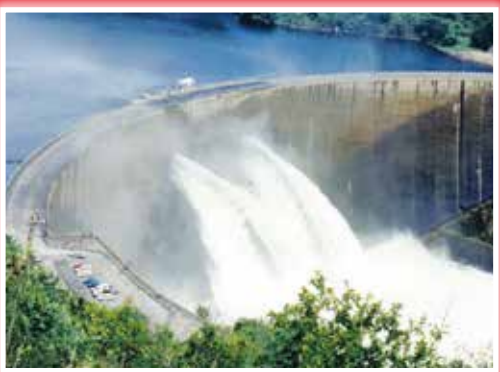
ENERGY
REGULATION
BOARD



ENERGY
SECTOR REPORT

2020


VISION

A proactive, firm and fair energy regulator

MISSION STATEMENT

To regulate the energy sector in order to ensure efficient provision of reliable and quality energy services and products

OUR MOTTO

“We safeguard your interests”

CORE VALUES

1. Integrity
2. Excellence
3. Team Work
4. Transparency
5. Predictability
6. Accountability.

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ABBREVIATIONS

AfDB	African Development Bank
BOZ	Bank of Zambia
BSA	Bulk Supply Agreement
CEC	Copperbelt Energy Corporation Plc
CoSS	Cost of Service Study
COVID-19	Corona Virus Disease
EF	Energy Fund
EIA	Energy Information Agency
ERB	Energy Regulation Board
ESR	Energy Sector Report
ESI	Electricity Supply Industry
EU	European Union
GETFiT	Global Energy Transfer Feed in Tariff
GRZ	Government of the Republic of Zambia
HFO	Heavy Fuel Oil
IAREP	International Access to Renewable Energy Programme
IDC	Industrial Development Corporation
IMF	International Monetary Fund
INDENI	INDENI Petroleum Refinery Company Limited
IPP	Independent Power Producer
IFC	International Finance Corporation
KNB	Kariba North Bank
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
MD	Maximum Demand
MoE	Ministry of Energy
NECL	Ndola Energy Company Limited
NEP	National Energy Policy
NFT	Ndola Fuel Terminal
NWEC	North Western Energy Corporation Limited

OMC	Oil Marketing Company
OPEC	Organisation of the Petroleum Exporting Countries
PPA	Power Purchase Agreement
PQD	Power Quality Directives
PQMS	Power Quality Management System
PSA	Power Supply Agreement
SADC	Southern Africa Development Community
SAPP	Southern Africa Power Pool
UPP	Uniform Pump Price
TAZAMA	TAZAMA Pipelines Limited
THA	Tanzania Harbour Authority
TPPL	TAZAMA Petroleum Products Limited
ZABS	Zambia Bureau of Standards
ZEMA	Zambia Environmental Management Agency
ZSA	Zambia Statistics Agency
ZPL	Zengamina Power Company Limited
ZESCO	ZESCO Limited

UNITS OF MEASUREMENT

Bbl	Barrels of oil
GWh	Giga-Watt hour (1,000 MWh)
K	Zambian Kwacha
Km	Kilometre
kV	Kilo Volt
kVA	Kilo Volt Amperes (1,000 Volt Amps)
kW	Kilo Watt
kWh	Kilo Watt Hour
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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Ndola Energy Company Limited
North Western Energy Corporation Limited
Office for Promotion of Private Power Investment
Oil Marketing Companies
Road Transport and Safety Agency
Rural Electrification Authority
Southern African Power Pool
TAZAMA Pipelines Limited
TAZAMA Petroleum Products Limited
Zambia Atomic Energy
Zambia Statistics Agency
Zengamina Power Limited
ZESCO Limited

FOREWORD

Energy is without doubt the lifeblood of an economy that is because it is a driver towards economic growth. Therefore, security of supply in the provision of quality energy services and products is fundamental to economic growth and development. The Energy Regulation Board (ERB) is mandated to ensure that there is orderly development in the energy sector. That is done mainly through licensing, determination of prices and tariffs, compliance monitoring and enforcement, as well as dispute resolution.

The Energy Sector Report (ESR) is an annual publication of the ERB which focuses on providing knowledge to energy stakeholders about the structure and conduct of the energy sector including its yearly performance, challenges and outlook. Specific focus is on the petroleum, electricity and renewable energy sub-sectors.

In the petroleum sub-sector, the outbreak of COVID-19 in 2019 had a negative impact on petroleum demand as partial lockdown measures constrained movement of people and goods both internally and externally. Generally, consumption of all petroleum products declined except for diesel and Liquified Petroleum Gas (LPG). For example in the aviation subsector, the demand for Jet A-1 decreased by 42.9 percent in 2020 mainly due to the shut-down of airports for a period of five (5) months.

In line with the National Energy Policy of 2019, the ERB facilitated the management of the Energy Fund (EF)[1] which continued to be used to construct storage depots in various regions in Zambia. Specifically in 2020, the Mansa fuel depot was completed while construction works were underway for the Chipata depot.

In 2020, the Government imported three (3) cargoes of petroleum feedstock compared to seven (7) in 2019. The total quantity of petroleum feedstock for the three (3) cargoes was 295,916 MT compared to 704,657 MT in 2019 reflecting a reduction of 58 percent. To fill the gap, due to reduced feedstock imports, Government issued waivers to Oil Marketing Companies (OMCs) to import Petrol, Diesel and Heavy Fuel Oil (HFO) to meet the national fuel demand. The finished petroleum products were mainly imported from Beira in Mozambique and Dar-es-Salaam in Tanzania.

In the electricity sub-sector the dominance of hydropower generation puts the country at risk due to changes in climatic conditions like global warming, insufficient rainfall and drought. In 2020, the national installed electricity capacity increased to 3,011.23 MW from 2,981.31 MW in 2019, this was as a result of the successful integration of the Dangote Cement Zambia Coal fired thermal power plant to the National grid. Despite this, only 1,500 MW was available for generation capacity against a demand of 2,310 MW reflecting a shortfall of 810 MW. Consequently, the Utility undertook load management procedures to balance supply and demand of electricity.

In terms of investment in electricity generation, there was notable progress made in the construction of the 750 MW Kafue Gorge Lower (KGL) and 15 MW Lusiwasi hydro power plants that had reached 93 and 99 percent completion, respectively in 2020. This was in line with the Government's policy of expanding generation, transmission and distribution capacity. It was envisaged that both power plants would be commissioned in 2021 which will increase the installed capacity by 20.4 percent. According to the project developers, the delay in commissioning both plants was due to COVID-19 pandemic.

1 SRF is now fused into the Energy Fund

During the year, the Cost of Service Study (CoSS) progressed steadily with completion of key tasks such as the load forecast. The study completion date was however extended to August, 2021 from 31st March, 2021 owing to the travel and other restrictions imposed to curb the spread of the COVID-19 pandemic which affected the Consultant's movements causing delays in data collection and validation.

On the renewable energy front, during the period under review, the ERB finalized the development of the mini-grid regulatory framework. The framework consists of the legal, grid encroachment, economic regulations, and technical requirements. This significant milestone will ensure investment for the mini-grid developers.

In conclusion, it is my sincere hope that this edition of the ESR will provide useful information to the public on energy statistics and the state of the energy sector in Zambia. It is envisaged that the information contained in the 2020 ESR will be an invaluable reference document to industry stakeholders, academia, Government, the public and Non- Governmental Organisations (NGOs) as we strive to develop the energy sector and the economy together.

Langiwe Hope Lungu (Ms.)
Director General
July 2021

OVERVIEW OF THE ENERGY SECTOR IN ZAMBIA

The structure of the energy sector in Zambia is comprised of 3 sub-sectors namely; electricity, petroleum and renewable energy. The energy sector in Zambia is overseen by the Ministry of Energy that provides policy guidance.

In the electricity sub-sector, ZESCO is dominated by the vertically integrated company owned by the Government through the Industrial Development Corporation (IDC). It holds over 75 percent of installed generation capacity, transmission and distribution network in Zambia. Other key players include; Independent Power Producers (IPPs), Copperbelt Energy Corporation (CEC) and North- Western Energy Corporation (NWEC).

The petroleum sub-sector comprises of the following upstream players; TAZAMA Pipelines Limited (TAZAMA), INDENI Petroleum Refinery Company Limited (INDENI and Tanzania Petroleum Products Limited (TPPL). TAZAMA is responsible for pumping petroleum feedstock and ensuring receipt and storage of imported products in Government depots, while INDENI is responsible for processing petroleum feedstock into finished petroleum products. TPPL offers handling and storage facilities and the sale of processed petroleum products to downstream players. Downstream players comprise of OMCs, Retailers (Dealers) and Transporters who are mainly private owned. OMC's offer distribution services to consumers, dealers and Government. Dealers are responsible for providing petroleum retailing services to consumers while transporters offer transportation services of petroleum products to dealers and consumers.

The renewable energy sub-sector consists of wholesalers and retailers of renewable energy generating equipment, producers of bio-energy, solar mini-grids, utility scale solar power plants as well as small hydro power generators. With a mixture of potential sources of renewable energy, such as Zambia's abundant water resources for hydropower generation, (accounting for 85 percent of the country's total installed capacity), useful energy continues to be harnessed from renewable and carbon neutral sources like sunlight, with keen interest on generation from wind, biomass and geothermal heat being exhibited. The Government of the Republic of Zambia has continued to support the uptake of renewable energy by ensuring an enabling environment, resulting in a swell in investment within the RE sub-sector, with over 170 companies trading in renewable energy generating equipment and approximately ten mini-grids involved in generation of electricity from RE sources.

During the period under review, the ERB finalized the development of the mini-grid regulatory framework. The general principle followed by ERB in regulating Mini-Grids is that light-handed regulations should be applied and as the size increases heavy handed regulation is introduced. The rationale is to enhance the easy of doing business in the electricity sub-sector for private companies intending to invest in rural areas.

Currently, Zambia's energy sector is governed by the Energy Regulation Act No.12 of 2019 (Energy Regulation Act), the Electricity Act No.11 of 2019 (Electricity Act), the Petroleum Act chapter 435 of the Laws of Zambia (Petroleum Act) and the Rural Electrification Act No.20 of 2003 (Rural Electrification Act). The Energy Regulation Board is a statutory body established under the Energy Regulation Act of 1995, Chapter 436 of the Laws of Zambia which was repealed and replaced by the Energy Regulation Act No. 12 0f 2019. The Petroleum Act provides for the importation, conveyance and storage of petroleum products while the Electricity Act provides for the regulation of generation, transmission, distribution and supply of electricity. Meanwhile, the Rural Electrification Act established the Rural Electrification Authority (REA) to facilitate access of electricity to rural areas of Zambia.

As at 31st December 2020, Zambia's Gross Domestic Product (GDP) at current prices was estimated at K354.4 million with Electricity contributing to 2.6 percent share, as shown in the table.

Gross Value Added and Percentage Shares by Industry at Current prices 2019 - 2020[2]

Kind of Economic Activity	2019 (K' million)					2020 (K' million)					Percentage Shares
	Q1	Q2	Q3	Q4	Q1+Q2+Q3+Q4	Q1*	Q2*	Q3*	Q4**	Q1+Q2+Q3+Q4	(2020 Q4**)
Agriculture, forestry and fishing	2,396	2,079	1,604	2,516	8,595	2,168	2,173	2,081	3,262	9,684	3.3
Mining and quarrying	10,962	12,190	10,026	9,465	42,643	12,722	15,341	22,152	24,032	74,246	24.3
Manufacturing	4,506	5,049	5,707	5,136	20,397	5,296	5,627	7,339	7,423	25,684	7.5
Electricity	2,041	1,945	1,890	1,865	7,741	2,541	2,507	3,239	2,548	10,835	2.6
Water supply	268	307	310	313	1,199	314	327	336	342	1,318	0.3
Construction	7,207	7,656	8,791	9,349	33,003	7,440	9,162	11,121	11,654	39,377	11.8
Wholesale and retail trade	14,052	14,516	16,293	15,558	60,419	13,410	13,332	16,176	14,916	57,833	15.1
Transportation and storage	5,558	6,031	6,967	6,499	25,056	5,829	5,542	7,055	5,087	23,513	5.1
Accommodation and food services	770	874	988	872	3,503	710	383	553	789	2,435	0.8
Information and communication	1,585	1,846	2,075	2,148	7,653	2,296	2,509	2,612	2,844	10,261	2.9
Financial and insurance	4,829	5,228	5,383	5,885	21,324	7,168	7,599	6,978	6,971	28,715	7.1
Real estate activities	3,033	2,617	2,768	2,691	11,108	3,098	3,235	3,414	3,658	13,404	3.7
Professional, scientific and technical	465	547	509	656	2,177	483	409	415	501	1,808	0.5
Administrative and support service	337	368	323	302	1,330	267	284	262	365	1,179	0.4
Public administration and defense	2,792	3,007	3,232	3,749	12,780	3,286	3,373	3,376	4,065	14,100	4.1
Education	2,838	2,801	2,774	2,735	11,148	2,688	2,808	2,752	2,765	11,013	2.8
Human health	1,220	1,302	1,365	1,553	5,441	1,432	1,532	1,521	1,570	6,055	1.6
Arts, entertainment and recreation	118	267	401	216	1,002	98	49	75	92	313	0.1
Other service activities	347	462	153	154	1,116	73	197	121	234	625	0.2
Total Gross Value Added for the economy	**65,323**	**69,092**	**71,559**	**71,660**	**277,634**	**71,318**	**76,387**	**91,576**	**93,116**	**332,397**	**94.3**
Taxes less subsidies	5,244	5,469	6,180	5,922	22,815	5,104	5,074	6,157	5,677	22,013	5.7
Total for the economy, at market prices	**70,567**	**74,560**	**77,739**	**77,582**	**300,449**	**76,423**	**81,462**	**97,732**	**98,793**	**354,410**	**100**

[2] Zambia Statistics Agency – March, 2021 monthly bulletin

1.0 INTRODUCTION

Macro-economic Performance

In 2020, the world economy was estimated to shrink by 3.3 percent owing to the Covid-19 pandemic[3]. The impact of COVID-19 was both extensive and severe, including but not limited to health and an economic crisis characterized by financial market stress and a collapse in commodity prices[4]. The outbreak led to disruptions in supply chains, created uncertainties and significantly dampened near-term growth prospects. The measures taken by Governments globally to contain the pandemic severely constrained private consumption, travel, investment and trade resulting in the weaker global demand.

According to the International Monetary Fund (IMF), growth in the Sub-Saharan Africa region was projected to decline by 1.6 percent in 2020 recorded as the region's worst and first recession in 25 years[5]. The substantial downturn in economic activity was estimated to cost the region at least US$115 billion in output losses. This was in part caused by lower domestic consumption and investment brought on by containment measures to curb the spread of the pandemic. The Eastern and Southern African countries were hit hardest by the economic impacts of the pandemic partly because of the stronger output contractions in South Africa and Angola. Disruptions in the tourism industry and lockdowns caused substantial slowdowns in Ethiopia, Kenya, and the island nations. These effects were also evident in the Zambian tourism sector.

