick at Robins revealed that the tripping was of XIPE cable about 19:3.226MV was of XIPE cable about 19:3.226MV was of XIPE cable1:10:00 AM109.2:3- Jun 20228:02:00 AMSNELSNEL network leading to fripping of file trophing of file at Robins' in the SNEL network leading to file ping of file at Robins' in the SNEL network leading to fripping of file at Robins' in the SNEL network leading to find file at Robins' in the SNEL network. IPS normalised t 8:02:00 AM4:30:00 PM101.2:6- Jun 20228:02:00 AMSNEL network leading to find file ping of file tripping of file tripping of file tripping of file robins' Robins' in the SNEL network. IPS normalised at t 8:02:00 AM4:30:00 FM101.2:6- Jun 20228:02:00 AM2:50 AM2:50 AM102.8:02:00 AMSS	106.	5- Jun 2022	6:46:00 AM	System Disturbance	System Disturbance on 05/06/2022 at 06:46hrs characterized by high voltage and loss of load (Total=146MW). Disturbance is suspected to have emanated from North Western Energy NWE where at Lumwana S/S, 33kV Village feeder tripped on O/C (1.1MW load lost). Investigation revealed cut jumper on customer side. IPS normalized at 06:50hrs.	5- Jun 2022	6:50:00 AM
108.17- Jun 20226:33:00 PMLWest132/33/11kV T2B tripped at 18:33hrs on both HV & LV side on Diff. [71.4MW load lost]. Investigations revealed that the tripping was attributed to accumulation of carbon on blue phase of XLPE cable Armoured. Restored at 00:10hrs on 18/06/2022 after cleaning the 	107.	8- Jun 2022	1:13:00 AM	SNEL	System Disturbance on 08/06/2022 at 01:13hrs due to tripping of 120kV Lwilu Kolwezi line in the SNEL network. Disturbance characterised by power swings and voltage and frequency fluctuations. IPS normalised at 01:18hrs.	8- Jun 2022	1:18:00 AM
109.23- Jun 20224:19:00 PMSNELSystem Disturbance experienced on 23/06/2022 at 16:19hs following the tripping of 220kV Nseke - SCK line at Kolwezi in the About 193.226MV was lost in the SNEL network leading to tripping of interconnectors all three on DOP: 16:30hrs.3:3- Jun 20224:30:00 PM110.26- Jun 20228:02:00 AMSystem Disturbance on 26/06/2022 at 08:02hrs attributed to the ripping of 720MW Generator at Midupe PS in the Eskom network as PS normalised by 8:278:27:00 AM	108.	17- Jun 2022	6:33:00 PM	L/West	132/33/11kV T2B tripped at 18:33hrs on both HV & LV side on Diff. [71.4MW load lost]. Investigations revealed that the tripping was attributed to accumulation of carbon on blue phase of XLPE cable Armoured. Restored at 00:10hrs on 18/06/2022 after cleaning the carbon.	18- Jun 2022	12:10:00 AM
110.26- Jun 20228:02:00 AMESKOMSystem Disturbance on 26/06/2022 at 08:02hrs attributed to the tripping of 720MW Generator at Midupe PS in the Eskom network as a result 400kV Insukamini-Phokoje line tripped due to power swings.8:27:00 AM110.26- Jun 20228:02:00 AMESKOM8:27:00 AM	109.	23- Jun 2022	4:19:00 PM	SNEL	System Disturbance experienced on 23/06/2022 at 16:19hrs following the tripping of 220kV Nseke - SCK line at Kolwezi in the SNEL network leading to tripping of interconnectors all three on DOP. About 193.226MW was lost in the SNEL network. IPS normalised at 16:30hrs.	23- Jun 2022	4:30:00 PM
	110.	26- Jun 2022	8:02:00 AM	ESKOM	System Disturbance on 26/06/2022 at 08:02hrs attributed to the tripping of 720MW Generator at Midupe PS in the Eskom network as a result 400kV Insukamini-Phokoje line tripped due to power swings. IPS normalised by 8:27	26- Jun 2022	8:27:00 AM

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	Restoration Time	5:13:00 AM	12:14:00 PM	8:16:00 PM	3:00:00 PM	4:33:00 AM	10:10:00 PM
	Restoration Date	1- Jul 2022	1- Jul 2022	1- Jul 2022	15- Jul 2022	25- Jul 2022	25- Jul 2022
of 2022 Abnormal Network Conditions/ System Disturbances Recorded	Event	System Disturbance on 01/07/2022 at 04:39hrs attributed to the tripping of Michelo Karavia line 1 and 2 which tripped on Main protection at 04:39 and 04:43 respectively. Restored line 1 at 06:23hrs. 400kV Insukamini-Phokoje line tripped due to power swings. Restored at 06:33hrs. HCB lost a 400MW unit. IPS Normalised by 5:13	System disturbance experienced on 01/07/2022 at 12:03hrs due to tripping of 400kV Insukamini-Phokoje line. Restored at 23:08hrs. FREQUENCY – Swung from 50.29Hz to 49.04Hz and settled at 50.099Hz. No load lost in ZESCO, CEC and the Mines. IPS normalised at 12:14hrs.	System disturbance experienced on 01/07/2022 at 20:03hrs due to tripping of 220kV Michelo-Karavia line 1 and 220kV Luano-Karavia line on DOP. Restored at 20:28hrs and 20:10hrs respectively. ZESCO lost load of 46.46MW, no load lost in CEC and the Mines. IPS normalised at 20:16hrs.	System Disturbance experienced at 14:45hrs on 15/07/2022 caused by the tripping of 220kV Michelo -Karavia lines 1&2 and 220kV Luano Karavia line on DOP due to tripping of two Converters at Kolwezi in the SNEL Network. The disturbance was characterized by power swings and rise in system voltages. IPS Normalised by 15:00hrs.	System Disturbance experienced on 25/07/2022 at 04:28hrs characterized by frequency excursions and power swings following loss of generation and tripping of bus coupler at Songo (350MW) in Mozambique network. IPS normalized at 04:33hrs.	System Disturbance experienced on 25/07/2022 at 22:06hrs characterized by high voltage and power swings following tripping of 220kV Michelo Karavia lines 1&2 and 220kV Luano Karavia on DOP. Michelo Karavia line 1 restored at 22:20hrs, line 2 at 22:12hrs, Luano Karavia line at 22:16hrs. IPS normalized at 22:10hrs.
Quarter 3 c	Station/ Area	SNEL	ESKOM	SNEL	SNEL	EDM	SNEL
	Outage Time	4:39:00 AM	12:03:00 PM	8:03:00 PM	2:45:00 PM	4:28:00 AM	10:06:00 PM
	Date	1- Jul 2022	1- Jul 2022	1- Jul 2022	15- Jul 2022	25- Jul 2022	25- Jul 2022
	No.	111.	112.	113.	114.	115.	116.

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	Restoration Time	11:36 AM	20:44 PM	12:33 PM	19:15 PM	19:57 PM
	Restoration Date	27- Jul 2022	4- Aug 2022	8- Aug 2022	14- Aug 2022	21- Aug 2022
of 2022 Abnormal Network Conditions/ System Disturbances Recorded	Event	System Disturbance experienced system disturbance on 27/07/2022 at 11:31hrs characterised by power swings following tripping of 120kV Ndenke line in SNEL network. Effect on System; Frequency dropped from 49.15Hz to 48.84Hz ZESA tie line power flow swung from 12MW export to 420MW export. SNEL interconnector swung from 193MW export to 18MW import. Kitwe voltage rose from 316kV to 324kV then settled at 318kV. ZESCO lost 91.56 MW. No load lost in CEC and Mines. IPS normalised at 11:36hrs.	System Disturbance experienced a system disturbance on 04/08/2022 at 20:04hrs attributed to the tripping of 400kV Insukamini-Phokoje line which lead to a loss of 409MW on the distribution network after the tripping 11kV and 33kV feeders on U/F. 53MW of load lost at Kalumbila. No load lost on CEC network. 11kV and 33kV feeders restored by 20:30hrs and 400kV Insukamini-Phokoje line restored at 20:44hrs.	G3 taken out on emergency at 10:17hrs due to high water level in the turbine pit resulted from the tripping of AC leakage water pump 1 on thermal over load and loss efficiency on pump 2 to manage water level. Findings: Pump 1 power cct. Contactor contacts were welded and pump was grounding. Unit restored at 12:33hrs after paralled pump 2 with a portable pump.	System Disturbance experienced a system disturbance on 14/08/2022 at 18:13hrs characterised by power swings, high voltage and loss of load. Disturbance is suspected to have emanated from SNEL network where there was a report of tripping 120kV Kolwezi – Luilu line. IPS stabilized at 18:18hrs, Kalumbila load normalized by 19:15hrs	System Disturbance experienced system disturbance on 21/08/2022 at 19:35hrs Characterized by power swings, high voltage and loss of load due to tripping of Converter # 2 at Inga in the SNEL network. This then lead to tripping of all three interconnectors to SNEL on U/V and DOP stage II. IPS normalised at 19:57 hrs.
Quarter 3 o	Station/ Area	SNEL	BPC/ ZESA	KNBPS	SNEL	SNEL
	Outage Time	11:31 AM	20:04 PM	10:17 AM	18:13 PM	19:35 PM
	Date	27- Jul 2022	4- Aug 2022	8- Aug 2022	14- Aug 2022	21- Aug 2022
	No.	117.	118.	119.	120.	121.