Zambia's GDP was projected to fall by 4.2 percent in 2020 from an initial estimated growth rate of 3.0 percent, owing to the effects of the COVID-19 outbreak. The projections were premised on forecasted poor performance of key economic sectors such as mining, energy, construction and manufacturing. In addition, service sectors including wholesale and retail trade, tourism, transport, and professional services were all expected to underperform[6]. Despite these projections, preliminary annual GDP results by the Zambia Statistics Agency (ZSA) showed that the economy declined by 3.0 percent. This was premised on positive contribution by the mining and quarrying; information and communication; financial and Insurance sector. Copper prices rebounded within the year to close at US$ 7,775/MT in December 2020 from US$ 5,750.73/MT in June 2020.

Meanwhile, the average monthly interbank exchange rate of the Zambian Kwacha to the United States (US) dollar depreciated from K14.44/ US$ in January 2020 to K21.11/US$ in December 2020. The depreciation of the Kwacha contributed to inflationary pressure which had an upward trajectory to close the year at 19.2 percent compared to 11.7 percent in 2019. In order to safeguard financial stability, people's lives and livelihoods in the wake of the COVID-19 pandemic, the Central Bank lowered the monetary policy rate from 11.50 percent in quarter one to 9 percent and 8 percent in quarter two and three respectively. As a result the average commercial bank lending rates reduced from 28.23 percent in January 2020 to 25.09 percent in December of the same year which was in response to the reduction in the monetary policy lending rate.

In Zambia, the international oil prices and the exchange rate between the Kwacha (ZMW) and the United States Dollar (US$) are the two major fundamentals that influence the price of petroleum products. This implies that, major changes in these two factors could result in either an increase or a reduction in the wholesale and the pump price.

Performance of the Global Energy Sector

According to International Energy Agency (IEA), global energy demand was forecasted to drop by 5 percent in 2020. The projected decline was mainly on account of the effects of the Covid-19 pandemic that had caused more disruption to the energy sector than any other event in recent history, leaving effects that will be felt for years to come.[7]

[3] https://www.imf.org/en/Publications/WEO/Issues/2021/03/23/world-economic-outlook-april-2021
[4] Statement by the Minister of Finance on the impact of covid-19 on the Zambian Economy – March 2020
[5] https://www.worldbank.org/en/region/afr/overview
[6] Statement by the Minister of Finance on the impact of covid-19 on the Zambian Economy – July 2020
[7] https://www.iea.org/reports/global-energy-review-2020/renewables

Global demand for renewables was projected to increase by 1 percent in 2020 despite supply chain disruptions that delayed activity in several key regions. The expansion of solar, wind and hydro power was expected to increase renewable electricity generation to 28 percent of global electricity generation in the first quarter of 2020 compared to the same period in 2019. Meanwhile, the global demand for oil was estimated to shrink by 8 percent, while Coal consumption was estimated to decline by 7 percent. Additionally, natural gas demand was estimated to shrink by 3 percent, while electricity by 2 percent. The decline in global oil demand was attributed to the deep contraction in oil consumption in China in addition to major disruptions to global travel and trade. These developments were as result of reduced global economic activity owing to the effects of the COVID-19 pandemic. This resulted in a decline in petroleum products for the transport sector[8] due to the lockdowns. The decline in energy demand was matched by a fall in the global economic growth.

IEA projected that the global electricity consumption would decline by 20 percent in 2020. This was on account of the effects of lockdowns that depressed demand in many markets by 20 percent or more for several weeks especially in the first quarter of 2020. The recovery in China in the subsequent quarters during the year prevented a higher global economic depression. China accounts for 28 percent of the world's electricity consumption. However, recovery was hampered in the fourth quarter of the year due to new control measures in Europe and North America to contain the pandemic. Africa, despite having one-sixth of the world's population and accounting for only 3 percent of the world's electricity consumption, had seen electricity demand decline by 2 percent compared to the 2 percent growth experienced in 2019.

Performance of the Petroleum Sub-Sector in Zambia

In the petroleum sub-sector, the demand for petroleum products declined by 8.6 percent from 1,453,191 MT in 2019 to 1,328,185 MT in 2020. As earlier mentioned the Covid-19 outbreak had a negative impact on petroleum demand as lockdown measures constrained movements of people and goods.

In terms of performance, the upstream players which include INDENI and TAZAMA experienced an increased number of shutdowns. INDENI was on shutdown for 190 days of which 162 days were due to lack of feedstock while TAZAMA experienced a cumulative period of 196 days of unplanned shutdowns.

In 2020, crude oil prices dropped to the lowest point in the world history owing to the decline in economic activities that resulted in reduced demand. The lowest prices were recorded in April 2020 at US$16.55/bbl, a decline from a peak of US$67.8/bbl in January 2020. However, towards the end of the fourth quarter, the prices started to increase as restrictions were being relaxed in most countries in the world. At the close of the year, crude oil prices were US$47.02/bbl, US$49.48/bbl and US$49.99/bbl for West Texas Intermediate (WTI) Midlands, Murban and Brent respectively.

The ERB continued to use the Cost Plus Model (CPM) to determine the wholesale and pump prices for petroleum products in the country. The CPM operates on the principle that the final price of petroleum products should cover all costs in the supply chain. On the basis of this price methodology, during the year, the ERB carried out periodic price reviews to ensure that price recovery on inputs was maintained.

In line with the 2019 NEP objective to ensure security of supply through increased investments in the petroleum infrastructure, Government completed the construction of the Mansa fuel storage depot. Meanwhile, construction works for Chipata and Lusaka (phase 2) depots had reached 72 and 54 percent completion, respectively. Once completed the two depots are expected to increase national installed capacity by 59.2 percent, from 158 million liters as at December 2019 to 267 million liters.

Performance of the Electricity Sub-Sector – Zambia

In 2020, the national installed electricity capacity increased to 3,011.31 MW from 2,981.31 MW in 2019. This follows the integration of the 30 MW Dangote coal power plant into the national grid. Despite this, only 1,500 MW was available for generation capacity against a peak demand of 2,310 MW recording the highest deficit of 810 MW in the period under review. This was attributed to the low water levels in the water reservoirs for power generation. The major generating power plants are hydro based which accounted for 80 percent of the national installed generation capacity in 2020. The national electricity generation sent out slightly increased from 15,040 GWh in 2019 to 15,159 GWh in 2020 reflecting a 1 percent rise. Further, overall the national consumption of electricity declined by 8.3 percent from 12,526 GWh in 2019 to 11,481 GWh in the period

[8] https://www.iea.org/news/global-oil-demand-to-decline-in-2020-as-coronavirus-weighs-heavily-on-markets

under review. The manufacturing sector recorded the highest decline at 34 percent followed by the Trade sector which recorded a negative growth rate of 21 percent. The growth rates shows that the sectors were affected by the impact of COVID-19 as witnessed by negative contributions of 0.1 and 2.6 growth rates towards the 2020 preliminary economic growth rate[9].

The development of power infrastructure and investment is critical in the electricity sub-sector to achieve increased access rates to reliable power. There were notable works done on the construction of the 750 MW Kafue Lower Gorge and 15 MW Lusiwasi hydro power plants that had reached 93 percent and 99 percent completion, respectively in 2020. According to the project developers, it is envisaged that both power plants will be commissioned in 2021 to increase the installed generation capacity by 20.4 percent which is in line with Government's policy of expanding generation, transmission and distribution capacity.

The Cost of Service Study was re-launched in December 2019, and was scheduled to be completed by 31st March, 2021. However, owing to the impact of COVID-19, the completion date was rescheduled to the 3rd quarter of 2021. Meanwhile, 70 percent of the study tasks were completed during the period under review.

The Electricity Act and the Energy Regulation Acts that were enacted in December 2019 became effective in 2020, in that regard, the ERB commenced the process of developing and revising the regulations in the energy sector to align them with the new legislation. In addition, the ERB commenced drafting and designing new regulatory tools for the development and operationalization of the open access regime.

Performance of the Renewable Sector - Zambia

Globally, there has been an increase in the renewable energy generation. During the period under review, Zambia experienced a rise of approximately 27.6 percent in solar generation from 118.96 GWh in 2019 to 151.75 GWh in 2020. The sector continued to witness an increase in the number of licensed companies engaged in manufacture, wholesale importation and installation of solar energy systems from 126 in 2019 to 173 in 2020 representing a growth of 37.3 percent. Additionally, the ERB in collaboration with key stakeholders finalized the development of the standards for stand-alone solar home systems. This was done with the assistance from the Africa Clean Energy-Technical Assistance Facility (ACE-TAF). Further, the ERB issued one licence for the generation, distribution and supply for an off-grid electricity system.

During the period under review, the MOE approved feasibility study rights to 39 pre-qualified developers for potential small hydropower sites under the Global Energy Transfer Feed-in- Tariff (GETFiT) programme. The GETFiT programme is a mechanism that aims to procure and support individual IPP projects up to 20MW.

In addition, the ERB with the assistance from the European Union (EU) through the IAEREP project finalized the mini-grid regulatory framework. The framework consists of legal, grid encroachment, economic regulations, and technical requirements. This is a significant milestone that will ensure security of investment for the mini-grid investors and developers. It will also provide protection for the consumers in the country. Further, the ERB continued working on the operationalization of the net-metering regulations and their integration into the Distribution Grid Code. The net-metering regulations are expected to be finalized in 2021.

Structure of the Report

The report is arranged as follows; section one presents the introduction, sections two, three and four presents the performance, challenges and outlook of the petroleum, electricity and renewable energy sub-sectors respectively. Section five covers licensing in the energy sector while section six focuses on consumer and public affairs.

[9] March 2021 Zambia Statistical Agency monthly report

2.0 PETROLEUM SUB-SECTOR

This section discusses Zambia's petroleum sub-sector value chain covering the upstream and downstream players in the petroleum sub-sector. The upstream players include INDENI, TAZAMA and TPPL, while downstream players include OMCs, Retailers (Dealers) and Transporters. This section also highlights the licensing activities, auditing, compliance monitoring and development of standards. Further, the challenges and outlook of the petroleum sub-sector are also discussed.

Petroleum products bulk storage tanks

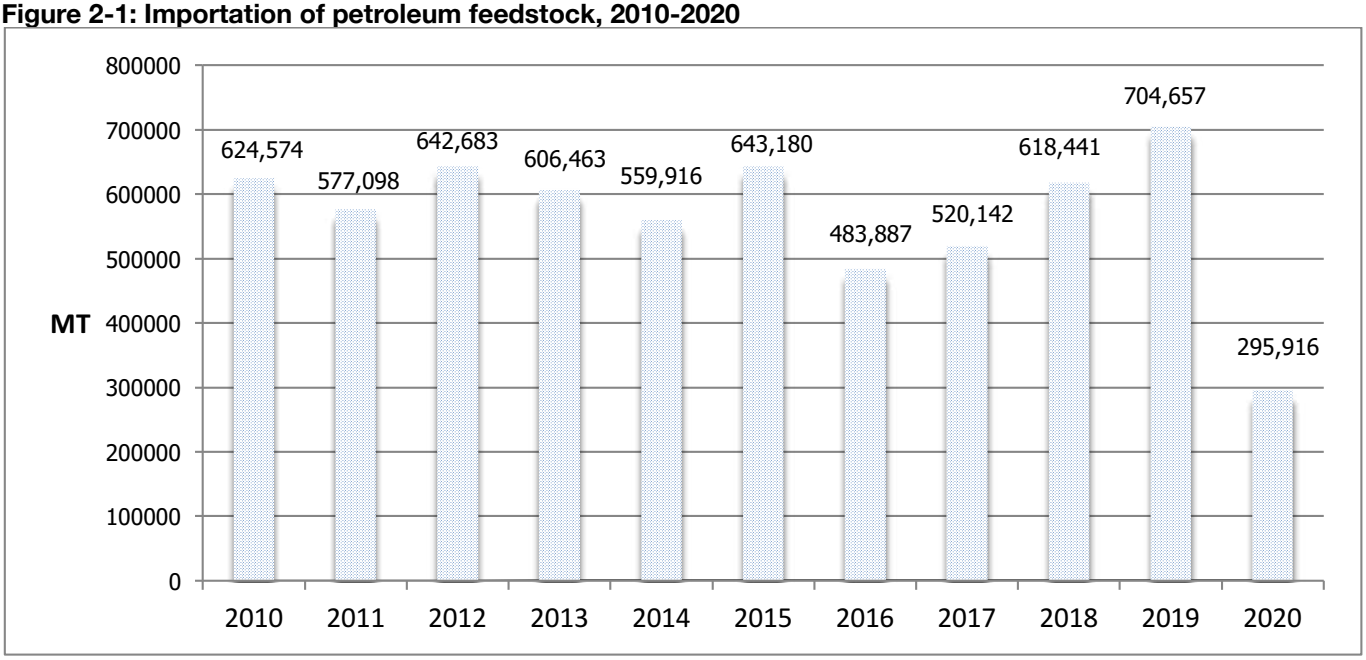
2.1 IMPORTATION OF FUEL

The demand for the national petroleum products in Zambia is met through the importation of petroleum feedstock and finished petroleum products by Government and OMCs. Government contracts suppliers through a competitive bidding process to procure petroleum feedstock and finished petroleum products. The imported petroleum feedstock is in the form of spiked crude oil which typically is composed of 46 percent diesel, 41 percent crude oil (from Oman or Murban) and 13 percent condensate/naptha. In 2020, INDENI and TAZAMA experienced an increased number of unplanned shutdowns. INDENI was on shutdown for 190 days of which 162 days was due to lack of feedstock. Consequently, Government issued waivers to OMCs to import petrol, diesel and HFO to meet the national demand.

2.1.1 Importation of petroleum feedstock

In 2020, suppliers contracted by Government imported three (3) cargoes of petroleum feedstock compared to seven (7) in 2019. The total quantity of petroleum feedstock for the three (3) cargoes was 295,916 MT compared to 704,657 MT in 2019 reflecting a reduction of 58 percent. The importation of petroleum feedstock is demand driven. The decline in the number of cargoes was compensated through the issuance of Government-granted import waivers to OMCs to ensure security of supply. The importation waivers granted were for a period of 12 months while in 2019, waivers were only granted in the month of December. Figure 2-1 shows the trend in the importation of petroleum feedstock in the country from 2010 to 2020.

Figure 2-1: Importation of petroleum feedstock, 2010-2020

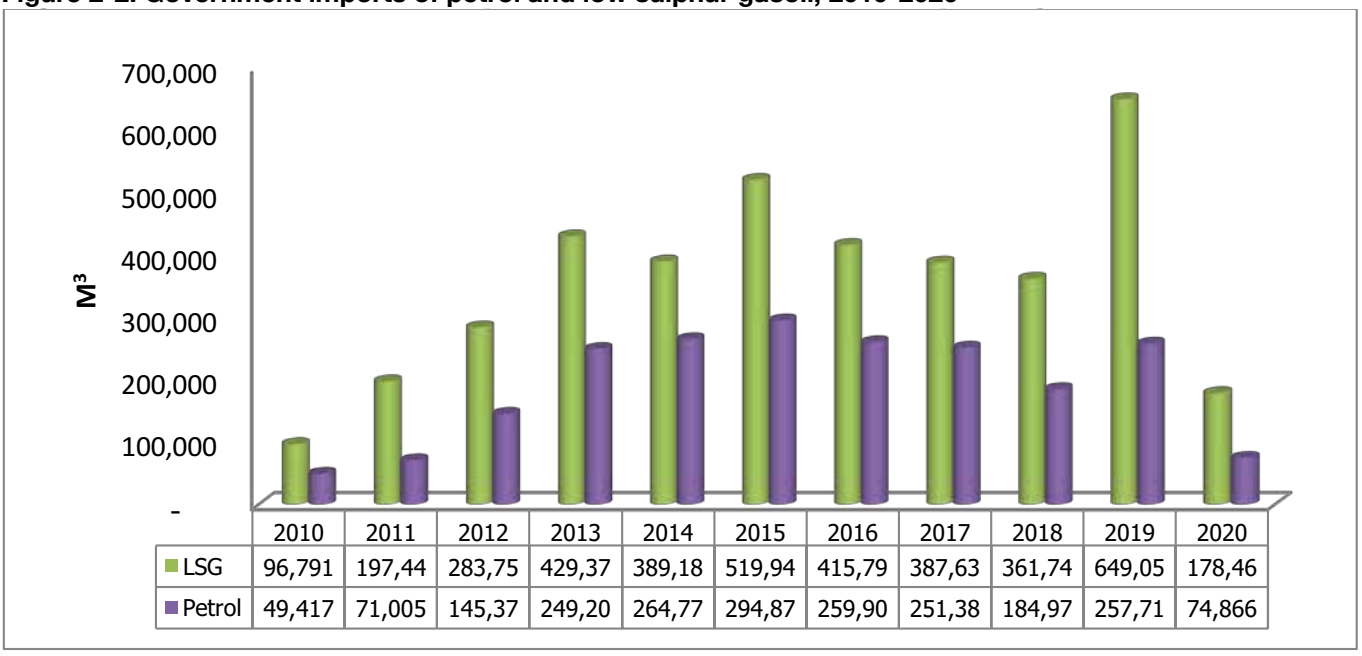


During the period 2010 to 2020, the importation of petroleum feedstock fluctuated with a peak of 704,657 MT in 2019 and a minimum of 295,916 MT in 2020. As earlier mentioned, the importation is influenced by demand. The significant drop depicted in 2020 was on account of increased OMCs importation in 2020.

2.1.2 Importation of finished petroleum products by Government

The importation of finished petroleum products is done through Government contracted suppliers and OMCs. In 2020, Government imports of LSGO declined by 72.5 percent from 649,058 m^3 to 178,463 m^3. Similarly, volume of petrol imports had declined by 71 percent from 257,719 m^3 in 2019 to 74,866 m^3 in 2020. The decline in Government imports was supplemented by OMCs. Figure 2-2 shows the trend of Government imports of petrol and diesel for the period 2010 to 2020.

Figure 2-2: Government imports of petrol and low sulphur gasoil, 2010-2020



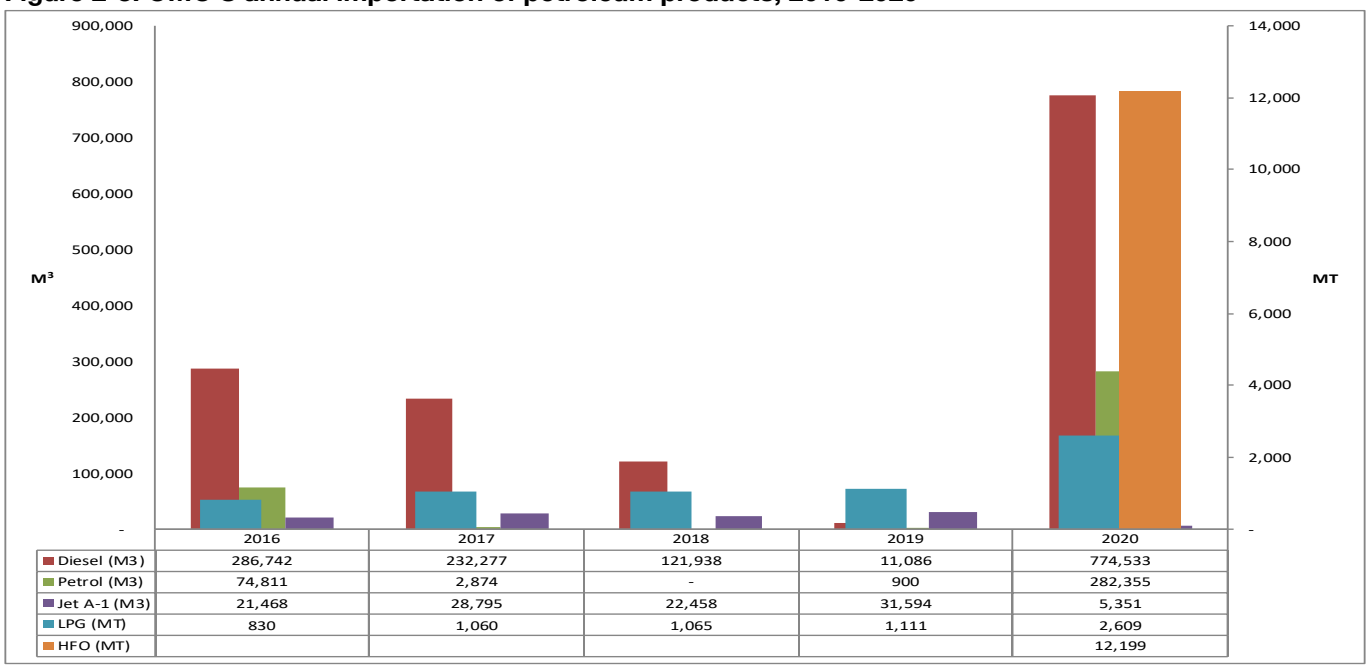
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LSG	96,791	197,44	283,75	429,37	389,18	519,94	415,79	387,63	361,74	649,05	178,46
Petrol	49,417	71,005	145,37	249,20	264,77	294,87	259,90	251,38	184,97	257,71	74,866

As depicted in figure 2-2, Government imports for LSGO and petrol had been on an increasing trajectory except for 2020 when there was a decline.

2.1.2.1 Imports of finished petroleum products by OMCs

The importation of finished petroleum products by OMCs is shown Figure 2-3. The number of OMCs granted waivers to import petrol and diesel in 2020 were 87. Additionally, the operational days in 2020 were less at 174 days compared to 330 days in 2019. This was mainly on account of lack of petroleum feedstock at the Refinery. As depicted, diesel imports increased from 11,086 m^3 in 2019 to 774,533 m^3 in 2020. Similarly, petrol imports increased from 900 m^3 to 282,355 m^3 during the same period.

Figure 2-3: OMC'S annual importation of petroleum products, 2016-2020



	2016	2017	2018	2019	2020
Diesel (M3)	286,742	232,277	121,938	11,086	774,533
Petrol (M3)	74,811	2,874	-	900	282,355
Jet A-1 (M3)	21,468	28,795	22,458	31,594	5,351
LPG (MT)	830	1,060	1,065	1,111	2,609
HFO (MT)					12,199

Further, the imports of LPG doubled to 2,609 MT in 2020 from 1,111 MT in 2019. Additionally, there was 12,199 MT of HFO imported in 2020. This was also due to non-production by the refinery.

2.2 OPERATIONS AT TAZAMA PIPELINES LIMITED

TAZAMA is jointly owned by the Government of Zambia owning 66.70 percent shareholding and the Government of Tanzania owning 33.30 percent. TAZAMA pipeline has an installed capacity of 1.1million MT per annum. TAZAMA's current annual throughput[10] capacity is now 800,000 MT per annum due to the degeneration of the pipeline over the years. The pipeline stretches over a 1,710 Km from Dar-es-Salaam, Tanzania, to INDENI Refinery in Ndola, Zambia.

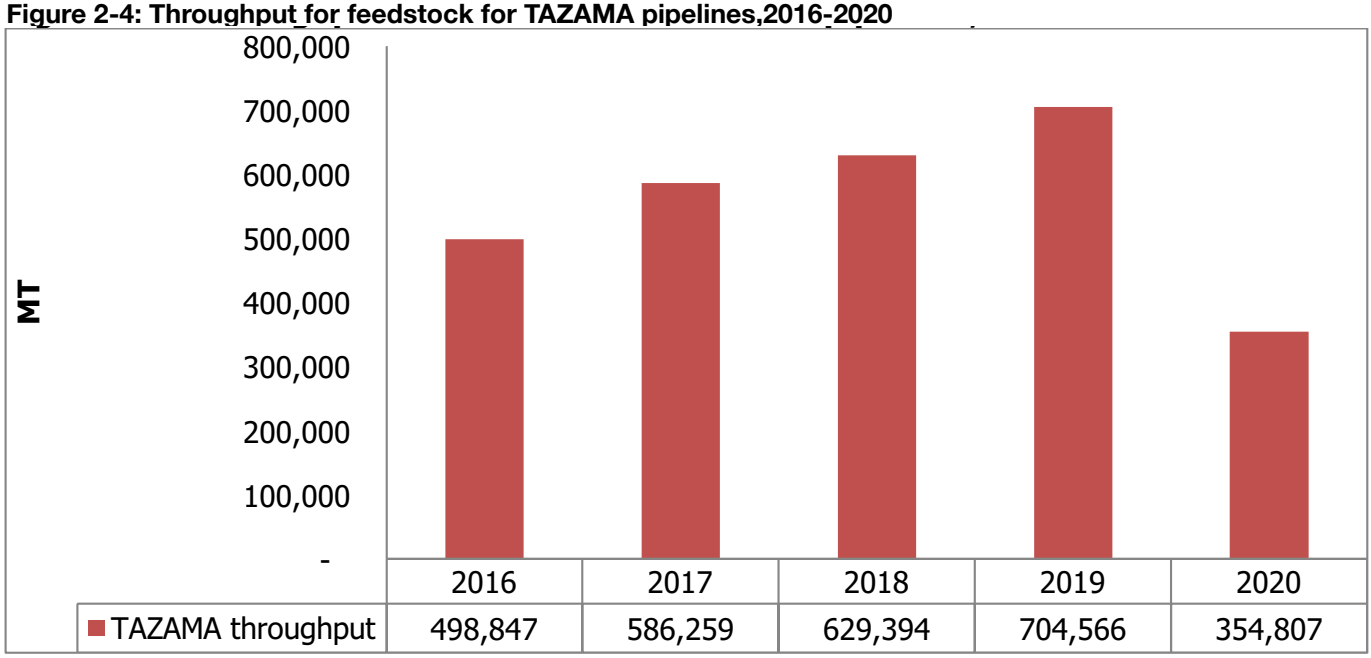
TAZAMA Pipelines Limited

[10] A rate of production

2.2.1 TAZAMA throughput

TAZAMA operated at a throughput of 354,808 MT in 2020 compared to 704,566 MT in 2019, representing a decrease of 49.64 percent. The significant reduction in throughput was mainly attributed to the increase in unscheduled shutdowns during the year arising from lack of petroleum feedstock to transport. In 2020, TAZAMA experienced 196 days or 6.5 months of unplanned shutdowns. For the five year period from 2016 to 2020, the pipeline operated at an average throughput of 554,775 MT. Figure 2-4 shows the throughput of the pipeline from 2016 to 2020.

Figure 2-4: Throughput for feedstock for TAZAMA pipelines,2016-2020



	2016	2017	2018	2019	2020
TAZAMA throughput	498,847	586,259	629,394	704,566	354,807

2.2.2 Rehabilitation and Maintenance works at TAZAMA

Petroleum pipeline

During the year TAZAMA conducted some rehabilitation works on the pipeline and pumping stations. The notable rehabilitation and replacement work at TAZAMA during the year is depicted in table 2-1.

Table 2-1 : TAZAMA Rehabilitation and replacement works

No.	Rehabilitation Works	Status/Comment
1.	Replacement of 2 main pumping units and auxiliary equipment at Iringa and Kalonje Pumping Stations	This is part of the on-going project of replacement of all old pumping units to improve the pump station discharge and enhance reliability of the pumping station.

2.3 OPERATIONS AT INDENI PETROLEUM REFINERY COMPANY LIMITED

INDENI refinery has a name plate (design) throughput capacity of 1.1 million MT per annum. Due to wear and tear of the plant throughput capacity has over the years reduced to 850,000 MT per annum. The annual throughput per year for INDENI is mainly reliant on the volume of petroleum feedstock received from TAZAMA.

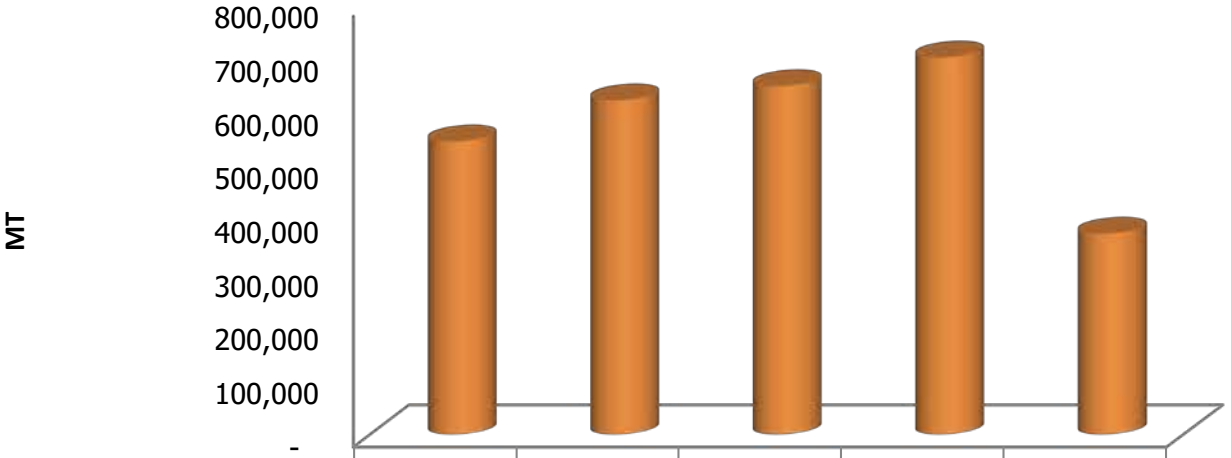
INDENI Petroleum Refinery Plant

2.3.1 INDENI throughput

INDENI's rate of production was at 700,277 MT in 2019, while in 2020 it was at 372,384 MT. INDENI's throughput declined significantly in 2020 compared to 2019 by 47 percent due to the reduction in the number of petroleum feedstock cargoes received. During 2020, three (3) petroleum feedstock cargoes were received compared to the annual average of six (6). The refinery was shut down for 191 days out of which 162 or 5.4 months was due to lack of petroleum feedstock.