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			Quarter 3	of 2022 Abnormal Network Conditions/ System Disturbances Recorded		
<u>.</u>	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
22.	21- Aug 2022	22:49 PM	SNEL	System Disturbance experienced system disturbance on 21/08/2022 at 22:49hrs Characterized by power swings, high voltage due to tripping of generating unit at Busanga power plant in the SNEL network. This then lead to tripping of all three interconnectors to SNEL on DOP stage I, a loss of 267MW. IPS normalised at 22:58hrs.	21- Aug 2022	22:58 PM
23.	22- Aug 2022	03:52 PM	SNEL	System Disturbance experienced system disturbance on 22/08/2022 at 03:52hrs Characterized by power swings, high voltage due to tripping of one 50MW generator at Busanga power plant in the SNEL network. This then lead to tripping of all three interconnectors to SNEL on DOP stage I, a loss of 252MW. IPS normalised at 03:56hrs.	22- Aug 2022	03:56 PM
24.	22- Aug 2022	11:28 AM	ITPC	G1 and G2 taken out on emergency at 11:28hrs due to ruptured valve on the fire hydrant leading to water gashing to the IPB and Excitation floors on the machines. Water for the Hydrant isolated at 11:30hrs. [116MW generation lost] G1 restored at 18:20hrs and G2 restored at 20:41hrs after replacing defective water valve on the hydrant system.	22- Aug 2022	20:41 PM
25.	3- Sept 2022	00:38 AM	ESKOM	System Disturbance experienced on 03/09/2022 at 00:38hrs characterised by frequency excursions and power swing following loss of 940MW generation in Eskom network. Frequency dropped from 49.913Hz to 49.395Hz and stabilized at 49.70Hz. ZESA tie line power flow increased from 70MW export to 321MW export. SNEL interconnector from 172MW export reduced to 144MW export. At KFG generation increased from 850MW to 917MW. At Kariba generation raised from 377MW to 660MW. At KGL from 377MW to 660MW.	3- Sept 2022	00:42 AM
26.	6- Sept 2022	01:38 AM	ESKOM	System Disturbance experienced on 06/09/2022 at 01:38hrs characterised by frequency excursions and power swing following the tripping of 684MW generator # 1 at Midupi PS in Eskom network as a result; At Songo s/s in EDM network, 330kV bus Coupler tripped on U/F. 400kV Insukamini-Phokonje interconnector tripped on power swing hence off parallel with Eskom. IPS Normalised at 01:56hrs.	6- Sept 2022	01:56 AM

			Quarter 3 c	f 2022 Abnormal Network Conditions/ System Disturbances Recorded		
No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
127.	9- Sept 2022	06:02 AM	BPC/ ZESA	System Disturbance experienced on 09/09/2022 at 06:02hrs characterised by frequency excursions and power swing following the tripping 400kV Insukamini-Phokonje interconnector tripped hence off parallel with Eskom. IPS normalised at 06:30hrs	9- Sept 2022	06:30 AM
128.	10- Sept 2022	06:06 AM	EDM	System Disturbance experienced on 10/09/2022 at 06:06hrs characterised by frequency excursions and power swing following the outage on 400kV Insukamini-Phokoje interconnector and ZESCO went off parallel with Eskom. Attributed to tripping of the Bus Coupler at Songo. IPS normalised at 06:27hrs	10- Sept 2022	06:27 AM
129.	15- Sept 2022	19:10 PM	Kalumbila	System Disturbance experienced on 15/09/2022 at 19:10hrs caused by the loss of 156MW at Kalumbila mine on O/V due to the tripping of 33kV mine feeder ring B on non -directional Earth Fault and O/C caused by a bird which shorted the aerial earth and one of the phases. IPS normalised at 19:20hrs.	15- Sept 2022	19:20 PM
130.	18- Sept 2022	07:28 AM	SNEL	System disturbance on 18/09/2022 at 07:28hrs caused by the loss of 150MW on the SNEL Network. IPS normalised at 07:35hrs.	18- Sept 2022	07:35 AM
131.	19- Sept 2022	1:22:00 PM	Kansanshi	System Disturbance experienced a system disturbance on 19/09/2022 at 13:22hrs caused by the loss of 112.52MW at Kansanshi mine followed by tripping of 33kV Solwezi line [14MW Lost] and Kimiteto line [2.48MW Lost]. IPS normalised at 13:32hrs.	19- Sept 2022	1:32:00 PM
132.	20- Sept 2022	10:59:00 PM	V/Falls	V/Falls – 220kV Sesheke line tripped at 22:59hrs on both ends. Report of rains and thunder in around Sesheke area. Nampower interconnector swung from 180MW export to 10MW import to support Western province. Consequently: B6 M/C tripped at 22:59hrs on Stator core high temperature on slot 69. Synchronised at 23:58hrs. Indications: V/Falls – DI, Zone 1, ABC phase, FL= 58.34km. Sesheke – O/C protection. NCC – Carrier received main prot 2, RYB. Line Restored at 23:30hrs and Nampower synchronized at 22:33hrs	20- Sept 2022	10:33:00 PM

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	Restoration Time	10:41:00 PM	8:18:00 PM	7:49:00 AM	11:48:00 AM	10:37:00 AM
	Restoration Date	23- Sept 2022	23- Sept 2022	26- Sept 2022	26- Sept 2022	27- Sept 2022
of 2022 Abnormal Network Conditions/ System Disturbances Recorded	Event	KNBPS – G4 Tripped at 13:36hrs on major governor fault.[Gen lost 160.6MW]. Restored at 21:00hrs after replacing proximity sensor and cleaning the actuator. Works required draining of penstock. The unit tripped at 21:05hrs on governor major fault. Restored at 22:02hrs.Taken out at 22:16hrs maintenance team to measure currents on proximity sensor then restored at 22:41hrs	G3 Tripped at 19:41hrs on shaft seal cooling water low flow.[load lost 143.3MW]. Synchronised at 20:18hrs after investigations revealed it was a false alarm.	System Disturbance experienced system disturbance on 26/09/2022 at 07:38hrs characterised by frequency excursions and power swing following the tripping of 400kV Insukamini- Phokoje line. IPS Normalised at 07:49hrs 400kV Insukamini-Phokoje line restored and back in parallel with Eskom at 08:34hrs.	System Disturbance experienced system disturbance on 26/09/2022 at 11:43hrs characterised by frequency excursions and power swing following the tripping of convertor # 1 and 2 at Kolwezi in SNEL network. IPS Normalised at 11:48hrs. Michelo – Karavia line 1 and 2 restored at 12:05hrs and 12:10hrs respectively	System Disturbance experienced system disturbance on 27/09/2022 at 10:23hrs characterised by over frequency, over voltage and power swings following the tripping of 330kV Alaska – Warren lines 1 and 2 on Distance protection. Several cascaded tripping on different lines were experienced on the ZESA Network leading to Nation Blackout in Zimbabwe following the tripping of all the interconnectors. Zesco IPS Normalised at 10:37hrs.
Quarter 3 o	Station/ Area	KNBPS	KGL	BPC/ ZESA	SNEL	ZESA
	Outage Time	1:36:00 PM	7:41:00 PM	7:38:00 AM	11:43:00 AM	10:32:00 AM
	Date	23- Sept 2022	23- Sept 2022	26- Sept 2022	26- Sept 2022	27- Sept 2022
	No.	133.	134.	135.	136.	137.

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	Qua	irter 4 of 2022 Abr	ormal Network Conditions/ System Disturbances Recorded		
Outage ⁻	Time	Station/ Area	Event	lestoration Date	Restoration Time
2:15:00	M	SNEL	System Disturbance experienced a system disturbance on 04/10/2022 at 14:15hrs Characterized by power swings, high voltage and loss of load due to tripping of Converter # 1 at Kolwezi in the SNEL network, As a result all the three interconnectors tripped on DOP. IPS normalised by 14:25hrs.	Oct 2022	2:25:00 PM
12:46:00	W	SNEL	System disturbance experience at 12:46hrs on 08/10/2022 characterised by power swings and frequency excursions due to tripping of convertor #1 at Kolwezi in the SNEL Network which resulted into tripping of all the three tie line on DOP. IPS normalised at 12:50hrs. Michelo – Karavia line 1 and 2 restored at 13:26hrs and 13:21hrs respectively. Luano – Karavia line 1 restored at 13:19hrs.	Oct 2022	12:50:00 PM
1:01:00	AM	SNEL	System disturbance experience at 01:01 hrs on 09/10/2022 characterised by power swings and frequency excursions due to tripping of Busanga Power station in the SNEL Network which resulted into tripping of all the three tie lines on DOP. IPS normalised at 01:15 hrs. Michelo – Karavia line 1 and 2 restored at 01:30 hrs and 02:16 hrs respectively. Luano – Karavia line 1 restored at 03:02 hrs.	Oct 2022	1:15:00 AM
7:57:00	M	EDM	System disturbance experienced at 19:57hrs due to tripping of B/ Coupler at Cahora Bassa PS, which led to tripping of 330kV Songo- Bindura line in EDM network. IPS normalised at 20:10hrs.	- Oct 2022	8:10:00 PM
1:45:00	Md	Kitwe	330kV Chambishi line tripped at 13:45hrs on both ends. Indications; Kitwe: Diff, DI Zone 1, FL=2.5km, Red phase Chambishi: Diff Red & Blue phases. Yellow Phase opened on pole discrepancy and later found to have low SF6 gas though had not yet reached alarm point. Line 12-isolated to top up SF6 gas. Investigations attributed tripping to have been caused by fire around the indicated FL near CEC solar panels. Restored at 18:51hrs.	- Oct 2022	6:51:00 PM
3:53:00	AM	SNEL	System Disturbance experienced system disturbance on 18/10/2022 at 03:53hrs characterised by frequency excursions and power swing following the tripping of 220kV Michelo – Karavia line 1 and 2, Luano Karavia line 1 interconnectors on DOP. Michelo – Karavia line 1 and 2, Luano 18. Luano – Karavia line 1 interconnectors restored 04:02hrs respectively IPS normalised at 03:55hrs.	- Oct 2022	3:55:00 AM