Figure 2-5 shows petroleum feedstock processed by INDENI, for the period 2016 to 2020.

Figure 2-5: Petroleum feedstock processed by INDENI, 2016-2020



	2016	2017	2018	2019	2020
Petroluem feedstock (MT)	544,069	620,465	646,907	700,277	372,384

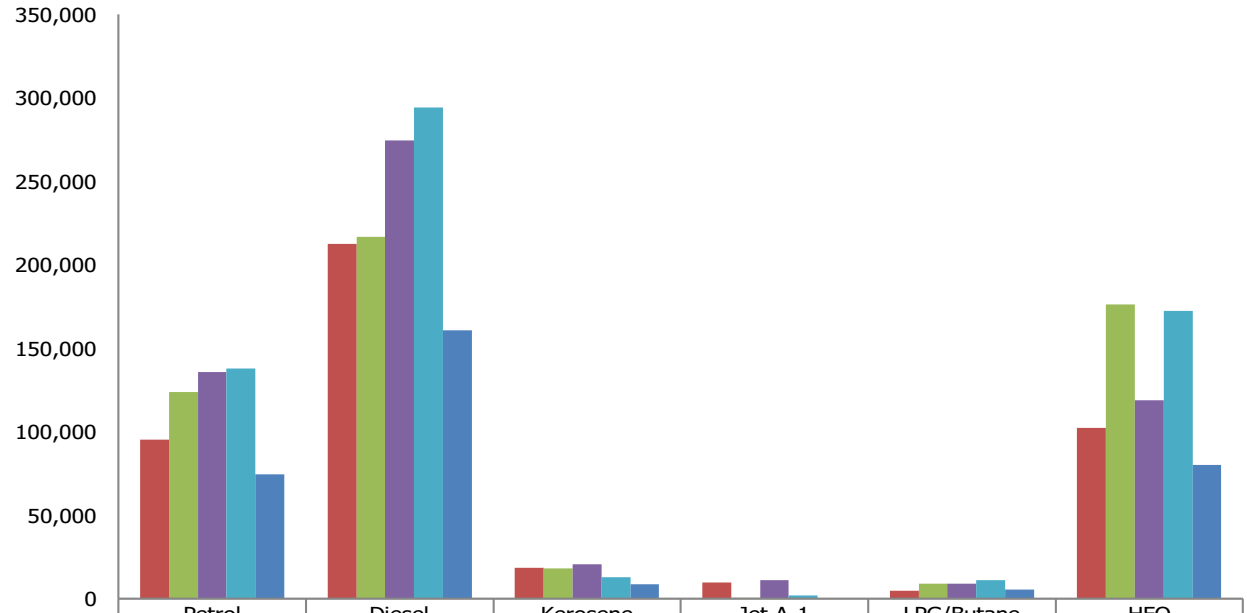
Source: INDENI

INDENI's throughput during the five year period, 2016 to 2020 averaged at 578,820 MT.

2.3.2 INDENI refinery production of petroleum products

In 2020, the Refinery contributed 18.8 percent to the total national consumption of petrol and diesel compared to 35.2 percent in 2019 representing a 16.4 percentage points decline. The main reason for this decline was due to lack of petroleum feedstock for processing. The Refinery was operational for 174 days compared to 330 days in 2019. Overall, the total volume of petroleum products produced declined by 47.7 percent to 329,366 MT in 2020 from 629,823 MT in 2019. Figure 2-6 shows the Refinery production for petroleum products from 2016 to 2020.

Figure 2-6: INDENI refinery production of petroleum products, 2016-2020



	Petrol	Diesel	Kerosene	Jet A-1	LPG/Butane	HFO
2016	95,285	212,638	18,499	9,464	4,839	102,133
2017	123,591	216,672	18,130	386	8,768	176,231
2018	135,733	274,292	20,538	10,948	9,027	118,751
2019	137,836	294,101	12,637	1,913	10,932	172,404
2020	74,497	160,762	8,685	-	5,424	79,998

Diesel production declined in 2020 by 45 percent to 160,762 MT from 294,101 MT in 2019. Similarly, petrol declined by 46.0 percent to 74,497 MT in 2020 from 137,836 MT in 2019. In addition, kerosene, LPG/Butane and HFO all recorded a reduction in production by 31.3 percent, 50 percent and 54 percent, respectively.

2.4 NATIONAL CONSUMPTION OF PETROLEUM PRODUCTS

In 2020, the total national consumption for petroleum products decreased by 8.5 percent from 1,453,190.52 MT in 2019 to 1,329,290.66 MT in 2020. The consumption of HFO had decreased by 74 percent from 173,485.18 MT in 2019 to 45,023.05 MT in 2020. The decrease in consumption of HFO is attributed to the lack of production of the commodity at INDENI owing to the unavailability of the petroleum feedstock most of the year. Similarly, the consumption for Jet A-1 decreased by 42.9 percent from 29,004.87 MT in 2019 to 16,573.35 MT in 2020. This decrease in consumption for Jet A-1 is attributed to the travel restrictions imposed to curb the spread of the COVID-19 pandemic. The consumption for Kerosene decreased from 10,831 MT in 2019 to 7,504.17 MT in 2020 representing a drop of 30.7 percent. It was observed that the consumption for petrol decreased by 2.1 percent from 346,575.33 MT in 2019 to 339,431.09 MT in 2020. However, the consumption for diesel increased by 3.1 percent from 885,453.33 MT in 2019 to 912,813.96 MT in 2020 while the consumption for LPG increased marginally by 1.3 percent from 7,840.81 MT in 2019 to 7,945.04 MT in 2020. Due to the power deficit of 810 MW experienced in 2020 induced by the low water levels, the consumption of LPG increased. Further, the supply for HFO was limited in 2020 resulting to the use of diesel as a substitute by the mines, therefore increasing diesel consumption. Table 2-2 shows the national consumption of petroleum products in the country, from 2019 to 2020.

Table 2-2: National fuel consumption of petroleum products, 2019-2020

Product	2019	2020	% Change
Diesel (MT)	885,453.33	912,813.96	3.1%
Petrol (MT)	346,575.33	339,431.09	-2.1%
Kerosene (MT)	10,831.00	7,504.17	-30.7%
Jet A-1 (MT)	29,004.87	16,573.35	-42.9%
Heavy Fuel Oil (MT)	173,485.18	45,023.05	-74.0%
LPG (MT)	7,840.81	7,945.04	1.3%
Grand Total	**1,453,190.52**	**1,329,290.66**	**-8.5%**

2.4.1 Daily national average consumption of petroleum products

The daily national average consumption of petroleum products is shown in Table 2-2. Generally, daily national average consumption for all petroleum products decreased between 2019 and 2020, except for Diesel and LPG.

The daily national average consumption for petrol decreased from 1,266,028.60 liters per day in 2019 to 1,236,543.13 liters per day in 2020. Similarly, daily national average consumption for HFO, Jet A-1 and Kerosene decreased from 475,302 kgs per day, 99,956.17 liters per day and 37,091.00 liters per day respectively to 123,013.80 kgs per day, 56,958.96 liters per day and 25,790.19 liters per day in 2020 respectively.

Meanwhile, daily national average consumption for diesel increased from 2,887,785.00 liters per day in 2019 to 2,969,080.02 liters per day in 2020. Similarly, the average national daily consumption for LPG increased from 21,481.68 kgs per day in 2019 to 21, 707.76 kgs per day in 2020.

Table 2-3: Daily national average consumption, 2019-2020

Product	2019	2020	% Change
Diesel (L)	2,887,975.62	2,969,080.02	2.8
Heavy Fuel Oil (Kg)	475,301.86	123,013.80	-74.1
Jet A-1 (L)	99,956.47	56,958.96	-43.0
Kerosene (L)	37,091.03	25,790.19	-30.5
LPG (Kg)	21,481.68	21,707.76	1.1
Petrol (L)	1,266,028.60	1,236,543.13	-2.3

2.4.2 Daily national average consumption by Province

During the period under review, there was variability in the consumption of petroleum products by province mainly on account of differences in economic and demographic factors. In 2020, high consumption of diesel and petrol was evident in Copperbelt, Lusaka and North-western Provinces. The provincial daily consumption for diesel, Jet A-1, kerosene, LPG and petrol is shown in Table 2-4.

Table 2-4: Provincial average daily consumption of petroleum products, 2019-2020

Product / Province	Diesel	% Share	Heavy Fuel Oil	% Share	Jet A-1	% Share	Kerosene	% Share	LPG	% Share	Petrol	% Share
Central	190,684.76	6.4	0	0.0	459.02	0.8	976.84	3.8	2,063.98	9.5	83,043.95	6.7
Copperbelt	786,842.08	26.5	114,467.73	93.1	3,017.43	5.3	7,403.46	28.7	4,805.87	22.1	255,252.78	20.6
Eastern	76,720.73	2.6	0	0.0	351.94	0.6	831.23	3.2	201.36	0.9	62,799.94	5.1
Luapula	38,968.61	1.3	0	0.0	-	0.0	5,057.72	19.6	15.94	0.1	23,204.85	1.9
Lusaka	915,226.65	30.8	1,606.45	1.3	51,183.23	89.9	9,204.47	35.7	13,469.07	62.0	627,870.66	50.8
Muchinga	30,144.67	1.0	0	0.0	-	0.0	183.71	0.7	2.75	0.0	14,866.53	1.2
Northern	34,604.55	1.2	0	0.0	893.14	1.6	1,123.11	4.4	14.93	0.1	31,330.30	2.5
Northwestern	716,667.00	24.1	6,939.62	5.6	906.65	1.6	444.67	1.7	504.26	2.3	43,290.52	3.5
Southern	145,985.14	4.9	0	0.0	147.55	0.3	564.98	2.2	575.84	2.7	74,665.18	6.0
Western	33,235.84	1.1	0	0.0	-	0.0	-	0.0	53.78	0.2	20,218.40	1.6
Grand Total	**2,969,080.02**	**100.0**	**123,013.80**	**100.0**	**56,958.96**	**100.0**	**25,790.19**	**100.0**	**21,707.76**	**100.0**	**1,236,543.13**	**100.0**

The total national average daily consumption for diesel was 2,969,080.02 liters in 2020. Of this consumption, Lusaka province accounted for the highest proportion at 30.8 percent followed by Copperbelt and North-western provinces at 26.5 percent and 24.1 percent respectively. The provinces with the least consumption for diesel on a daily basis were Muchinga, Western, Northern and Luapula which accounted for 1.0 percent, 1.1 percent, 1.2 percent and 1.3 percent respectively.

The average national daily consumption for petrol was 1,236,543.13 liters in 2020. Of this consumption, Lusaka province accounted for the highest proportion at 50.8 percent followed by Copperbelt at 20.6 percent. The provinces with the least consumption of petrol were Muchinga, Western and Luapula provinces which accounted for 1.2 percent, 1.6 percent and 1.9 percent respectively.

In 2020, the national average daily consumption for kerosene was 25,790.19 liters per day. Lusaka province accounted for the highest share of this consumption at 35.7 percent. Overall, Copperbelt, Luapula and Lusaka provinces accounted for 84.0 percent of the national daily consumption.

The average national daily consumption for Jet A-1 was 56,958.96 liters in 2020. Of this consumption, Lusaka province accounted for the highest proportion at 89.9 percent followed by Copperbelt province at 5.3 percent. The province with the least consumption for Jet A-1 on a daily basis was Southern province at 0.3 percent.

The average national daily consumption for LPG was 21,707.16 kgs in 2020. Of this consumption, Lusaka province accounted for the highest proportion at 62.0 percent followed by Copperbelt and Central provinces at 22.1 percent and 9.5 percent respectively. The provinces with the least consumption for LPG on a daily basis were Luapula, and Northern provinces both at 0.1 percent.

2.4.3 Consumption by Economic sector

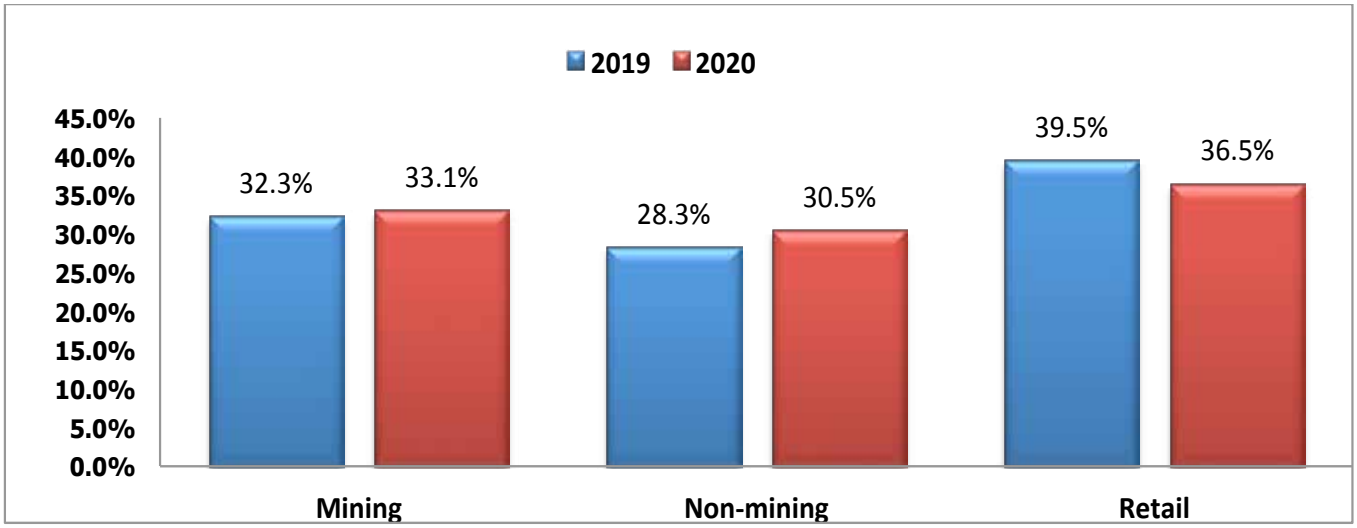
This section discusses the consumption of petrol and diesel by economic sector in 2020 in comparison to 2019. The economic sectors are classified as follows: retail, mining and non - mining. Retail refers to petroleum products that are sold at the filling station while mining refers to petroleum products delivered to and directly consumed by the mines. Non-mining refers to all the other sectors in the economy.

2.4.3.1 Consumption of Diesel by economic sector

In 2020, the consumption of diesel continued to be dominated by the retail sector which consumed 36.5 percent. Despite the dominance, it declined by 3.0 percentage points from 39.5 percent in 2019. Meanwhile, mining increased its share of consumption to 33.1 percent from 32.3 percent in 2019. Similarly, there was a

slight increase of 2.2 percentage points for the non-mining sectors share of national consumption from 28.3 percent in 2019 to 30.5 percent in 2020. Figure 2-7 shows the consumption of diesel by economic sector in 2019 and 2020.

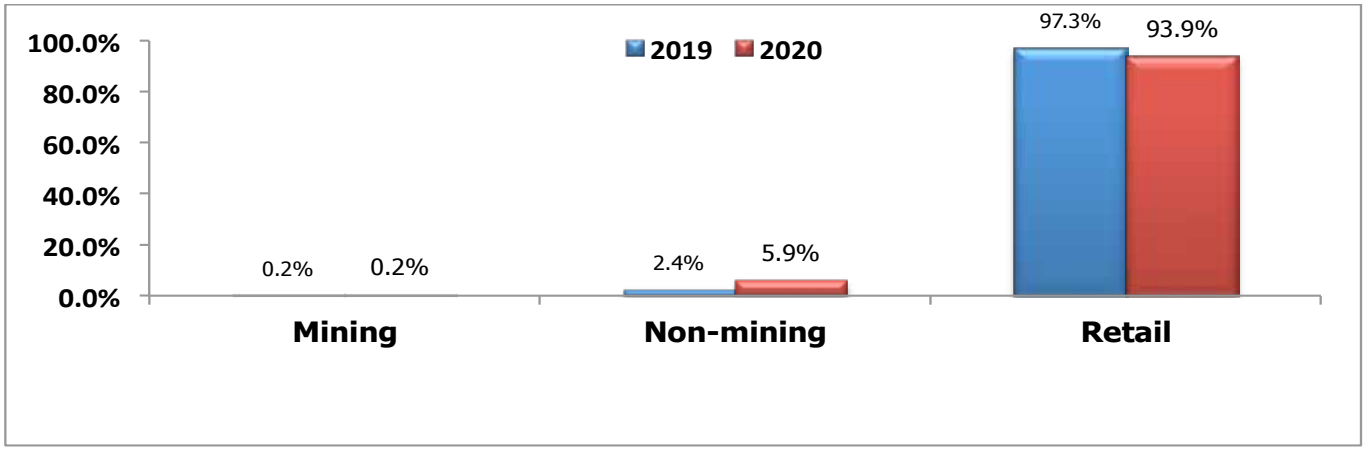
Figure 2-7: Diesel consumption by economic sector in 2019 and 2020



2.4.3.2 Consumption of petrol by economic sector

The consumption of petrol by sector namely; mining, retail and other non-mining is shown in Figure 2-8. In both 2019 and 2020, the retail sector obtained the largest portion by economic sector followed by the non-mining sector. Despite the dominance, the retail sector recorded a decline of 3.2 percentage points from 97.3 percent in 2019 to 94.1 percent by economic sector in 2020.

Figure 2-8: Petrol consumption by economic sector in 2019 and 2020



2.5 MARKET SHARE OF OIL MARKETING COMPANIES

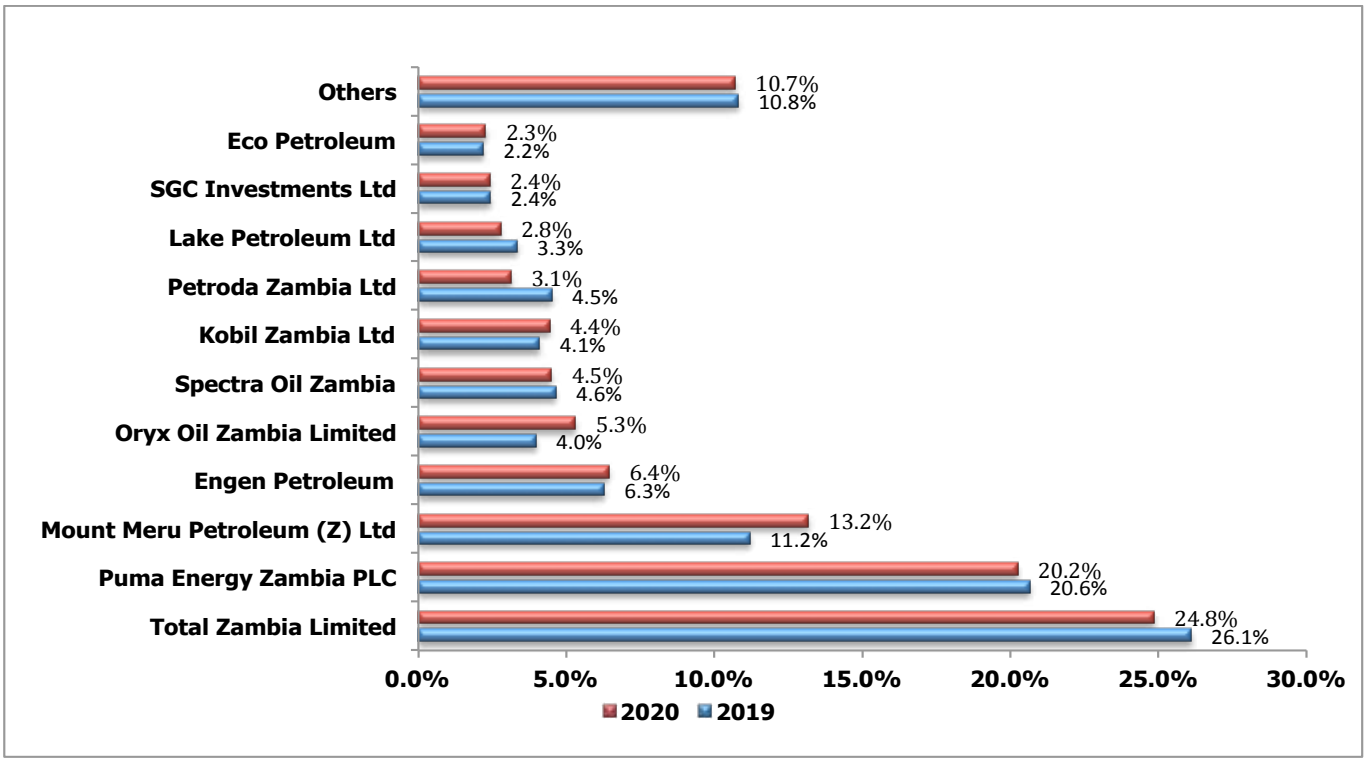
This section discusses the combined market share for OMCs in 2020 for white products (diesel, petrol, kerosene, lubricants and Jet A-1). The size of an OMC is determined by its market share[11].

2.5.1 Market share of white products

In 2020, the market share of OMCs for white products, comprising petrol, kerosene and diesel (inclusive of LSGO) was dominated by Total Zambia Limited at 24.8 percent followed by Puma Energy Zambia Plc at 20.2 percent. Figure 2-9 shows the market share for white products in 2019 and 2020.

[11] Percentage of an OMCs' total sales to the total industry market sales in a specified period of time

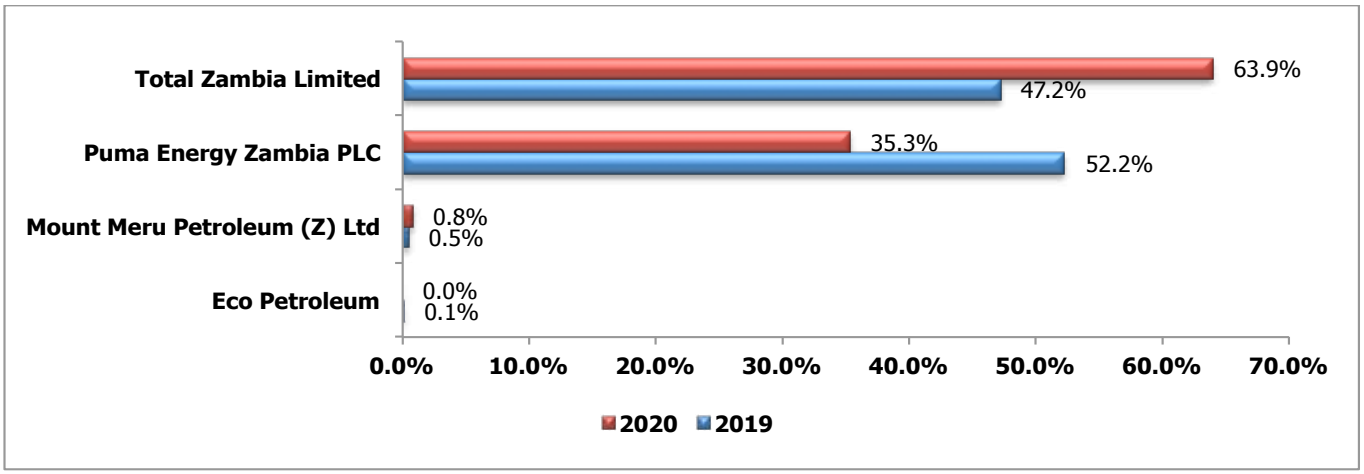
Figure 2-9: OMC market share for white petroleum products, 2019-2020



2.5.2 Market share for Jet A-1

In 2020, there were four (04) OMCs trading in Jet A-1 namely; Eco Petroleum; Mount Meru; Puma Energy Zambia Plc and Total Zambia Limited. The market share for Jet A-1 in 2020 was dominated by Total Zambia accounting for 63.9 percent which is an increase of 16.7 percentage points from 47.2 percent share in 2019. Puma was second at 35.3 percent, recording a decrease of 16.9 percentage points from 52.2 percent recorded in 2019. Conversely, Mount Meru increased its market share by 0.3 percentage points from 0.5 percent share in 2019 to 0.8 percent share in 2020. Figure 2-10 shows the OMCs' market share for Jet A-1 in 2019 and 2020.

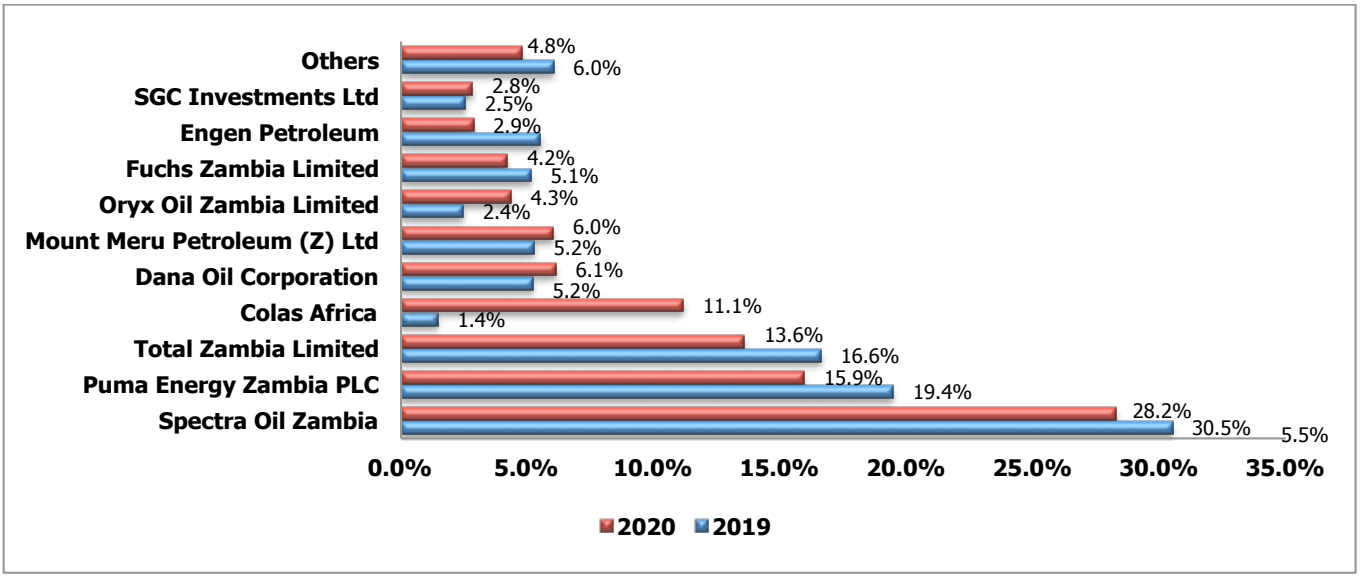
Figure 2-10: Market share for Jet A1,2019-2020



2.5.3 Market share for Lubricants

In 2020, there were a total of 31 companies licenced by the ERB to deal in lubricants. Figure 2-11 depicts the market share for lubricants in 2020 with comparative figures for 2019.

Figure 2 -11: Market share for Lubricant, 2019-2020

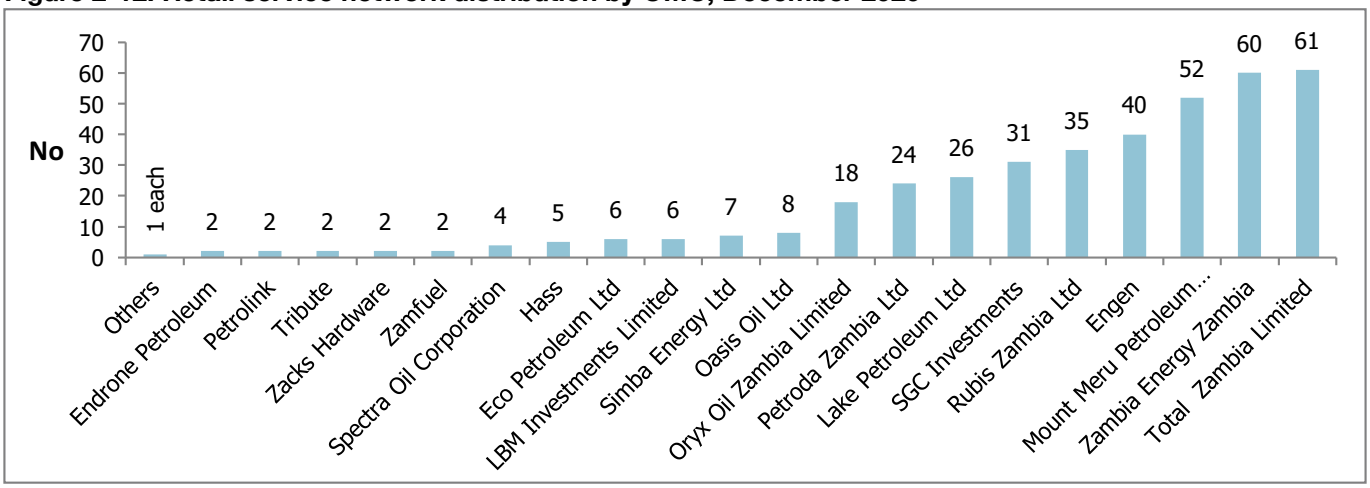


Spectra Oil Zambia maintained its lead in the market for lubricants with its market share standing at 28.2 percent in 2020 despite decreasing by 2.3 percentage points from 30.5 percent in 2019.This was followed by Puma Energy at 15.9 percent in 2020 which also recorded a decrease from 19.4 percent in 2019. Thirdly, Total Zambia at 13.6 percent in 2020 from 16.6 percent in 2019.