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No. Date Outege Time Station / Area Event Restoration			Quart	ter 4 of 2022 Abr	ormal Network Conditions/ System Disturbances Recorded		
(44. 19- Oct 2022 1:11:00 PM Kansanshi t 3:11 ms of meanershi of 000 wing at fastranshi meri od sixturbance in kansanshi mine witch led to loss of 000 wing the architeance in Kansanshi mine witch led to loss of 000 wing the architeance in Kansanshi mine witch led to loss of 000 wing the architeance in Kansanshi mine witch led to loss of 000 wing the architeance in Kansanshi mine witch led to loss of 000 wing the architeance in Kansanshi mine witch led to loss of 000 wing the architeance experienced system disturbance on 19/10/2022 1:11: 1:11: 1:11 ms of meanershi of 000 wing the architeance in the architeance on 19/10/2022 1:21: 1:21: 1:21: 1:21: 2:11: 2:11 ms of meanershi of 000 mine the architeance experienced System disturbance on 24/10/2022 1:21: 1:21: 1:21: 2:11: 2:11 ms of meanershi at 000 mine the architeance experienced System disturbance on 24/10/2022 1:21: 2:11:	No.	Date	Outage Time	Station/ Area	Event	Restoration Date	Restoration Time
14. 11:53:00 PM SNEL System Disturbance experienced system disturbance on 19/10/2022 12:10 14.6 11:53:00 PM SNEL 23:50 hrs. characterised by frequency excursions and power at 23:50 hrs. characterised by frequency excursions and power at 23:50 hrs. characterised by frequency excursions and power at 23:50 hrs. luano Karawa line 1 interconnectors no DOP. Fish normalised at 00:30 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and count sectored 00:32 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and power at 00:30 hrs. characterised by frequency excursions and power at 03:50 hrs. characterised by frequency excursions and power at 03:50 hrs. characterised by frequency excursions and power at 03:50 hrs. characterised by frequency excursions and power at 03:50 hrs. characterised by frequencies by frequencies by frequencies at 03:50 hrs. characterised by frequencies at 03:50 hrs. characterised by frequencies at 03:10:2022 frecuencies by frequencies by frequencies and frequencies	44.	19- Oct 2022	1:11:00 PM	Kansanshi	System Disturbance experienced system disturbance on 19/10/2022 at 13:11hrs characterised by frequency excursions and power swing following an internal disturbance in Kansanshi mine which led to loss of 100MW at Kansanshi and 30MW at Lumwana. IPS normalised at 13:14hrs.	19- Oct 2022	1:14:00 PM
14b 24- Oct 2022 3:41:00 AM System Disturbance experienced System disturbance on 24/10/2022 3:55: 147. 24- Oct 2022 3:41:00 AM SNEL swing following tripping of 220kW Michelo Karavia lines 1 & 2 and 220kW 24- Oct 2022 3:55: 147. 26- Oct 2022 7:03:00 PM System Disturbance experienced a system disturbance on 26/10/202 at 19:05:05 hrs 24- Oct 2022 3:56: 147. 26- Oct 2022 7:03:00 PM System Disturbance experienced a system disturbance on 26/10/202 at 19:05:05 hrs 24- Oct 2022 7:10: 148. 26- Oct 2022 7:03:00 PM SNEL Externation at Nsete PS in SNEL network PS normalised at 03:55 hrs 26- Oct 2022 7:10: 148. 28- Oct 2022 7:03:00 PM SNEL Externation at Nsete PS in SNEL network PS normalised at 03:10: 26- Oct 2022 7:10: 148. 28- Oct 2022 7:01: PS normalised at 19:10: 26- Oct 2022 7:10: 148. 28- Oct 2022 7:17:00 PM SNEL PS normalised at 19:10: 26- Oct 2022 7:24: 149. 17:17:05 PM SNEL PS normalised at 19:10: 26- Oct 2022 7:24:	145.	19- Oct 2022	11:53:00 PM	SNEL	System Disturbance experienced system disturbance on 19/10/2022 at 23:53hrs characterised by frequency excursions and power swing following the tripping of 220kV Michelo – Karavia line 1 and 2, Luano Karavia line 1 interconnectors on DOP. IPS normalised at 00:31hrs; Luano – Karavia line 1 interconnectors restored 00:32hrs	19- Oct 2022	12:16:00 AM
147. 26- Oct 2022 7:03:00 PM System Disturbance experienced a system disturbance on 26/10/22 at 19:03 trom the tripping of 220kV Interconnectors bin OEC & SNEL 1e Michelo 26- Oct 2022 7:10: 148. 28- Oct 2022 7:17:00 PM SNEL 19:10 from the tripping of 220kV Interconnectors bin OEC & SNEL 1e Michelo 26- Oct 2022 7:10: 148. 28- Oct 2022 7:17:00 PM SNEL 19:10 from SNEL 19:10	46.	24- Oct 2022	3:41:00 AM	SNEL	System Disturbance experienced System disturbance on 24/10/2022 at 03:41hrs characterised by high voltage, high frequency and power swing following tripping of 220kV Michelo Karavia lines 1 & 2 and 220kV Luano Karavia line on DOP. Cause f tripping attributed to loss of 65MV generation at Nseke PS in SNEL network IPS normalised at 03:55hrs	24- Oct 2022	3:55:00 AM
148. 28- Oct 2022 7:17:00 PM System Disturbance experienced System disturbance on 28/10/2022 8- Oct 2022 7:24: 148. 28- Oct 2022 7:17:00 PM SNEL Inpoing of 220kV Michelo Karavia lines 1 & 2 and 220kV Luano Karavia 28- Oct 2022 7:24: 149. 1- Nov 2022 8:14:00 PM ZESA System Disturbance experienced System disturbance on 01/11/2022 1- Nov 2022	147.	26- Oct 2022	7:03:00 PM	SNEL	System Disturbance experienced a system disturbance on 26/10/22 at 19:03hrs characterised high voltage and power swings resulting from the tripping of 220kV Interconnectors bth CEC & SNEL i.e Michelo Karavia lines 1& 2 and Luano- Karavia line tripped on DOP at 225MW. IPS normalised at 19:10hrs.	26- Oct 2022	7:10:00 PM
49. 1- Nov 2022 8:14:00 PM ZESA System Disturbance experienced System disturbance on 01/11/2022 140. 1- Nov 2022 8:14:00 PM 150. 14 hrs due to tripping of Songo - 330kV Bindura interconnectors. 140. 1- Nov 2022	48.	28- Oct 2022	7:17:00 PM	SNEL	System Disturbance experienced System disturbance on 28/10/2022 at 19:17hrs characterised by high voltage, and power swing following tripping of 220kV Michelo Karavia lines 1 & 2 and 220kV Luano Karavia line on DOP. Cause of ripping attributed to tripping of the SNEL tie lines. IPS normalised at 19:24hrs	28- Oct 2022	7:24:00 PM
	149.	1- Nov 2022	8:14:00 PM	ZESA	System Disturbance experienced System disturbance on 01/11/2022 at 20:14hrs due to tripping of Songo – 330kV Bindura interconnectors. IPS normalised at 20:29hrs	1- Nov 2022	8:29:00 PM

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	Restoration Time	11:07:00 PM	3:48:00 AM	2:11:00 AM	1:40:00 PM	7:52:00 AM	22:44 PM
	Restoration Date	1- Nov 2022	2- Nov 2022	4- Nov 2022	4- Nov 2022	5- Nov 2022	9-Nov-22
rmal Network Conditions/ System Disturbances Recorded	Event	System Disturbance experienced System disturbance on 01/11/2022 23:03hrs due to loss of 200MW at Inga PS which lead to tripping of Michelo – 220kV Karavia line 2, Luano -220kV Karavia line 1 tripped on DOP & Michelo – 220kV Karavia line 1 on DI. IPS Normalised at 23:07hrs.	System Disturbance experienced System disturbance on 02/11/2022at 03:42hrs due to tripping of all SNEL interconnectors on DOP. IPS normalised at 03:48hrs.	System Disturbance Experienced system disturbance on 04/11/2022 at 02:05hrs characterised by high voltage and power swings following tripping of 220kV CEC - SNEL interconnector on DOP. Cause of disturbance attributed to loss of 65MW generation at Busanga P/S in SNEL network. IPS stable at 02:11hrs and interconnector restored at 02:26hrs.	Kabwe -330kV Pensulo line tripped both ends at 13:07hrs. At KSD line tripped and L/out on Line Differential and DI Zone2 all phases. FL= 213.1KM. At Pensulo 330kV line tripped and locked out on DI Zone 1, all phases, FL= 87.66 KM.(Load lost 171MVA). 330kV Kabwe-Pensulo line restored at 13:40hrs.	System Disturbance Experienced system disturbance on 05/11/2022 at 07:47hrs characterised by high voltage and power swings following tripping of 220kV CEC - SNEL interconnector on DOP. Cause of disturbance attributed to increase in load in SNEL network. IPS stable at 07:52hrs and interconnector restored at 08:08hrs.	System Disturbance Experienced system disturbance on 09/11/2022 at 22:14hrs characterised by high voltage and power swings following tripping of 220kV Michelo – Karavia line 2 and Luano Karavia line 1 on DOP. Cause of disturbance attributed to loss of generation in the SNEL network. IPS stable at 22:29hrs and interconnector restored at 22:44hrs
ter 4 of 2022 Abr	Station/ Area	SNEL	SNEL		Kabwe	SNEL	SNEL
Quar	Outage Time	11:03:00 PM	3:42:00 AM	2:05:00 AM	1:07:00 PM	7:47:00 AM	22:14 PM
	Date	1- Nov 2022	2- Nov 2022	4- Nov 2022	4- Nov 2022	5- Nov 2022	9-Nov-22
	No.	150.	151.	152.	153.	154.	155.

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		Quar	ter 4 of 2022 Abn	ormal Network Conditions/ System Disturbances Recorded	Restoration	Restoration
Date Outage Tir	Outage Tir	ne	Station/ Area	Event	Restoration Date	Hestoration Time
15- Nov 2022 22:08 PM	22:08 PM		SNEL	System Disturbance experienced a System disturbance on 15/11/2022 at 22:08hrs characterised by high voltage and power swings following the tripping of 220kV Michelo Karavia line 2 and Luano Karavia line on DOP. Tripping was attributed to loss of 74MW generation at Nsilo PS in SNEL network. IPS stable at 22:12hrs and SNEL normalised at 22:16hrs.	15- Nov 2022	22:16 PM
22- Nov 2022 3:38 AM	3:38 AM		SNEL	System Disturbance ZESCO experienced a system disturbance on 22/11/2022 at 03:38hrs characterised high voltage and power swings resulting from the tripping of 220kV interconnectors Michelo-Karavia lines 1 and Luano- Karavia line 1 on Main 1 and Distance protection. 220kV Luano-Karavia line tripped in Zone 1, R & B phase. FL=87.8KM. IPS normalised at 03:45hrs.	22-Nov-22	3:45 AM
22- Nov 2022 21:18 PM	21:18 PM		SNEL	System Disturbance ZESCO experienced a system disturbance on 22/11/2022 at 21:28hrs characterised by high voltage and power swings resulting from the tripping of 220kV interconnectors Michelo-Karavia lines 1 and Luano-Karavia line 1 on DOP. IPS normalised at 21:33hrs.	22- Nov 2022	21:33 PM
24-Nov-22 12:11 PM	12:11 PM		CEC	System Disturbance experienced System disturbance on 24/11/2022 at 12:11hrs characterised by high voltage and loss of load [Total=397MW]. The disturbance emanated from Bancroft Central S/S in CEC network where all the incomers to the B/B tripped. Effect on System: Kitwe voltage first dipped from 314.8kV to 230kV then rose to 342.94kV and controlled to 329kV. Frequency rose from 50.16Hz to 50.40Hz & settled at 50.12Hz 330kV Kansanshi Lumwana line tripped at both ends on O/V. Restored at 12:19hrs. IPS stable at 12:30hrs.	24-Nov-22	12:19 PM
29-Nov-22 2:24 AM	2:24 AM		SNEL	System Disturbance experience system disturbance on 29/11/2022 at 02:24hrs characterized by high voltage and power swing following tripping of 220kV Luano Karavia and Michelo Karavia 2 lines on DOP. The cause of disturbance was due to tripping of 75MW generation at Mwadingusha and Koni power plants in SNEL network. IPS stable at 02:35hrs and interconnector normalised at 03:20hrs after engagement with SNEL.	29-Nov-22	2:35 AM