2.5.4 Retail Sites Network

In 2020, there were 411 OMCs, among these, 38 had retail service stations spread across the country. The total number of retail sites stood at 411 as at 31st December 2020. Total Zambia Limited had the largest retail network at 61 followed by Puma Energy Zambia at 60 then Mount Meru with 52 retail sites and Vivo Zambia Limited (trading as Engen) at 40. Further, Rubis, SGC, Lake Petroleum, Petroda and Oryx had 35, 31, 26, 24 and 18 respectively. Figure 2-12 shows the distribution of retail service stations by OMCs as at 31st December, 2020.

Figure 2-12: Retail service network distribution by OMC, December 2020

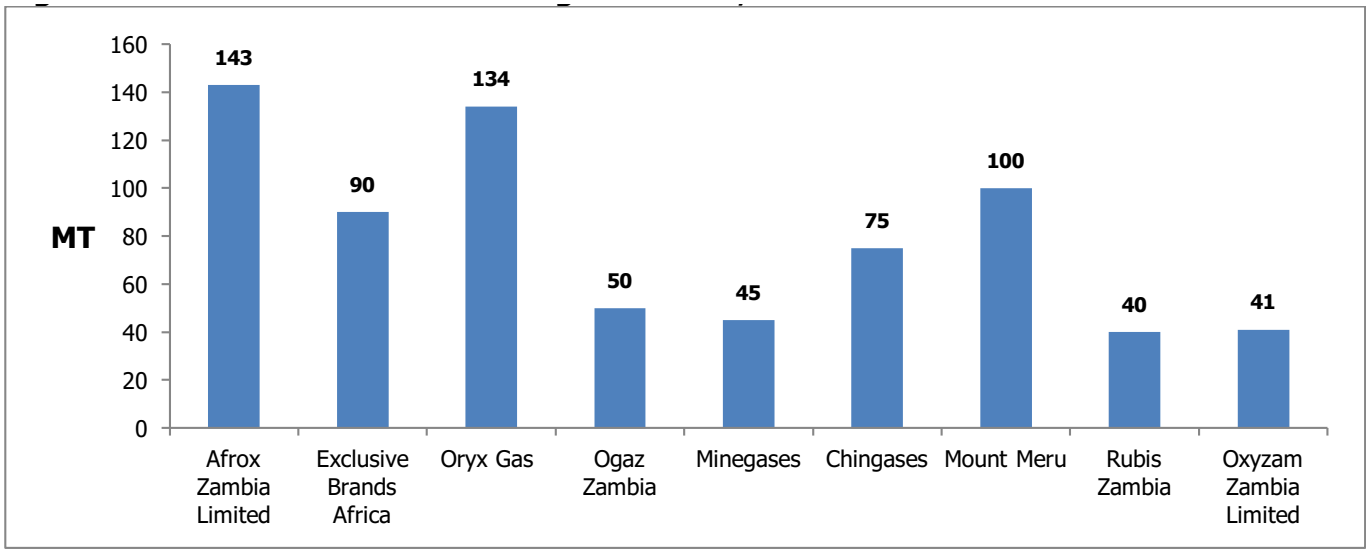


In terms of distribution of retail sites by province, Lusaka dominated with the largest number of sites at 156 followed by Copperbelt province at 108. (See Appendix 1 for full details)

2.5.5 LPG storage facilities

The national installed capacity for LPG Bulk facilities is made up of storage at INDENI and in OMCs. In 2020, LPG Bulk storage facilities increased to 2,518 MT from 2,498 MT in 2019. This comprised 1,800 MT at INDENI, while the rest were under OMCs ownership. Figure 2-13 shows the distribution of LPG bulk storage facilities by OMC in 2020.

Figure 2-13: OMC's LPG bulk storage facilities, 2020



2.6 PRICING OF PETROLEUM PRODUCTS

Fuel Pumps at a Retail Service Station

The ERB uses the Cost Plus Method (CPM) to set fuel prices in Zambia. The CPM operates on the principle that the final price of petroleum products should cover all costs in the supply chain. The role of pricing of petroleum products for the ERB commences when importation documents are presented by the importer in this case Government through the Department of Petroleum under the Ministry of Energy. This commences the pricing process using CPM.

Table 2-5 depicts the different supply chain players and the roles that they play in the supply and pricing of petroleum products.

Table 2-5 Details of the roles of the players in the petroleum supply chain

No.	Petroleum Supply Chain Player	Role
1.0	Ministry of Energy	i) Float import tenders based on requirements of Petroleum products. ii) Opening of tender, evaluation and awarding of supply Contract. iii) Coordinate the determination of quantity requirements/projection for a specified period. iv) Ensure that the quantities from the supplier are delivered. v) Give policy guidance to the petroleum sector. vi) Monitor and manage strategic reserves. vii) To procure petroleum products to meet market demand.
2.0	Energy Regulation Board	i) Regulate the petroleum sector. ii) Ensure compliance by Suppliers and OMCs to operational requirements to be licenced. iii) Facilitate fuel marking process and product quality monitoring. iv) Forecast supply and demand of petroleum products in consultation with MoE and OMCs.
3.0	TAZAMA Pipelines Limited	i) Transport petroleum feedstock via pipeline to INDENI from Dar-es-salaam. ii) Ensure receipt of imported products of Suppliers in designated GRZ Depots. iii) Participate in procurement of petroleum feedstock in collaboration with INDENI.
4.0	INDENI Petroleum Refinery Limited	i) Process petroleum feedstock to finished petroleum products. ii) Participate in the procurement of petroleum feedstock in collaboration with TAZAMA.
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 the Ndola Fuel Terminal (NFT) and Government Depots to OMCs.
6.0	Oil Marketing Companies	i) Distribute petroleum products to Consumers, Retailers (Dealers) and Government.
7.0	Petroleum Transporters	i) Transport petroleum products to OMCs, Retailers (Dealers) and Government.
8.0	Retailers (Dealers)	i) Retailing of petroleum products to consumers.
9.0	Consumers	i) Buy petroleum products at prices regulated by the ERB.

2.6.1 Determinants of petroleum product's prices

The factors that determine the price of fuel globally differ according to each country's specific fuel market characteristics. The major determinants of global petroleum prices are demand and supply of petroleum in major oil producing countries such as the United States of America (USA), Russia and Saudi Arabia. In addition to demand and supply, petroleum prices are determined by several other factors combined. These include; the exchange rate, cost of crude oil, refining costs, distribution costs, marketing costs and government policy in terms of taxes and subsides. Some of these factors that may influence global oil prices are depicted in Figure 2-14.

Figure 2-14: Global factors that influence global oil prices

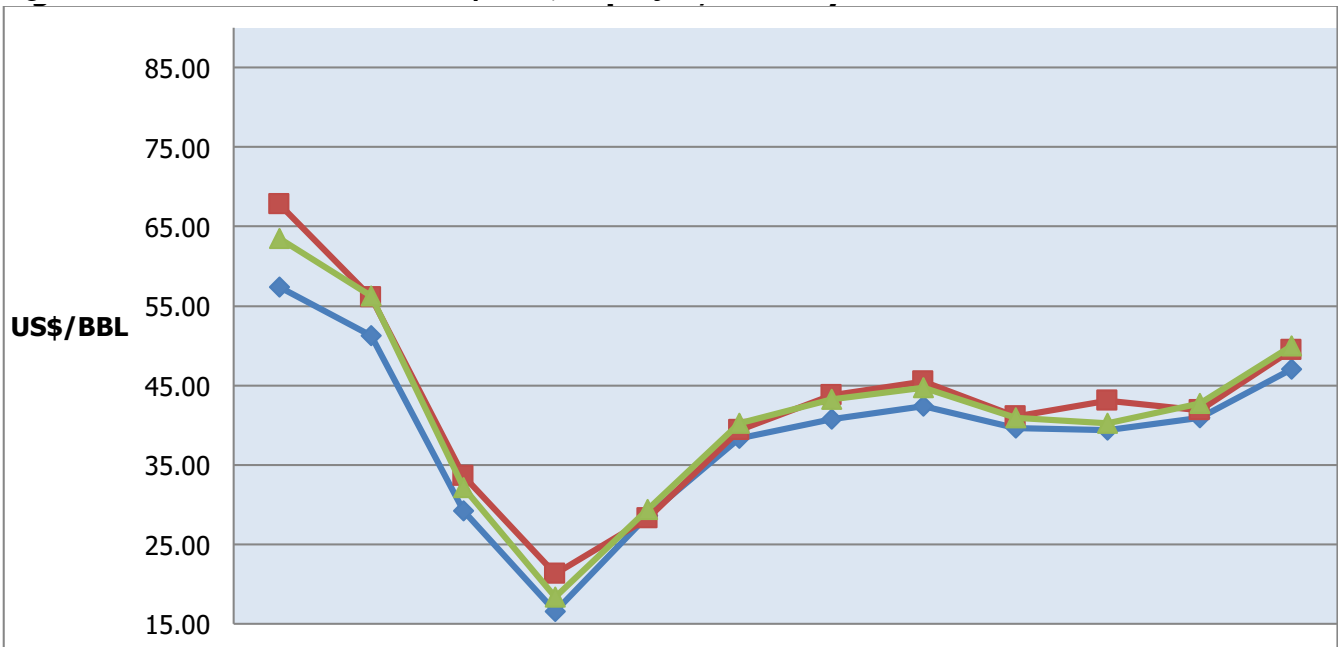
Source: US Energy Information Administration (EIA)

In Zambia, the international oil prices and the exchange rate between the Kwacha (ZMW) and the United States Dollar (US$) are the two major fundamentals that influence the price of petroleum products. This implies that, major changes in these two factors could result in either an increase or a reduction in the wholesale and the pump price. In addition, changes in the cost-lines such as levies, duties and fees; margins for transporters, OMCs or dealers, fees and pumping or processing fees can also trigger a price adjustment.

2.6.2 Trends in the International Oil Prices for 2020

In 2020, crude oil prices dropped to the lowest point in world history. As billions of people around the world stayed home to slow down the spread of the corona virus, physical demand for crude oil dried up creating a global supply surplus. The lowest prices were recorded in April 2020, as low as US$16.55/bbl while a peak of US$67.8/bbl was recorded in January 2020 just before the COVID-19 pandemic. However, towards the end of the fourth quarter of 2020 oil prices began to increase as restrictions were relaxed in most countries globally. At the close of the year, crude oil prices were US$47.02/bbl, US$49.48/bbl and US$49.99/bbl for West Texas Intermediate (WTI) Midlands, Murban and Brent respectively. Figure 2-15 shows the trend in international oil prices for 2020.

Figure 2-15: Trend in international oil prices, January to December 2020

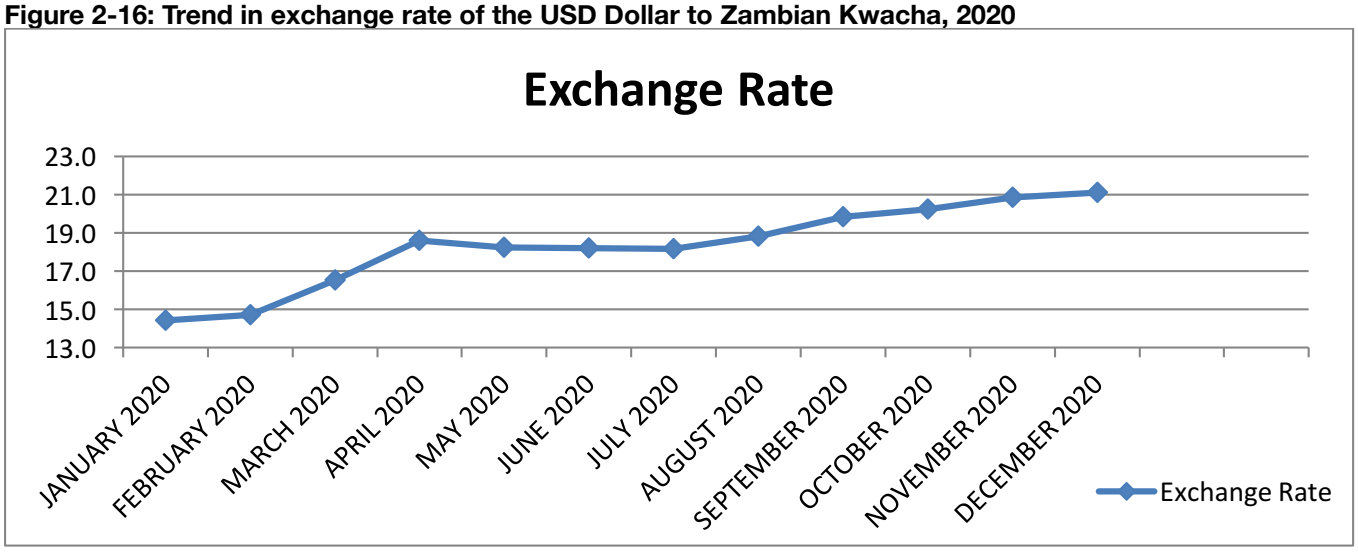


	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
WTI Midland	57.34	51.23	29.21	16.55	28.56	38.31	40.71	42.34	39.63	39.40	40.94	47.02
Murban	67.8	56.10	33.58	21.27	28.23	39.33	43.73	45.49	41.06	43.09	41.88	49.48
Brent	63.48	56.21	32.12	18.38	29.38	40.27	43.24	44.74	40.91	40.19	42.69	49.99

2.6.3 Trend in the exchange rate in 2020

Between January and December 2020, the Zambian Kwacha to the US dollar exchange rate depreciated by 46.24 percent, from K14.00/US$ to K21.11/US$. The trend was consistent throughout the year. The general trend in depreciation was attributed to increased demand for foreign exchange and reduction of economic activities due to effects of the Covid – 19 pandemic.

Figure 2-16: Trend in exchange rate of the USD Dollar to Zambian Kwacha, 2020

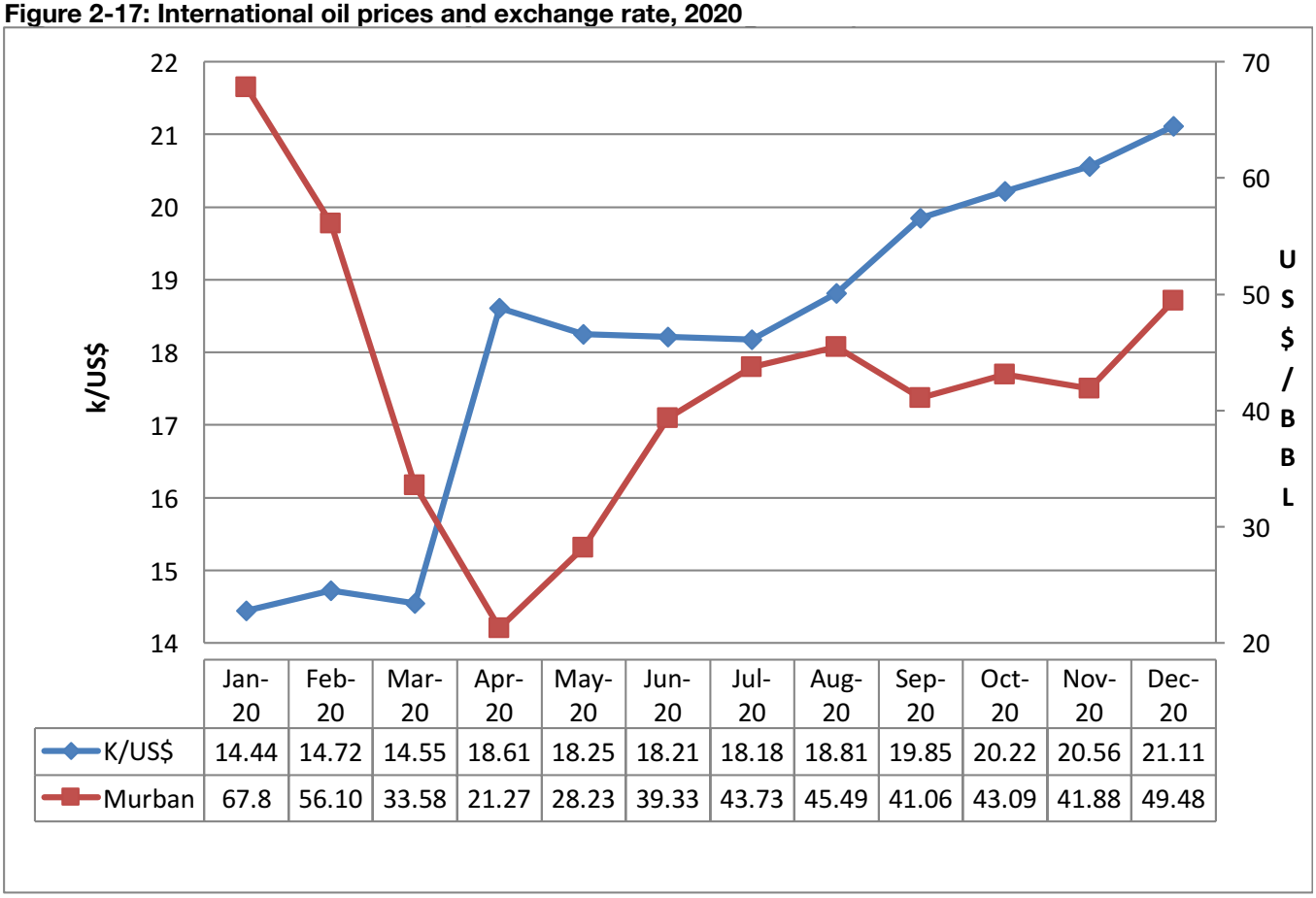


2.6.4 Trends in the international oil prices and the exchange rate

International oil prices and the exchange rate between the Zambian Kwacha and the United States Dollar are the two fundamentals that influence the fuel prices in Zambia. In cases where the Zambian Kwacha appreciates against the United States Dollar and International Oil prices decline, fuel prices would be expected to reduce. Similarly, when the fundamentals move in the same direction where the Zambian Kwacha depreciates against the United States Dollar and international oil prices increase, fuel prices would be expected to increase.

However, in some instances the two fundamentals may move in opposite directions, where the Zambian Kwacha depreciates while the international prices decline. In such cases, the depreciation of the Zambian Kwacha against the United States Dollar is negated by the one variable being the declined international oil prices. Therefore, fuel prices would change slightly or remain constant during the period of review.

Figure 2-17: International oil prices and exchange rate, 2020



	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
K/US$	14.44	14.72	14.55	18.61	18.25	18.21	18.18	18.81	19.85	20.22	20.56	21.11
Murban	67.8	56.10	33.58	21.27	28.23	39.33	43.73	45.49	41.06	43.09	41.88	49.48

2.6.5 Petroleum Pricing Mechanism in Zambia

The pricing of petroleum products in Zambia is done by the ERB. The ERB has been using the CPM to price petroleum products since 2008. In 2020, the ERB continued to review fuel prices using the CPM whenever petroleum feedstock and finished petroleum products were imported into the country, that is, every 45 to 60 days. The ERB regulates both the wholesale and retail prices for petroleum products. However in the case of LPG, Jet A-1, HFO and Bitumen, the ERB only sets the wholesale price. For LPG, Jet A-1, HFO and Bitumen, the ERB uses light-handed regulation where the seller is allowed to set the retail price but the cost build-ups are reviewed and considered for reasonableness by the ERB.

The cost elements in the CPM are divided into two groups:

i. Wholesale price build-up; and

ii. Pump Price build-up.

2.6.5.1 Wholesale Price Build-up

Table 2-6 shows the different cost elements in the wholesale price build-up.

Table 2-6 Cost Elements in the Wholesale Price as at 31st December, 2020

No	COST ELEMENT	VALUE	BASIS
a.	Cost-Insurance-Freight (US$/MT)	Variable Cost	Contract/Supplier Invoice
b.	Ocean Losses	0.00%	Contract
c.	Wharfage[12]	1.25%	Tanzanian Harbour Authority (THA)
d.	Insurance	0.11%	Insurer
e.	TAZAMA Storage Fee (US$/MT)	2.00	TAZAMA
f.	TAZAMA Pumping Fee (US$/MT)	49.00	Determined by ERB
g.	TAZAMA Pipeline Losses *(pipeline consumption of 0.50% & allowable pumping losses of 0.50%)*	1.00%	Determined by ERB
h.	Agency Fee (US$/MT)	5.00	Agency Agreement
i.	Refinery Fee (US$/MT)	55.38	Determined by ERB
j.	Refinery Processing Losses	7.50%	Determined by ERB
k.	Terminal Losses *(0.5% for Petrol Kerosene & Jet A-1 and 0.3% for diesel)*	0.5%, 0.3%	Best Practice

Appendix 2. shows the petroleum value chain in Zambia while the components of the CPM are depicted in Appendix 3. To account for both petroleum feedstock and finished petroleum products, the CPM computes a weighted wholesale price for both diesel and petrol as depicted below:

The weighted average wholesale price for diesel is calculated as follows:

i. *Expected Revenue from imported Low Sulphur Gasoil (LSG) (A) = Total quantity of Imported LSG* ***x*** *The landed unit cost (Cost, Insuarance and Frieght price) CIF TAZAMA depot*

ii. *Revenue expected from INDENI Diesel (B)* **=** *Expected Diesel yields from processed Cargo* ***x*** *Computed Diesel Wholesale price as per CPM*

iii. *Weighted Average Wholesale Price (C)* $= \dfrac{(A+B)}{\text{INDENI diesel yields} + \text{LSG Import Quantity}}$

$$C = \frac{(A + B)}{\delta}$$

Where

The weighted average wholesale price for petrol is calculated as follows:

i. *Expected Revenue from imported Petrol (D) = Total quantity of Imported Petrol x The landed unit cost CIF TAZAMA depot*

ii. *Revenue expected from INDENI Petrol (E)* **=** *Expected Petrol yields from processed Cargo* ***x*** *Computed Petrol Wholesale price as per CPM*

[12] Fee charged by ocean carriers to cover the port authority's cost of using a wharf to upload cargo from a vessel.

iii. *Weighted Average Wholesale Price (F) =* $\frac{(D+E)}{INDENI\ Petrol\ yields + Petrol\ Import\ Quantity}$

Where

Table 2-7 details the exposition of different cost elements in the wholesale price build-up.

Table 2-7: Exposition of different cost elements in wholesale price build-up

No.	Cost Element	Description
1.	CIF	The Cost-Insurance-Freight (CIF) of the petroleum feedstock cargo is the landed cost of the cargo at the port of Dar-es-Salaam. The quantities of the constituent components of the petroleum feedstock, which include crude oil, condensate, naphtha and diesel, are multiplied by the unit costs to derive the total monetary cost of the feedstock.
2.	Ocean Losses	The normally acceptable loss incurred in the loading and offloading of petroleum feedstock and petroleum products from a vessel.
3.	Wharfage	THA levies a statutory charge on the importation of petroleum products.
4.	Insurance	The insurance costs are set at 0.11% of CIF. The insurance covers the cost of insuring the feedstock from Dar-es-Salaam to Ndola.
5.	TAZAMA Storage Fee	TAZAMA charges US$2/MT to the importer for any petroleum feedstock quantities that are stored at the Dar-es-Salaam tank farm on the last day of the month. The amount was agreed upon between TAZAMA and Government.
6.	TAZAMA Pumping Fee	TAZAMA charges US$49.00/MT to the importer for transporting petroleum feedstock through the pipeline from the Dar-es-Salaam tank farm to the Refinery in Ndola.
7.	TAZAMA Pipeline Losses	Consumption and losses for TAZAMA are currently set at 1.00%.
8.	Agency Fee	Government appointed TAZAMA as an agent to discharge specific duties in the procurement of petroleum feedstock. The Agency fee is currently US$5/MT.
9.	Processing Fee	INDENI charges a processing fee of US$55.38/MT to the importer for refining (processing) petroleum feedstock.
10.	Refinery Losses	Some petroleum feedstock quantities are lost during the refining process due to normal processing losses and consumption, as some quantities are consumed as fuel in the process. The consumption and losses figure is set at 7.5%.
11.	Terminal Losses	These are terminal losses as prescribed by international norms. A loss level of 0.5% is allowed for petrol and 0.3% for kerosene, jet A-1 and diesel.

2.6.5.2 Pump Price Build-up

The pump price build-up constitutes the terminal fee, marking fee, respective statutory excise duty on the different products, the OMC, dealer and transporters margins which are all determined by the ERB, the ERB fees, SRF and Value Added Tax (VAT) on products. Table 2-8 below shows the price build-up for the retail prices of petrol, diesel, kerosene and LSG.

Table 2-8: Cost elements in the pump price as at 31st December 2020

No.	DETAILS	UNIT COSTS	WORKINGS
1	Wholesale Price to OMC	K10.90, K10.57, K13.33 & K12.53 per litre each for petrol, diesel, kerosene and LSG, respectively.	a
2	Terminal Fee	K0.063/litre	b
3	Marking Fee	K0.10/litre	c
4	Excise Duty (incl.) road levy	K2.07 for Petrol, K0.66 for Diesel, K0 for Kerosene and K0.66 for LSG	d
5	Ex TAZAMA depot		E=(a+b+c+d)
6	Transport Cost	K0.26/litre for Petrol, K0.26/litre for Diesel, K0.09/litre for Kerosene and K0.26/litre for LSG	f
7	OMC Margin	K0.89/litre	g
8	TOTAL (Excl VAT)		h=(e+f+g)
9	Dealer Margin	K0.65/litre	i
10	PRICE TO DEALER		j= (h+i)
11	ERB Fees	0.7%	k
12	Strategic Reserves Fund	K0.15/litre for Petrol, Diesel, Kerosene and LSG	l
13	Price before VAT		m=(j+k+l)
14	VAT	16%	n
15	UNFORM PUMP PRICE	K/litre	o=(m+n)

2.7 STRATEGIC RESERVE FUND

The Strategic Reserve Fund (SRF) was introduced in 2005 by the Government of the Republic of Zambia with the objective of financing construction and rehabilitation of petroleum infrastructure as well as stabilising the fuel prices as was the case in both 2015 and 2016, when the price of Jet-A1 importation was stabilized using the Fund.

The Government levies 15 ngwee per liter on petrol, kerosene, Jet-A1, HFO and LPG that is sold in the country. The ERB has put in place a mechanism to monitor collections from OMC's on a monthly basis. This Fund is now part of the Energy Fund following the enactment of the Energy Regulation Act.

2.8 ANNUAL REVIEW OF PETROLEUM DOWNSTREAM MARGINS

The ERB is mandated to determine, regulate and review charges and tariffs in the energy sector of Zambia. The petroleum sub-sector comprises the upstream and the downstream value chain. The players in the upstream are TAZAMA Pipeline Limited (TPL), INDENI and TPPL. The downstream consists of OMCs, Retailers (Dealers) and Transporters. For the upstream, the ERB regulates the pumping fee for TPL, the refinery fee for INDENI and the throughput fee for TPPL. The ERB also regulates and determines the margins of OMCs, Dealers and Transporters in the downstream.

The guiding principle in reviewing the petroleum downstream margins (profit) annually is to ensure that the margins are updated and reflective of the cost of doing business. Further, the margins are reviewed so as to ensure that they are consistent with the changing economic variables such as inflation and exchange rate among others. The ERB has established a stakeholder margins review committee comprising representatives from the following; ERB, OMCs, rural and urban dealers, petroleum transporters, MOE and the Uniform Pump Price (UPP) manager.

In 2020, the stakeholder margins review committee met to review margins for OMCs, Dealers and Transporters. The purpose of the review was to update the margins which last were determined in 2019 in line with the changes in macro-economic factors such as the exchange rate and inflation. During 2020, the following margins were obtaining; OMCs at K0.89/litre and dealers at K0.65/litre while transporters margins were pegged at K0.95/M^3/km for distances above 20 km and K1.39/M^3/km for distances below 20 km. The margins remained the same as in 2019.

2.9 UNIFORM PETROLEUM PUMP PRICE

The Uniform Pump Pricing (UPP) was introduced in September 2010. The objective of the UPP is to standardize transport costs for areas that are far from the Government fuel depots and those that are near. Before the UPP was introduced, the cost of petrol, diesel kerosene and LSG at retail sites farthest from the Government fuel depots was higher than the price obtaining at retail sites closer to the depots.

The UPP Mechanism is designed to be self-financing through a cross subsidization of consumers that are far away from the fuel depots by those that are close to the fuel depots. This entails that OMCs with service stations that are located closer to the fuel depots contribute to the Fund whilst OMCs with service stations, located further away from the fuel depots claim from the Fund. Independent dealers remit to or claim directly from the Fund. However, the UPP mechanism only applies to fuel sold at retail pump stations and does not apply to fuel supplied by OMCs to commercial customers such as mines, commercial farmers and construction companies under negotiated commercial contracts. Under these arrangements the OMCs may sell fuel at prices above or below the UPP prices.

The receipts into and payments from the fund are managed by the ERB whereas Government has contracted a private company to audit the claims and contributions into the UPP. The role of the UPP manager also includes safeguarding the integrity of the UPP fund when any of the factors in the cost build-up change. The UPP fund is influenced by changes in petroleum prices and other cost build-up factors. Table 2-9 depicts an example of how transport differentials are determined under the UPP mechanism.

Table 2-9: Transport differentials for Chirundu from government fuel depots

Diesel				
Transportation costs by town				
Town	**Distribution Hub**	**Total Cost in Build Up**	**Actual Cost**	**Differential**
		K/ Litre	**K/ Litre/Km**	**K/ Litre**
		A	**B**	**C=(A-B)**
Chirundu	Ndola Fuel Terminal	0.52	0.78	(0.26)
Chirundu	Mpika Depot	0.52	1.28	(0.76)
Chirundu	Lusaka Depot	0.52	0.24	0.28
Chirundu	Mongu Depot	0.52	1.19	(0.67)
Chirundu	Solwezi Depot	0.52	1.19	(0.67)

Table 2-9 shows that the ERB determined transport margin resulted into actual transport costs of K0.78/litre/Km, K1.28/litre/Km, K0.24/litre/Km, K1.19/litre/Km and K1.19/litre/Km for retail sites uplifted from NFT, Mpika, Lusaka, Mongu and Solwezi depots respectively, for Chirundu town.