BOARD BEGULATION

	Restoration Time	17:48 PM	17:42 PM	23:30 PM	18:54 PM	15:33 PM
	Restoration Date	2-Dec-22	4-Dec-22	4-Dec-22	12- Dec 2022	16- Dec 2022
ormal Network Conditions/ System Disturbances Recorded	Event	System disturbance experienced on 02/12/2022 at 17:35hrs characterised by high voltage, power swings and frequency excursion. This was due to the tripping of 220kV Luano- Karavia 1 and 220kV Michelo – Karavia line 1 and 2 on DOP. IPS normalised at 17:38hrs. 220kVMichelo-Karavia line 2 restored at 17:54hrs. 220kV Luano-Karavia line 1 restored at 17:48hrs.	Kansanshi Mine – Mine lost 101MW load at 17:28hrs. Report lightning at the mine, This resulted in O/V which lead to loss of 11kV feeders within the 132kV N/Western Network. All 33kV and 11k feeders restored at 17:42hrss	System disturbance experienced on 04/12/2022 at 20:02hrs characterised by high voltage, power swings and frequency excursion. This was due to the tripping of 220kV Luano- Karavia 1 and 220kV Michelo – Karavia line 1 and 2 on DOP caused by tripping of Power stations machines at Nseke, Nsilo, Mwadungushi and Busanga PS in the SNEL Network. IPS normalised at 23:30hrs. Michelo-Karavia line 1 and 2 restored at 20:16hrs.	System disturbance experienced on 12/12/2022 at 18:08hrs characterized by power swings, U/F & O/V following the tripping of Mwadigusha and Ngoni Power Plants losing about 75MW in SNEL network , which led to tripping of all interconnectors between CEC and SNEL on DOP. IPS normalised at 18:15hrs	Nambala – 330kV Kalumbila lines 1 & 2 tripped and L/out at 15:22hrs on O/V due to loss of all SNEL interconnectors which tripped on DOP. Restored at 15:53hrs.
ter 4 of 2022 Abr	Station/ Area	SNEL	Kansanshi Mine	SNEL	SNEL	Nambala
Quar	Outage Time	17:35 PM	17:28 PM	20:02 PM	18:08 PM	15:22 PM
	Date	2-Dec-22	4-Dec-22	4-Dec-22	12- Dec 2022	16- Dec 2022
	No.	161.	162.	163.	164.	165.

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	Restoration Time	13:04 PM	9:10 AM
	Restoration Date	20- Dec 2022	22- Dec 2022
rmal Network Conditions/ System Disturbances Recorded	Event	System disturbance experience on 20/12/2022 at 10:27hrs characterised by high voltage, power swings and frequency excursions due to tripping of 330/220/11kV Transformers T9,T7B and T8A at Luano S/S and T7AB Bank,T8AB bank and T9B at Kitwe S/S on O/C, followed by tripping of 330kV Kabwe- Pensulo, Kabwe – Luano 1, Kansanshi – Luano, Kalumbila-Nambala line 1, Pensulo- Mpika SD, Mpika –Kasama lines on O/V. IPS normalised at 13:04hrs.	System Disturbance experienced on 22/12/2022 at 08:55hrs characterised by high voltage and power swings following tripping on Nzilo power station in SNEL network. As a result, 220kV CEC-SNEL interconnector tripped on DOP. IPS normalised at 09:10hrs, SNEL interconnector restored at 09:13hrs.
rter 4 of 2022 Abr	Station/ Area	Luano	SNEL
Qua	Outage Time	10:27 AM	8:55 AM
	Date	20- Dec 2022	22- Dec 2022
	No.	166.	167.

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Appendix 9: Salient features of the White Paper for Cost of Service Study

These include the following:

- *i.* The Government supported the migration of tariffs to cost reflective levels to attractive investment in the sector.
- *ii.* The load forecast should incorporate Government's aspiration of increasing copper production to three (3) million tonnes per annum in the next 10 years. In sync with this desire, the Integrated Resource Plan has projected electricity demand to grow to 8,000MW by 2030.
- iii. On the basis of the projected demand, the cost of investment into expanded power generation, transmission and distribution infrastructure to meet the growth demand was estimated at US\$10.78 million.
- *iv.* The Government guided that tariffs adjustments should not place a heavier burden on residential customers at the expense of other customer categories. To ensure that ZESCO's financial position is improved, the tariff adjustment will be complemented by the implementation of reforms at ZESCO such as debt restructuring and enhancing prudence in resource management.
- v. The Government guided to maintain a lifeline tariff band at an affordable level as part of the multi-year electricity tariff framework, and the size of the band will be determined in line with the endorsed tariff-setting principles.





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Appendix 11: Construction Permit checklist

CHECKLIST

CONSTRUCTION PERMIT – PETROLEUM ENERGY PROJECTS

Requirement	Check
Proof of payment for Application Fee K1,000.20	
Written approval from Zambia Environmental Management Agency	
Two copies of detailed site plans	
Two copies of engineering and structural drawings	
Approval from appropriate authority having jurisdiction in the area being proposed to be developed (where applicable)	
Completed appendix showing the capacity of facility	
Approval from Road Development Agency or designated agency	
Practicing Certificate issued by Engineering Institution of Zambia for the registered engineering professional that will supervise the project	
Letter of Appointment of the registered engineering professional that will supervise the project	
Liability insurance to cover the cost of any damage that may be incurred	
Application duly/not duly lodged. (Cross out what is not applicable)	

Submitted by:		Date:
	(Name and Signature)	
Received by:		Date:
	(Name and Signature)	
Checked by:		Date:
	(Name and Signature)	



CHECKLIST

CONSTRUCTION PERMIT – RENEWABLE ENERGY PROJECTS

Requirement	Check
Proof of payment for Application Fee	
Approved Feasibility study	
Written approval from Zambia Environmental Management Agency	
Two copies of detailed site plans	
 Two copies of detailed project description including the following; Estimated customer base (e.g., No. of households, churches, rural health centres, schools etc) Detailed Geographical Location 	
Completed appendix showing the capacity of the Energy facility	
Site Survey Report	
Approval from Road Development Agency or designated agency (where applicable)	
Valid practicing Certificate issued by Engineering Institution of Zambia for the registered engineering professional that will supervise the project	
Letter of Appointment of the registered engineering professional that will supervise the project	
Approval by relevant local authority for siting of energy facility	
Approval from appropriate authority having jurisdiction in the area being proposed to be developed (where applicable)	
Project implementation schedules or Gantt chart (project timelines) duly signed by an authorized representative or project developer	
Details and justification of the tariff proposed by the applicant as a consequence of the project to be included in the business plan	
Water abstraction permit from WARMA (where applicable)	
Clearance with National Heritage Conservation Commission	
Liability insurance to cover the cost of any damage that may be incurred	

Application duly/not duly lodged. (Cross out what is not applicable)

Submitted by:		Date:
	(Name and Signature)	
Received by:		Date
neceived by	(Name and Signature)	Dale
Checked by:		Date:
Offected by	(Name and Signature)	Date

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App	pendix 12: Summary	/ of enforcemer	nts against erring licensee	es – 2022				
No.	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3rd Breach	4 th Breach
-	Exclusive Brands Africa Limited	11/1/2022	Applied for renewal of combined LPG licence 3 months before expiry contrary to clause 6 of the licence conditions which requires application for be renewal to be done 6 months before expiration of the licence	Licensee was in breach of licensed conditions	K6,000			
N	Juba Transport Limited	11/1/2022	Licensee did not submit comprehensive incident report within 7 days of the occurance of the accident involving Tanker enroute from Mozambique to Zambia in line with clause 2.1.4 (c) of the licence to transport petroleum products	Licensee did not comply with clause 2.1.4	warning			
<i>с</i> о	Mpanshya Oil Transporters Limited	14/01/2022	 Licensee did not submit comprehensive incident report within 7 days of the occurance of the accident involving Tanker enroute from Mozambique to Zambia in line with clause 2.1.4 (c) of the licence to transport petroleum products Operating road tank vehicle not in authorised appendix contrary to clause 2.1.1 of the licence condition 	licensee breached licence conditions	K10,000			
4	Mount Meru Petroleum Zambia Limited	18/01/2022	Failure to notify the ERB on notifiable Incidents within stipulated time frame contrary to clause 3.1.2 of their Licence to retail petroleum products	licensee failed to comply with notice period of within 24 hours of the incident occuring	warning	K20,000 + Final warning		

BOARD BECULATION

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No.	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
Q	U-Fuel Zambia Limited	20/01/2022	Operating without a Licence to Retail Petroleum Products	(i) Enterprise was in breach of section 10 of the Energy Regulation Act No.12 of 2019	K35,000 Compounded			
				Consent to compound the offence was sought and granted by DPP				
Q	Simba Oil Company Zambia Limited	24/01/2022	Failure to submit returns in line with conditions of licence to retal petroleum products	Licensee was found to be in breach of conditions of licence	K20,000			
~	Amideast Enterprises Limited (Oleum Energy Limited)	26/01/2022	Failure to submit returns in line with conditions of licence to distribute, import and export petroleum products	Licensee was found to be in breach of conditions of licence	K20,000			
ω	Lake Petroleum Limited	31/01/2022	Constructing an Energy Facility without a construction permit in Katete District of Eastern Province	(i) Enterprise was in breach of section 10 of the Energy Regulation Act No.12 of 2019 (ii)	K35,000 Compounded			
				Consent to compound the offence was sought and granted by DPP				
o	Apex Energies Limited	22/02/2022	Non-submission of returns contrary to conditions of licence to distribute, import & export of petroleum products	Applicant penalized K20,000 in line with Clause 44 of Item I of the Enforcement Manual	K20,000			
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No.	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
10	Vivo Energy Zambia Limited	15/03/2022	breach of condition 4.4 of construction permit: <i>If the</i> <i>project includes installation of</i> <i>underground tanks, the permit</i> <i>holder shall apply to the ERB in</i> <i>writing for the burial consent.</i> <i>In this regard, the permit holder</i> <i>shall not bury the tanks and pipe</i> <i>work without the written approval</i> <i>of the ERB</i>	 (i) Licensee was in breach of permit conditions at Addis Ababa site and Tokyo way service stations. (ii) Licensee should be penalized K45,000 for each site 	K90,000			
÷	Oryx Energies Limited	22/03/2022	 Clause 3.1.2 – The Licensee shall not vary the total licensed capacity of the licensed premises or facilities without prior written authority of the ERB; Clause 3.4.1 – The Licensee shall obtain prior written approval from the ERB in respect of the siting or decommissioning of facilities, plant or installation to be used for the purposes of the licensee shall not construct or commission any storage and/or dispensing facilities and related facilities at any of the Licensed prior written authority of the ERB. 	licensee breached licence conditions	K45,000			
12	Mount Meru Petroleum Zambia Limited	22/03/2022	Commissioning an energy facility without prior written authority from the ERB	Licensee was in breach of clause 3.4.4 of their licence to retail petroleum products	K75,000			

2022
REPORT
SECTOR
ENERGY

No.	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
ب	Karan Investments Zambia Limited	25/03/2022	(i) Karan has breached a directive of the ERB (ii) clause 9.12 of the Wayleave Code of Practice "storage and handling of flammable liquid or gases is not permitted within 30m from the centre of the distribution line for voltage levels between 11kV and 66kV, the required clearance is 30 metres."	 (i) Clause 42 of Appendix I of the Enforcement Manual stipulates that breach of a directive from the ERB warrants a penalty of up to 100, 000 penalty units (ii) Clause 7 of Appendix I of the Enforcement Manual provides that failure to comply with standards pertaining to safety, health and environment warrants a penalty units per site and an order to implement remedial measures. 	K45,000			
£	Rubis Energy Limited	18/03/2022	Rubis did not follow a directive from the ERB not to begin construction works without submitting the following: (i) Documentary evidence from the Road Development Agency for road infringement prior to commencement of construction works; and (ii) Copy of approval of the planning permission with consistent plot numbers as contained in the other documents prior to commencement of construction works.	Licensee should be penalized 40,000 penalty units for breach of ERB directive as per Energy Regulation Board Enforcement Manual Item 18 of Appendix 1	K12,000			
15	City Junction Limited	25/03/2022	Implemented the Canopy variations without prior approval contrary to clause 3.2 of their Construction Permit conditions	Licensee should be penalized 150,000 penalty units in line with Item 44 of Appendix 1	K45,000			

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<u>.</u>	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
16	Mesaka Energy Limited	30/03/2022	Licensee failed to submit monthly returns as per clause 3.4 of their combined license conditions	Licensee should be penalised 66,667 penalty units in line with clause 44 of Appendix I of the Enforcement Manual	K20,000			
1	Bulavilla Investments Limited	7/3/2022	Operating a road tank vehicle without a transportation Licence contrary to section 10 of the Energy Regulation Act No. 12 of 2019	Enterprise should be issued with a reprimand as stiffer punitive action would affect security of supply	Reprimand			
18	Kasgon Energy Limited	7/3/2022	Engaging in the retail of petroleum products without a Retail Licence from the ERB contrary to Section 10 of the Energy Regulation Act No. 12 of 2019	 (i) Enterprise should be issued with a reprimand as stiffer punitive action would affect security of supply (ii) Enterprise had already been penalized in earlier enforcement action 	Reprimand			
6	Vivo Energy Zambia Limited	7/3/2022	Failure to provide compressed air services at licensed premises contrary to clause 4.3.1 of their Retail Licence	stipulated procedure for handling of the complaint was not followed as CPA was supposed to investigate before refering to Legal for enforcement.	Matter referred to CPA			
50	SGC Investments Limited	7/3/2022	Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements for Road Tank Vehicles - Code of Practice 372	Licensee should be penalized 100,000 penalty units for failure to comply with a directive of the ERB	K30,000			

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Nan	ne of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach	
Alfa H	aulers Zambia Limited	7/3/2022	Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements for Road Tank Vehicles - Code of Practice 372	Licensee should be penalized 100,000 penalty units for failure to comply with a directive of the ERB	K30,000				7.1
Alfa Z	ambia Limited	7/3/2022	Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements for Road Tank Vehicles - Code of Practice 372	Licensee should be penalized 100,000 penalty units for failure to comply with a directive of the ERB	K30,000				A A State
Nguc	ha Enterprises Limited	7/3/2022	Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements for Road Tank Vehicles - Code of Practice 372	Licensee should be penalized 100,000 penalty units for failure to comply with a directive of the ERB	Acquital. Applicant submitted valid fire certificate				
Admire	e Energy Limited	7/3/2022	Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements for Road Tank Vehicles - Code of Practice 372	Licensee should be penalized 100,000 penalty units for failure to comply with a directive of the ERB	K30,000				
Qeigl Consti	ruction Limited	7/3/2022	Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements fo Road Tank Vehicles - Code of Practice 372	Licensee should be penalized 100,000 penalty units for failure to comply with a directive of the ERB	K30,000				

Name of Licensee Enforcement	Date of Enforcement	ſ	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
Blue Zebra Limited 7/3	7/3	/2022	Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements fo Road Tank Vehicles - Code of Practice 372	Licensee should be penalized 100,000 penalty units for failure to comply with a directive of the ERB	K30,000			
Uuba Transport Limited 7/3/2022	7/3/2022		Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements for Road Tank Vehicles - Code of Practice 372	Licensee should be penalized 100,000 penalty units for failure to comply with a directive of the ERB	K30,000			
Limited 7/3/2022	7/3/2022		Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements fo Road Tank Vehicles - Code of Practice 372	Licensee should be penalized 100,000 penalty units for failure to comply with a directive of the ERB	K30,000			
Mohab Transport 7/3/2022 Limited	7/3/2022		Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements for Road Tank Vehicles - Code of Practice 372	Licensee should be penalized 100,000 penalty units for failure to comply with a directive of the ERB	K30,000			
Petroda Zambia Limited	7/3/2022		Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements fo Road Tank Vehicles - Code of Practice 372	Licensee acquited as trucks found parked in breach of directive do not belong to Licensee	Acquital			

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BOARD BOARD

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ċ	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
	Shilili Investments Limited	24/06/2022	Failure to apply for renewal of their licence to transport petroleum products six months before expiry of their licence contrary to clause 7.1 of the conditions of the licence to transport petroleum products	Licensee be penalized 10,000 penalty units	K3,000			
N	Ordod Oil Company Limited	17/06/2022	Constructing an Energy Facility without a construction permit in Lusaka District	Offence compounded to 100,000 penalty units	K30,000			
υ	Auhad Investments Limited	29/06/2022	Failure to apply for renewal of their licence to transport petroleum products six months before expiry of their licence contrary to clause 7.1 of the conditions of the licence to transport petroleum products	Licensee be penalized 10,000 penalty units	K5,000			
4	Kasgon Energy Limited	1/7/2022	Failure to pay Licence fees owing to the ERB	Suspension of Licence	License Suspended			
ю	Luapula Energy Limited	1/7/2022	Failure to pay Licence fees owing to the ERB	Suspension of Licence	License Suspended			
6	Ravasia Motors Limited	1/7/2022	Failure to pay License fees owing to the ERB	Suspension of Licence	License Suspended			
~	Qeight Trading and Construction Limited	4/8/2022	Failure to apply for renewal of their licence to transport petroleum products six months before expiry of their licence contrary to clause 7.1 of the conditions of the licence to transport petroleum products	Licensee be penalized 6,667 penalty units	K3,000			

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ENERGY SECTOR REPORT 2022

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·	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
8	Climax Car Centre Limited	11/8/2022	Failure to apply for renewal of their licence to transport petroleum products six months before expiry of their licence contrary to clause 7.1 of the conditions of the licence to transport petroleum products	Licensee be penalized 23,333.33 penalty units	K7,000			
6	Delta Energy Limited	20/8/2022	Establishing an enterprise contrary to section 10 of the Energy Regulation Act	TBA				
9	Lake Gas Zambia Limited	25/9/2022	Engaging in the retail of LPG without a Retail Licence from the ERB contrary to Section 10 of the Energy Regulation Act No. 12 of 2019	Offence compounded to 200,000 penalty units	K60,000			
	Sonde Holdings Limited	4/8/2022	Operating seven road Tank vehicles not set fourth in the authorized schedule of their Licence contrary to caluse 2.1.1 of their Licence conditions.	Licensee Reprimanded for failure to comply with Licence condition and directed to cease operating unlicensed tankers until the ERB makes a decision on the request for change of combination				
2	Masdav Petroleum Limited	4/8/2022	Failure to pay K 349, 393.64 in unpaid licence fees, fuel marking fees and strategic reserve fund.	licensee was offered a Time to Pay Agreement for three months effective 10th August, 2022 and in the event that the licensee failed to pay as per the Time to Pay Agreement the ERB would suspend the licence.				
е	Safe Energy Limited	4/8/2022	Failure to pay K 37,645.41 in unpaid Fuel Marking Fees.	Matter was closed as Safe Energy had liquidated their debt on the 5th August, 2022.				
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ċ	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
4	Sun Gas Limited	4/8/2022	Failure to pay K 448,895.80 in unpaid Fuel Marking Fees, Licence Fees and Strategic Reserve Fund fees.	recommended that the Licensee be given upto the end of August to settle the outstanding balance				
22	Dana Oil Corporation	4/8/2022	Failure to pay K 8,433.00 in unpaid Strategic Reserve Fund fees.	Matter be closed as the licensee had already settled the debt.	Acquitted			
Q	Gojestic Energy Limited	4/8/2022	Failure to pay K 59,228.43 in unpaid Fuel Marking Fees, Licence Fees and Strategic Reserve Fund fees.	Licensee be written to and provide guidance on how the overpayment would be treated as requested by the licensee in order to allow the licensee to make further payment.				
N-	Techzone Limited	4/8/2022	Failure to pay K 195,556.52 in unpaid Strategic Reserve Fund fees.	It was recommended that the licensee be allowed to submit documentary evidence of the amount being liquidated.				
<u></u>	Dizab Zambia Limited	4/8/2022	Failure to pay K 159,106.81 in unpaid Fuel Marking Fees, Licence Fees and Strategic Reserve Fund fees.	Finance Department confirmed having received the amount owed and recommended that the matter be closed.				
୦	Zengamina Limited	4/8/2022	Failure to pay Licence Fees	Recommended that Zangamina be offered a Time to Pay Agreement to liquidate the amount owed in three equal installments.				
0	United Metro Energy Limited	4/8/2022	Failure to pay Licence fees	Recommended that the Licence be suspended				

ENERGY SECTOR REPORT 2022

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<u>.</u>	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
<u>.</u>	Caliber Energy Limited	4/8/2022	Failure to pay Licence fees	Recommended that the Licence be suspended				
22	Captec Limited	4/8/2022	Failure to Pay Licence fees	Matter closed as Licensee already paid the fees on 16th June, 2022				
613	Crown Energy Limited	4/8/2022	Failure to Pay Licence fees	Matter closed as Licensee already paid the fees on 14th June, 2022				
40	TBS Limited	4/8/2022	Failure to Pay Licence fees	Recommended that the Licence be suspended				
55	Cashfin Limited	4/8/2022	Failure to Pay Licence fees	Finance Department recommended to reconcile figures				
20	Marianesh Limited	4/8/2022	Failure to Pay Licence fees	Recommended that the Licence be suspended				
22	Hamdi Investment Limited	4/8/2022	Failure to Pay Licence fees	Finance Department reconciles the figures with Hamdi.				
80	Mount Meru Petroleum Zambia Limited	26/10/2022	Contravened section 10 of the Energy Regulation Act	TBA				
60	Chingases Company Limited	26/10/2022	Contravened section 10 of the Energy Regulation Act	TBA				
30	Unicorn Logistics Limited	26/10/2022	Contravened section 10 of the Energy Regulation Act	TBA				

ENERGY SECTOR REPORT 2022

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ġ	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
<u>10</u>	Deepak Gas Services Limited	26/10/2022	Contravened section 10 of the Energy Regulation Act	TBA				
62	Rajvi Logistics Limited	31/10/2022	Licensee did not submit comprehensive incident report within 7 days of the occurrence of the accident involving Tanker in line with clause 2.1.4 (c) of the licence to transport petroleum products	TBA				
03	TotalEnergies Limited	25/11/2022	Licensee contravened clause 2.5 of their Licence to Retail Petroleum Products by hoarding fuel at Total Energies Chingola Service Station	Licensee Penalized 100,000 penalty units in line with clause 10 of Appendix I of the Enforcement Manual				
64	Oryx Energies Limited	25/11/2022	Licensee contravened clause 2.5 of their Licence to Retail Petroleum Products by hoarding fuel at Kwacha Service Station in Kitwe	Licensee Penalized 100,000 penalty units in line with clause 10 of Appendix I of the Enforcement Manual				
05	Mount Meru Petroleum Zambia Limited	25/11/2022	 Licensee breached conditions of their licence to Distribute, Import and Export Petroleum Products by delivering fuel to an unlicensed entity; Breached clause 3.1.2 of their licence to Retail Petroleum Products for failure to promptly inform the ERB of the incident within 24 hours and clause 9.2 of ZS 385 part 5 for failure to consistently follow procedures prior to offloading at a service station. 	Licensee penalized 150,000 penalty units and a reprimand in line with clause 44 of Appendix I of the Enforcement Manual				

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No.	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
66	Rubis Energy Limited	25/11/2022	Licensee contravened clause 2.5 of their Licence to Retail Petroleum Products by hoarding fuel at Rubis Chingola Service Station	Licensee Penalized 100,000 penalty units in line with clause 10 of Appendix I of the Enforcement Manual				
67	Puma Energy Limited	25/11/2022	Licensee contravened clause 4.8.3.2 of ZS 385 Part 5 by refueling into a metallic drum inside a vehicle at Puma Chainama Service Station	Licensee penalized 80,000 penalty units in line with clause 43 of Appendix I of the Enforcement Manual				
08	Surya Energy Limited	25/11/2022	Contravened conditions of their licence to Distribute, Import and Export petroleum products by delivering fuel to an unlicensed entity contrary to clause 2.1	Licensee penalized 100,000 penalty units in line with clause 10 of Appendix I of the Enforcement Manual				
69	Karan Investments Zambia Limited	25/11/2022	Licensee breached clause 3.1.1 of their retail licence by commencing operations at Zambezi-Kasangula Road Service Station without approval by the ERB	Licensee Acquited as Breach was dealt with in Technical Hearing	Acquitted			
02	Vivo Energy Zambia Limited	25/11/2022	 Licensee contravened clause 4.8.3.2 of ZS 385 Part 5 by refueling into a metallic drum inside a vehicle at Puma Chainama Service Station Breached clause 3.6.4 of their licence to retail petroleum products by retailing petroleum products at old pump price at their Kasama Road Service Station in Lusaka 	 Licensee penalized 80,000 penalty units in line with clause 43 of Appendix I of the Enforcement Manual 2. Licensee penalized 100,000 penalty units and a reprimand in line with clause 44 of Appendix I of the Enforcement Manual 				

4 th Breach				
3 rd Breach				
2 nd Breach				
1 st Breach				
Decision of the ERB	Licensee penalized 100,000 penalty units for failure to comply with a directive of the ERB	Licensee penalized 66,667 penalty units for breach of any other conditions of their licence	Licensee penalized 66,667 penalty units for breach of any other conditions of their licence	
Nature of breach	Parking of road tank vehicles in undesignated areas contrary to clause 6.4.2 (b) and (c) ZS Transportation of Petroleum Products : Operational Requirements for Road Tank Vehicles - Code of Practice 372	 breach of clause 2.2 of the conditions of their retail licence by refuelling two (2) buses with passengers on board at Broadway Service station in Ndola 	The licensee disregarded a directive of the ERB to submit two (2) copies of the revised site layout duly approved by the Local planning authority prior to commencement of any construction works	Breached clause 7.1 of the conditions of the licence for the transportation of petroleum products which states: "The License shall be valid for a period of three (3) years from the licence effective date. The licence shall be subject to renewal on application by the Licensee made at least six (6) months before the date of the expiry of the licence on the same conditions or on such conditions as the ERB shall prescribe."
Date of Enforcement	25/11/2022	25/11/2022	25/11/2022	5/12/2022
Name of Licensee	SGC Investments Limited	Lake Petroleum Limited	Oasis Oil Zambia Limited	Independence Service Station Limited
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V	Name of Licensee	Date of Enforcement	Nature of breach	Decision of the ERB	1 st Breach	2 nd Breach	3 rd Breach	4 th Breach
75	Oryx Energies Limited	2/12/2022	breach of clause 2.2.2 of the conditions of licence to distribute, import and export petroleum products which provide: "The Licensee or its agents shall only offload petroleum products relating to the distribution and importation activity at premises licensed by the ERB"					
76	Estim Construction Zambia Limited	2/12/2022	Installation of energy facility without a licence from the ERB contrary to section 10 of the Energy Regulation Act	Request to Compound offence sent to DPP pursuant to section 51 of the Act				





Annex 1: Petroleum supply chain – Petroleum sub-sector reforms





Annex 2: Zambia's installed electricity generation capacity, 2022

Licensee's Name	Station	Technology	Installed Capacity (MW)
	Kafue Gorge	Hydro	990
	Kariba North Bank	Hydro	720
	Victoria Falls	Hydro	108
	Lunzua	Hydro	14.8
ZESCO Limited	Lusiwasi	hydro	12
	Lusiwasi Upper	Hydro	15
	Shiwangá ndu	Hydro	1
	Chishimba Falls	Hydro	6
	Musonda Falls	Hydro	10
Kariba North Bank Extension Power Corporation (ZESCO's SPV)	Kariba North Bank Extension	Hydro	360
Kafue Gorge Lower Power Development Corporation (ZESCO's SPV)	Kafue Gorge Lower	Hydro	750
Itezhi-Tezhi Power Corporation	Itezhi-Tezhi	Hydro	120
	Mulungushi	Hydro	32
	Lunsemfwa	Hydro	24
Rural Electrification Authority	Kasanjiku (off-grid)	Hyrdo	0.640
Total hydro electricity generation instal	led capacity		3,163.44
Maamba Collieries Limited	Maamba	Thermal	300
Dangote Cement Zambia Limited	Dangote	Thermal	30
Total coal thermal electricity generation	n installed capacity		330
Ndola Energy Company Limited		HFO	110
Total HFO electricity generation installe	ed capacity		110
Bangweulu Power Company	LSMEFZ	Solar	54
Ngonye Power Company	LSMEFZ	Solar	34
Muhanya Solar Limited	Sinda Village (off-grid)	Solar	0.03
Copperbelt Energy Corporation	Riverside-Kitwe	Solar	1
Solera Power	Luangwa Bridge(off-grid)	Solar	0.01
	Ngwerere (off-grid)	Solar	0.01
Standard Micro Grid	Mugurameno-Chirundu (off-grid)	Solar	0.01
Total Solar Electricity generation instal	led capacity		89.06
	Shangómbo (off-grid)	Diesel	1.6
ZESCO Limited	Chama (off-grid)	Diesel	1.45
	Lundazi (off-grid)	Diesel	1.75
	Luano (Emergency Plant)	Diesel	40
	Bancroft (Emergency Plant)	Diesel	20
Copperbelt Energy Corporation	Kankoyo (Emergency Plant)	Diesel	10
	Maclaren(Emergency Plant)	Diesel	10
Total diesel electricity installed generation	tion capacity		84.8
Total on-grid installed electricity generation	capacity		3,771.8
Total off-grid (mini-grid) installed electricity of	generation capacity		5.50
Total Electricity Generation Installed C	apacity		3,777.3



Annex 3: Structure of Electricity Supply Industry in Zambia

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The ERB uses the Revenue Requirement Methodology otherwise known as the Cost of Service methodology in its tariff determination process. Revenue Requirement means the revenue that a regulated utility needs to earn in a test year in order to provide adequate service to its customers and earn a fair return for its shareholders. Typical formula of RR is as presented as follows:

$RR = O + D + T + r^*RB$

Where;

RR = Revenue Requirement;

OMA = Operating Expenses, maintenance and administration expense;

D = Depreciation and amortization expense;

- T = Income Tax Expenses;
- r = allowed rate of return on Rate Base (Fixed Asset plus working Capital);

RB = rate base (or regulatory asset base - RAB = (OC - AD);

OC = original cost of assets when placed in service;

AD = accumulated depreciation on assets since placed in service; and

*R***RB* = return on rate base or cost of capital;

In reviewing tariff applications, the ERB's use of the RR methodology is also premised on the following key regulatory principles:

- *i.* Recovery of prudently incurred costs by the Utility only just and reasonable costs incurred wholly and exclusively for the provision of electricity are allowed in the tariff determination process ;
- *ii.* Recognition of used and useful Utility assets only assets currently used by the utility to provide electricity to its customers are included in the Rate Base;
- *iii.* Financial sustainability of the Utility the applicable tariffs should enable the utility cover both capital and operational costs as well as earn a reasonable return;
- *iv.* The need to attain cost reflective tariffs the Government's National Energy Policy (NEP) advocates for cost reflective pricing of all energy services;
- v. Delivery of quality service tariff increases must be accompanied by noticeable improvements in the quality of services provided; and
- vi. Social considerations for the indigent customers accessibility and affordability for the poor (R1 as proxy for lifeline tariff).

The above are internationally accepted tariff determination principles.



Annex 5: ERB licensing process flow chart



Annex 6: ZESCO's approved Tariff Schedule, 2023 to 2027

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		Current		ERB A	pproved Ta	riffs (K/kW	(
Customer Category	Tariff	Tariffs (K/kWh)	2023	2024	2025	2026	2027
1. METERED RESIDENTIAL TARIFFS [Capacity up to 15KV	AJ						
R1-Consumption up to 100kWh	Energy Charge/kWh	0.47	0.40	0.44	0.54	0.63	0.73
R2-Consumption above 100 to 300kWh	Energy Charge/kWh	0.85	0.95	1.05	1.28	1.50	1.76
R3-Consumption above 300 to 500kWh	Energy Charge/kWh	1.94	1.54	1.69	2.07	2.42	2.83
R4- Consumption above 500kWh	Energy Charge/kWh	N/A	2.22	2.44	3.23	3.45	4.04
2. COMMERCIAL TARIFFS (Capacity up to 15KVA)							
C1-Consumption up to 100kWh	Energy Charge/kWh	1.07	0.67	0.78	0.92	0.98	1.05
C2- Consumption above 100 to 300kWh	Energy Charge/kWh	1.85	1.15	1.35	1.58	1.69	1.81
C3-Consumption above 300 to 500kWh	Energy Charge/kWh	N/A	1.99	2.19	2.52	2.65	2.78
C4-Consumption above 500kWh	Energy Charge/kWh	N/A	2.26	2.28	2.39	2.51	2.63
3. SOCIAL SERVICES TARIFFS (Schools, Hospitals, street I	lighting)						
S1- Consumption up to 100kWh	Energy Charge/kWh	1.19	0.62	0.69	0.76	0.81	0.87
S2- Consumption above 100 to 300kWh	Energy Charge/kWh		0.94	1.04	1.15	1.23	1.32
S3- Consumption above 300 to 500kWh	Energy Charge/kWh		1.00	1.11	1.22	1.31	1.40
S4- Consumption above 500kWh	Energy Charge/kWh		1.13	1.25	1.38	1.48	1.59
	Fixed Monthly Charge	83.84			Abolish	pe	

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Customer CategoryTatiffTatiffTatiffTatiffTatiffCosa20244. WATER PUMPING STATIONS \mathbf{F}_{WATER}						(
4. WATER PUMPING STATIONS FNERgy Charge/WhIII $M1$ - Consumption up to 12,000kMhEnergy Charge/Wh 0.50 0.56 $M2$ - Consumption above 12,000 to 50,000kMhEnergy Charge/Wh 1.01 1.13 $M3$ - Consumption above 50,000 to 100,000kWhEnergy Charge/Wh 1.01 1.13 $M4$ - Consumption above 100,000kWhEnergy Charge/Wh 1.01 1.13 $M4$ - Consumption above 100,000kWhEnergy Charge/Wh 1.52 1.72 $M4$ - Consumption above 100,000kWhEnergy Charge/Wh 1.53 1.72 $M4$ - Consumption above 100,000kWhEnergy Charge/Wh 1.53 1.72 $M2$ - Consumption above 100,000kWhEnergy Charge/Wh 1.53 1.72 $M2$ - Consumption above 100,000kWhEnergy Charge/Wh 0.54 0.62 $M2$ - Consumption above 100,000kWhEnergy Charge/Wh 0.54 0.62 $M2$ - Consumption above 100,000kWh $M2$ -Charge/Wh 0.62 0.62 $M2$ - Consumption above 100,000kWhEnergy Charge/Wh 0.64 0.62 $M2$ - Consumption above 100,000kWhEnergy Charge/Wh 0.64 0.62 $M2$ - Consumption above 100,000kWhMD Charge/Wh 0.64 0.62 0.62 $M2$ - Consumption above 100,000kWhMD Charge/Wh 0.64 0.74 0.64 $M2$ - Consumption above 100,000kWhEnergy Charge/Wh 0.64 0.74 0.64 $M2$ - Consumption above 100 aboveMD Charge/Wh 0.64 0.74 0.64 $M2$ - Consumption aboveEnergy Charge/W	Tariffs (K/kWh)	2023	2024	2025	2026	2027
W1- Consumption up to 12,000kWhEnergy Charge/kWh0.500.56 $M2$ - Consumption above 12,000 to 50,000kWhEnergy Charge/kWh0.570.65 $M3$ - Consumption above 50,000 to 100,000kWhEnergy Charge/kWh1.101.13 $M3$ - Consumption above 50,000 to 100,000kWhEnergy Charge/kWh1.531.72 $M3$ - Consumption above 50,000 to 100,000kWhEnergy Charge/kWh1.531.73 $M4$ - Consumption above 100,000kWhEnergy Charge/kWh2.1532.508 $M4$ - Consumption above 100,000kWhEnergy Charge/kWh2.1632.54.8 $M4$ - Consumption above 100,000kWhMD Charge/kWh0.540.62 $M4$ - Consumption above 100,000kWhMD Charge/kWh0.540.62 $M4$ - Consumption to Retail customersMD Charge/KWh0.640.62 $M2$ - Maximum DEMAND TARIFESMD Charge/KWh0.610.740.61 $M1$ - Capacity from 16 to 300KVAMD Charge/KWh0.610.740.61 $M1$ - Capacity from 16 to 300KVAEnergy Charge/KWh0.610.740.61 $M1$ - Capacity from 16 to 300KVAEnergy Charge/KWh0.610.740.61 $M1$ - Capacity from 16 to 300KVAEnergy Charge/KWh0.610.740.74 $M1$ - Capacity from 16 to 300KVAEnergy Charge/KWH0.610.740.74 $M1$ - Capacity from 16 to 300KVAEnergy Charge/KWH0.610.740.74 $M1$ - Capacity from 16 to 300KVAEnergy Charge/KWH0.740.740.74 $M1$ - Capacity from 16 to 300KV						
W2 - Consumption above 12,000 to 50,000kWhEnergy Charge/kWh 0.57 0.65 0.65 $W3$ - Consumption above 50,000 to 100,000kWhEnergy Charge/kWh 1.01 1.13 $W4$ - Consumption above 100,000kWhEnergy Charge/kWh 1.53 1.73 $W4$ - Consumption above 100,000kWhEnergy Charge/kWh 1.53 1.73 $W4$ - Consumption above 100,000kWhEnergy Charge/kWh 1.53 1.73 $W4$ - Consumption above 100,000kWhEnergy Charge/kWh 2.163 $2.50.8$ $W4$ - Consumption above 100,000kWh $2.18.7$ $2.50.8$ $2.54.8$ $W1$ - Consumption above 100,000kWh $2.18.7$ $2.50.8$ $2.54.8$ $W1$ - Consumption above 100,000kWh $2.18.7$ $2.50.8$ $2.54.8$ $W2$ - Consumption above 100,000kWh $2.18.7$ $2.50.8$ $2.54.8$ $W1$ - Consumption above 100,000kWh $2.19.7$ $2.59.8$ $2.54.8$ $W1$ - Consumption above 100,000kWh 0.61 0.61 0.61 $W2$ - Consumption above 100,000kWh 0.61 0.61 0.61 $W1$ - Consumption above 100,000kWh 0.61 0.74 0.81 $W1$ - Consumption above 100,000kWh 0.61 0.74 0.81 $W2$ - Consumption above 100,000kWh 0.61 0.74 0.81 $W1$ - Consumption above 100,000kWh 0.61 0.74 0.81 $W2$ - Consumption above 100,000kWh 0.61 0.74 0.81 $W2$ - Consumption above 100,000kWh 0.61 0.74 0.81 $W1$ - Consumption above 100,000kW		0.50	0.56	0.60	0.65	0.70
W3 - Consumption above 50,000 to 100,000k/hEnergy Charge/k/h1.011.011.13 $W4$ - Consumption above 100,000k/hEnergy Charge/k/h 1.53 1.73 1.72 $W4$ - Consumption above 100,000k/hEnergy Charge/k/h 1.53 1.73 1.72 E DISTRIBUTION TARIFS M 1.67 1.63 2.618 2.618 E DISTRIBUTION TARIFS M M $2.18.73$ $2.50.8$ $2.54.8$ $Purchasers of power for distribution to Retail customersMD2.18.732.50.82.54.8Purchasers of power for distribution to Retail customersMD2.18.732.50.82.54.8Purchasers of power for distribution to Retail customersMD2.18.732.50.82.54.8Purchasers of power for distribution to Retail customersMD2.18.732.50.82.52.8MM$		0.57	0.65	0.76	0.81	0.88
W4 - Consumption above 100,000kWhEnergy Charge/kWhI.531.531.72 5. Distribution by Explorition to Betail customers MD Charge/KVAMonth218.73250.8254.8Purchasers of power for distribution to Retail customersMD Charge/KVAMonth218.73250.8254.8Purchasers of power for distribution to Retail customersMD Charge/KVAMonth0.540.620.63Purchasers of power for distribution to Retail customersEnergy Charge/KVM0.540.620.63MD Charge/KVMMD Charge/KVM0.540.740.610.74VD1-Capacity from 16 to 300KVAMD Charge/KVM0.610.740.81VD1-Capacity from 16 to 300KVAEnergy Charge/KVM0.610.740.81Charge/KVMOff Peak MD Charge/KVM21.3925.9827.62		1.01	1.13	1.21	1.30	1.41
5. Distribution behavior $(1, 1, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,$		1.53	1.72	1.84	1.97	2.15
6. DISTRIBUTION TARIFS \cdot \cdot \cdot \cdot \cdot \cdot Purchasers of power for distribution to Retail customersMD Charge/KVMMonth 218.73 250.8 254.8 Purchasers of power for distribution to Retail customersEnergy Charge/KVM 0.64 0.62 0.63 MD Charge/KVM 0.54 0.62 0.63 MD Charge/KVMMonth 42.79 51.96 55.23 VD1-Capacity from 16 to 300KVA $MD Charge/KVA/Month$ 42.79 51.96 55.23 Fired Monthy Charge 19.02 50.882 548 Off Peak MD Charge/KVM 21.39 25.98 27.62						
Durchasers of power for distribution to Retail customersMD Charge/KVMMonth 218.73 250.8 254.8 Rereption to Retain the Name of						
Energy Charge/kWh 0.54 0.62 0.63 6. MAXIMUNEMAND TARIFS	218.73	250.8	254.8	258.2	261.7	268.5
6. MAXIMUM DEMAND TARIFS M Charge/KVA/Month 1 1 1 MD1-Capacity from 16 to 300K/A M D Charge/KVA/Month 42.79 51.96 55.23 MD1-Capacity from 16 to 300K/A Energy Charge/KVA/Month 0.61 0.74 0.81 Fixed Monthly Charge/KVA/ 0.61 0.74 0.81 0.81 Monthly Charge/KVA/ 21.39 25.98 27.62	0.54	0.62	0.63	0.64	0.65	0.66
MD1-Capacity from 16 to 300KVA MD Charge/KVA/Month 42.79 51.96 55.23 MD1-Capacity from 16 to 300KVA Energy Charge/KVH 0.61 0.74 0.81 Fixed Monthly Charge 419.02 508.82 548 Monthly Off Peak MD Charge/KVA 21.39 25.98 27.62						
Energy Charge/kWh 0.61 0.74 0.81 Fixed Monthly Charge 419.02 508.82 548 Off Peak MD Charge/KVA/ 21.39 25.98 27.62	42.79	51.96	55.23	60.2	65.62	71.53
Fixed Monthly Charge 419.02 508.82 548 Off Peak MD Charge/KVA/ 21.39 25.98 27.62	0.61	0.74	0.81	0.88	0.96	1.05
Off Peak MD Charge/KVA/ 21.39 25.98 27.62 Month	419.02	508.82	548	597.32	651.07	709.67
	/ 21.39	25.98	27.62	30.1	32.81	35.76
Off Peak Energy Charge/ 0.46 0.56 0.61 KWh	0.46	0.56	0.61	0.66	0.72	0.79
Peak MD Charge/KVA/ 53.48 64.95 69.04 Month 53.48	53.48	64.95	69.04	75.26	82.03	89.41
Peak Energy Charge/kWh 0.77 0.93 1.01	0.77	0.93	1.01	1.10	1.20	1.31
MD2-Capacity from 301KVA to 2,000KVA MDC harge/KVA/Month 80.03 97.18 106.22	80.03	97.18	106.22	115.78	126.2	137.56
Energy Charge/kWh 0.53 0.64 0.70	0.53	0.64	0.70	0.77	0.84	0.91

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	:	Current		ERB A	pproved Ta	riffs (K/kWI	(
Customer Category	Tariff	Tariffs (K/kWh)	2023	2024	2025	2026	2027
	Fixed Monthly Charge	837.97	1,017.55	1,112.18	1,212.28	1,312.38	1,440.31
	Off Peak MD Charge/KVA/ Month	40.01	48.59	53.11	57.89	63.1	68.78
	Off Peak Energy Charge/ kWh	0.39	0.48	0.53	0.58	0.63	0.68
	Peak MD Charge/KVA/ Month	100.03	121.48	132.77	144.72	157.75	171.95
	Peak Energy Charge/kWh	0.66	0.80	0.88	0.96	1.04	1.14
MD3-Capacity from 2,000KVA to 5,000KVA	MD Charge/KVA/Month	126.39	295.33	319.84	364.62	390.15	429.16
	Energy Charge/kWh	0.43	1.00	1.09	1.24	1.33	1.46
	Fixed Monthly Charge	1,755.17	3,397.77	3,815.70	4,349.89	4,654.39	5,119.82
	Off Peak MD Charge/KVA/ Month	63.2	147.67	159.92	182.31	195.07	214.58
	Off Peak Energy Charge/ kWh	0.32	0.75	0.82	0.93	1.00	1.1
	Peak MD Charge/KVA/ Month	157.99	369.16	399.8	455.78	487.68	536.45
	Peak Energy Charge/kWh	0.54	1.26	1.36	1.55	1.66	1.83
MD4-Capacity >5,000KVA							
			This cateo	jory has bee	n migrated t	o Power Sup	oply Agreements
NOTE:							
The above tariffs are:							

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		Current		ERB A	pproved Ta	riffs (K/kWh	(
Customer Category	Tariff	Tariffs (K/kWh)	2023	2024	2025	2026	2027
(1)Exclusive of 3% Government excise duty							
(2)Exclusive of 16% Value Added Tax (VAT)							

Note: Tariff Decision can be accessed at the ERB website: www.erb.org.zm



Annex 7: ZESCO's KPI for the year, 2020 - 2022

Ampender

No.	Thematic areas	Sub indicators	Rationale	Proposed Weight
1)	New Customer connections	Maintain Ratio of paid up quotations to new connections at 1:2 Connect all new standard applications within 20 days from the date of payment of the quotation Connect all new non-standard application within 60 days from the date of payment Issue quotations for new applications of all connection types within 10 days from date of application	The KPI has been selected due to the increasing delays in customer connections, this will also assist ZESCO comply with the Electricity Supply and Quality of Consumer Service as per ZS 397	10%
নি	Efficiency	Cost Management (monitoring only) Operating Cost of electricity per MWh (excluding Depreciation) Capacity costs - Indicator of costs of peak - consumption Cost per kW of installed capacity Operating cost per megawatt installed Asset Reliability Maintain Replacement of Distribution transformers as % of Installed Transformers at 0.1% of total number of transformers in operation Capacity Maintain Replacement of meters as % of installed meters at 0.25% of the total number of meters. Debtor Days Reduce export debtor days to not more than 60 days Reduce domestic debtor days to not more than 60, and Reduce domestic debtor days to not more than 90. System losses Maintain Transmission losses at 6% or less; and Maintain distribution Losses at 12% or better per quarter.	To assist ZESCO in becoming efficient with regards to system losses, cost management, customer debt collections and payments to suppliers, through this KPI the ERB will also monitor ZESCO's asset reliability.	25%
ଚ	Staff productivity	Number Generation staff to total energy generated per generation station Maintain one (1) Technical Transmission staff per seven (7) kilometer of transmission line Mzintain one (1) Technical Distribution Staff per 10 kilometres of distribution line Maintain one (1) Distribution Staff per 120 customers Maintain one (1) Distribution Staff per 120 customers Maintain 30 percent Staff Costs as proportion of total O&M Costs (<i>Excluding. Dep and Purchases from IPPs</i>) Ratio of technical to non-technical staff	To encourage staff productivity at generation, transmission and distribution level. The KPI will also assist benchmark ZESCO's staff productivity to best international practice and monitor the deployment of its staff especially those that are directly involved in the operations and maintenance of the infrastructure used in the generation, transmission and distribution.	7.5%

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<u>.</u>	Thematic areas	Sub indicators	Rationale	Proposed Weight
4)	Quality of Service	Maintain the Dry Season (DS) System Average Interruption Duration Index (SAIDI) at 27 hours or less and Wet Season (WS)-SAIDI at 36 hours or less; Maintain the DS System Average Interruption Frequency Index (SAIFI) of 5 times or less and WS-SAIFI 5.5 times or less; Maintain the DS-Customer Average Interruption Duration Index (CAIDI) at 5 hours or less and WS-CAIDI at 7 hours or less; and Maintain the Average System Availability Index (ASA) at 90% or better.	To encourage ZESCO improve its quality of service through the eduction of outage duration and its frequency	20%
5)	Power Quality	Install 123 power quality meters by 2021 Maintain the power quality at a minimum of 70% in 2020 and 75% and above beyond 2021 for monitored sites	To ensure ZESCO improves power quality in accordance with the ZS 387 (Electricity Supply – Power Quality & Reliability)	2.5%
(9	Power Generation	Plant Capacity Factor for each generation plant (monitoring) Maintain the Unit Capability Factor (UCF) for large hydro plants at 80% or better. Maintain the UCF for Mini hydro plants at 60% or better per quarter. Planned Loss factor Unplanned Loss factor	To monitor the efficiency of ZESCO's power generation plants and encourage utilization at full capacity subject to availability of water.	5%
4	Safety	Maintain Zero fatality per quarter Maintain Zero Life Threatening Injuries (LTI) per quarter. Number of high potential Misses per employee (monitoring) Recordable Case Incident Severity Index (monitoring)	To ensure that ZESCO maintains higher safety standards for its employees and the general public	10%
8	Customer Service	Maintain outage complaints resolution rate at 90% Maintain Non-Outage complaints resolution rate at 87% Resolve outage complaints within 24 hours from the date the complaint is logged Resolve Non-outage complaints within 30 days from the date the complaint is logged Call centre answer speed (Percentage of calls answered within 30 seconds) – monitoring	To improve service delivery by ensuring that customer complaints are attended to and resolved in good time in accordance with ZS 397	2%
6	Meter maintenance and reading	Replacement of faulty Meters must be done within 3 days after a complaint is lodged Maintain time lag between meter reading and bill dispatch of not exceeding 14 days	To ensure faulty meters are replaced as soon as possible to essen inconvenience to the affected customers. Also to ensure bills are dispatched in good time to reduce debt age	5%



Weight		alth Liquidity, solvent and 10%
	rrage ZESCO to maintain a health Liquidity, solviability and sustainability.	
To encourage ZE financial viability	ie (monitoring) f 60%	
iquidity Maintain Current Ratio of one (1) and above Maintain Quick ratio of 0.5 or above Profitability (monitoring) Calculation of a ROCE Calculation of Gross profit margin Calculation of Net profit margin Calculation of the Asset turnover ratio Solvency	Maintain Debt to Equity ratio of 2 or above Maintain Debt ratio of 1 or above Maintain interest coverage ratio of 1 or more Sustainability Average capital expenditure to net asset value Maintain Total O&M Cost to Revenue ratio of	
	Financial KPIs	Total
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