In order to conform to the uniform pump pricing in the price build-up for diesel, a rate of K0.52/km/litre is applied. This implies that if a transporter delivers petrol to a retail site in Chirundu from each respective fuel depots, the applicable charge for the transportation service to the OMC will be the actual transport cost (i.e. K0.78/litre/Km for NFT, K1.28/litre/Km for Mpika fuel depot, K0.24/litre/Km for Lusaka fuel depot, K1.19/litre/Km for Mongu fuel depot and K1.19/litre/Km for Solwezi fuel depot). Therefore, the OMC will then claim the difference of K0.26/litre/Km, K0.76/litre/Km and K0.67/litre/Km from the UPP Fund for quantities uplifted from NFT, Mpika, Mongu and Solwezi depots, respectively. However, for products uplifted from Lusaka fuel depot, the OMC will remit the difference of K0.28/litre/Km to the Fund.

2.10 PRICING FRAMEWORK FOR JET A-1

In 2020, the ERB continued to conduct test runs of the pricing of Jet A-1 using an alternative pricing model called Import Parity Pricing (IPP). Being a fundamental shift in pricing, the implementation of the IPP framework for Jet A-1 was subjected to additional stakeholder and policy consultations so as to firm up the position taken to migrate it from the current CPM. As at end of 2020, the policy interrogations processes were still underway.

2.11 DOMESTIC AND REGIONAL FUEL PRICES

2.11.1 Domestic Fuel Pump Prices

The ERB continued to use the CPM to determine the wholesale and the pump prices for petroleum products, during 2020.

In line with Government policy, fuel prices in Zambia are reviewed on a 60 day cycle based on the time it takes to consume the imported petroleum feedstock and finished petroleum products. Fuel price revisions in Zambia are also dependent on the size and direction of the movement in the exchange rate between the Zambian Kwacha and the United States Dollar and the International oil prices.

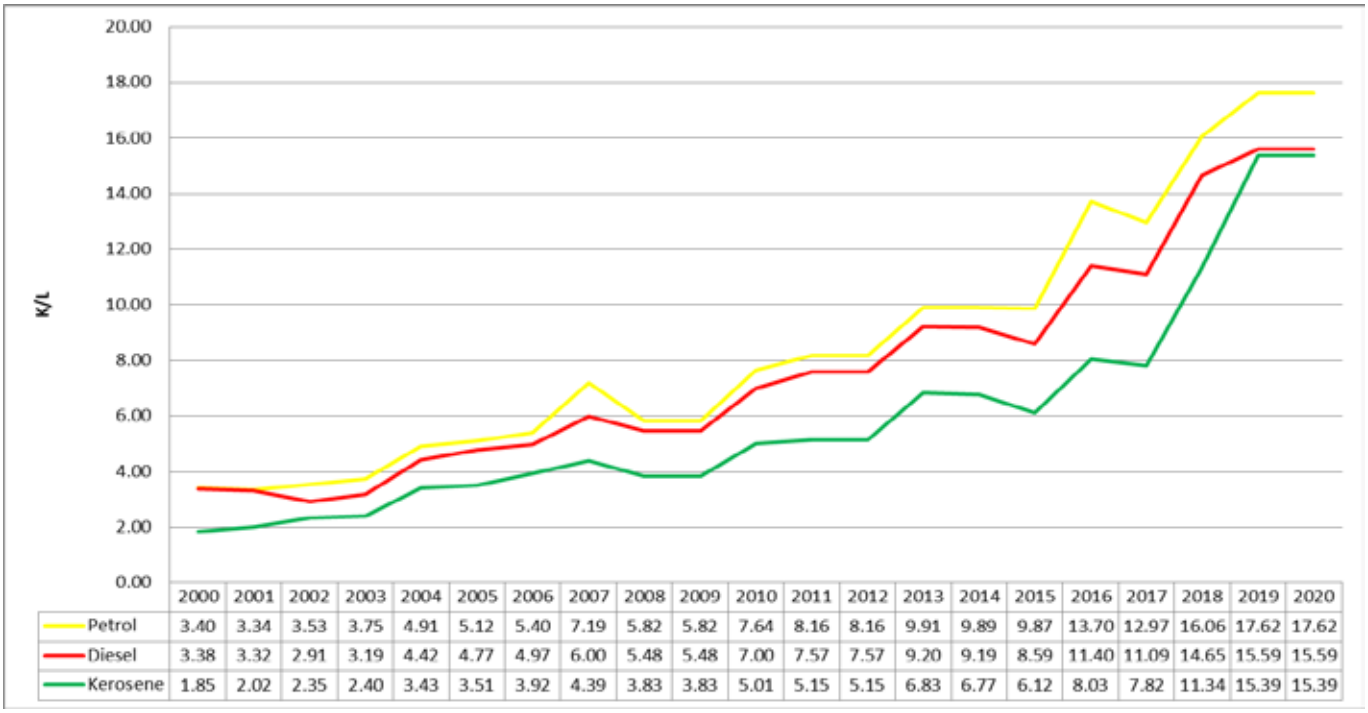
In addition, for each respective price reviews, fuel prices are only adjusted when the 2.5 percent threshold of wholesale prices is exceeded. This implies that fuel prices are not adjusted if the average change in the proposed wholesale price is less than the 2.5 percent threshold. This is for the purpose of maintaining price stability.

Notably, there were no petroleum price adjustments made by the ERB during 2020.

2.11.2 Trends in domestic fuel prices

Figure 2-18 shows the trend in nominal pump prices[13] of petrol, diesel and kerosene since 2000.

Figure 2-18: Trends in nominal pump prices, 2000-2020



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Petrol	3.40	3.34	3.53	3.75	4.91	5.12	5.40	7.19	5.82	5.82	7.64	8.16	8.16	9.91	9.89	9.87	13.70	12.97	16.06	17.62	17.62
Diesel	3.38	3.32	2.91	3.19	4.42	4.77	4.97	6.00	5.48	5.48	7.00	7.57	7.57	9.20	9.19	8.59	11.40	11.09	14.65	15.59	15.59
Kerosene	1.85	2.02	2.35	2.40	3.43	3.51	3.92	4.39	3.83	3.83	5.01	5.15	5.15	6.83	6.77	6.12	8.03	7.82	11.34	15.39	15.39

Trends in domestic fuel prices have generally been rising since 2001. During the period under review, the price of petrol has constantly been higher than the price of diesel and kerosene, respectively, except before 2001. The difference between the price of petrol, diesel and kerosene is mainly on account of taxes. Specifically, petrol attracted a higher excise duty than the other two products. As at 31st December, 2020, excise duty on petrol was at K2.07/litre compared to K0.66/litre on diesel and zero on kerosene. In 2013, Government removed fuel subsidies in order to make the prices more cost reflective. This resulted in a steep rise in the prices of petrol, diesel and kerosene from 2013 onwards as depicted in Figure 2-17.

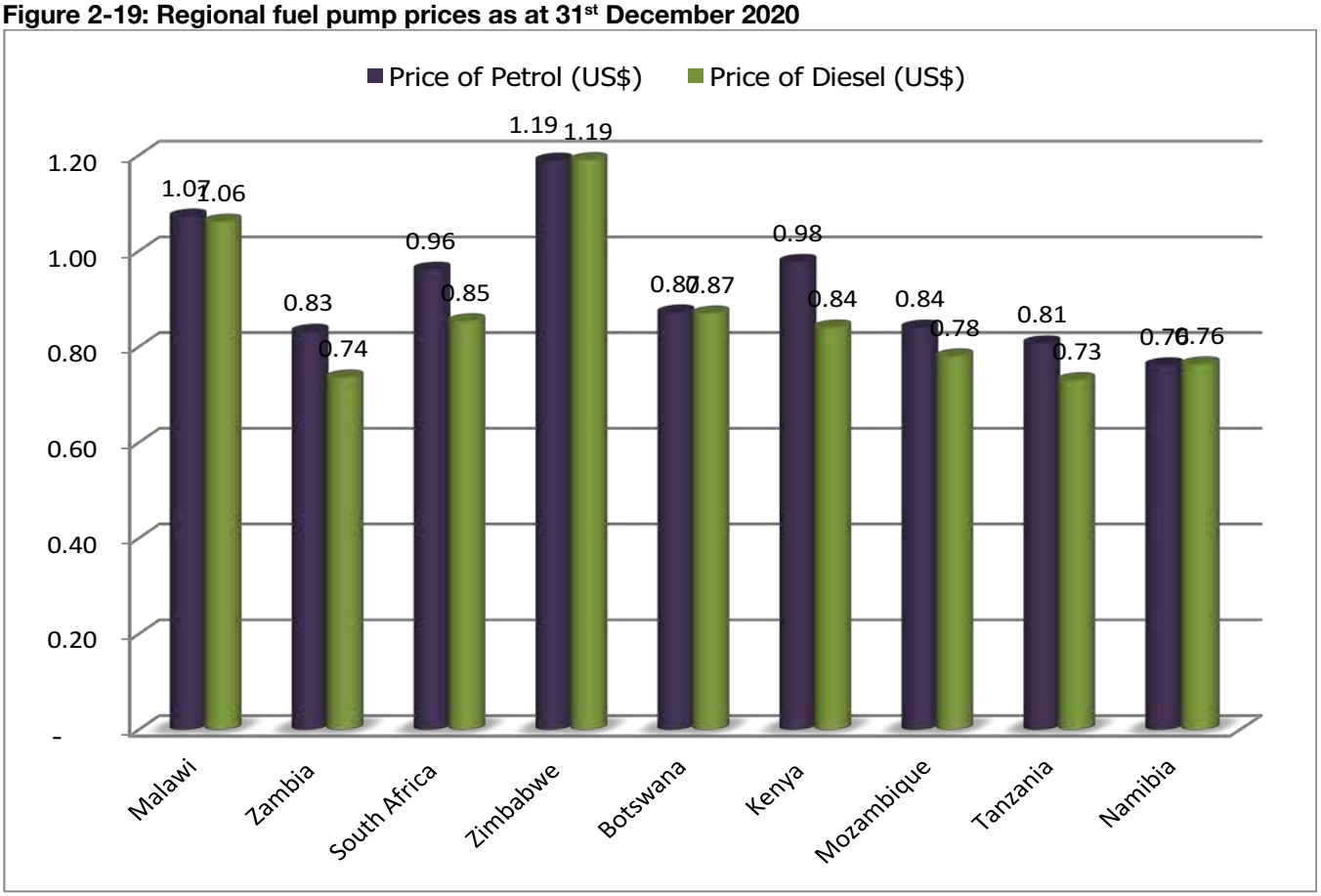
The price of petrol, diesel and kerosene remained constant at K17.62/litre, K15.59/litre and K15.39/litre, respectively, in 2019 and 2020.

[13] The BOZ daily market average rate of K21.19/US$, as at 31st December, 2020 exchange rate was used to convert the local prices for Zambia from K/litre to US$ per litre

2.11.3 Regional Fuel Prices

Figure 2-19 shows the regional pump price comparison of petrol and diesel as at 31st December 2020 for selected countries Southern and Eastern Africa.

Figure 2-19: Regional fuel pump prices as at 31st December 2020



Source: National Energy Regulators/Department of Energy websites

There are several reasons that explain the variations in the pump price of fuel in Eastern and Southern Africa. These include the following: proximity to the sea; differences in levies and taxes that are applied in the cost build-up; application of taxes and quantum; government policy on subsidies and cost reflectivity; varying importation modes; production modes (Refinery vs Finished Products); different supply options (road or rail); different infrastructure investment (roads, refinery or pipeline) and different pricing models (CPM vs IPP).

The price of both petrol and diesel in the region was highest in Zimbabwe, followed by Malawi, as at 31st December, 2020. The prices in Zambia[14], Kenya, South Africa, Namibia, Botswana and Tanzania remained below US$1 per litre. Namibia and Tanzania recorded the lowest pump prices for petrol and diesel, respectively, in the region as shown in Figure 2.19.

2.12 COMPLIANCE OF LICENSEES IN THE PETROLEUM SUB-SECTOR

2.12.1 Petroleum Product Quality Monitoring

By mandate, ERB is supposed to monitor the quality of petroleum products on the market. This is to ensure that the products conform to the set standards. During the period under review, two hundred and fifty two (252) petroleum product samples were collected from the Government depots and OMC owned depots country wide for testing. This was in line with the ERB's mandate of ensuring provision of quality, reliable and affordable product and services as stipulated in the SBP. The overall results for the tests are presented in Table 2-10.

[14] The BOZ daily market average rate of K21.19/US$, as at 31st December, 2020 exchange rate was used to convert the local prices for Zambia from K/litre to US$ per litre

Table 2-10: Petroleum products sample test results, 2019-2020

Product	No. of Samples Collected		Quality Compliance (%)	
	2019	**2020**	**2019**	**2020**
Petrol	57	76	95	97
Diesel	73	117	99	97
LSGO	43	34	100	97
Kerosene	3	7	100	100
Jet A -1	7	18	100	100
Total	183	252	98	98

In comparison with the set SBP target of 95 percent, an overall average quality compliance rate was maintained at 98 percent as was the case in 2019. The high quality compliance rate of petroleum products was attributed to the implementation of the fuel marking programme which commenced in February 2018.

2.12.2 Technical audits of petroleum infrastructure

The ERB continued to undertake technical audits of petroleum infrastructure in 2020. The results of the technical audits are shown in Table 2-11.

Table 2-11 : Results of petroleum infrastructure compliance monitoring, 2019-2020

Facility	% COMPLIANCE	
	2019	**2020**
Filling Station	89.6	89.9
Fuel Depot	87.1	94.7
LPG Depot/ Filling Plant	76.6	96.7
Refinery	97.5	97.7
Pipeline	94.5	96.2
Total	90.2	95.1

The overall average compliance for petroleum infrastructure recorded in 2020 was 95.10 percent compared to 90.20 percent in 2019 against set targets of 91 and 89 percent respectively. This increase in compliance was attributed to enforcement action undertaken against erring licensees following technical hearings during the year 2019 and 2020 respectively.

2.12.3 Infrastructure grading of service stations

During the period under review, several stakeholders' concerns about the grading system were raised which warranted the need for their revision. Consequently, no infrastructure grading of service stations was carried out in 2020. The grading is planned to commence in the first quarter of 2021 after stakeholder concerns have been addressed such as misconceptions of the grading against product quality of fuel, visibility of stickers among other.

2.12.4 Technical KPIs for TAZAMA Pipelines Limited

The performance of TAZAMA was satisfactory as the company's failure to meet the KPI targets set by the ERB was as result of lack of petroleum feedstock. The performance of TAZAMA against the ERB set Key Performance Indicators (KPIs) for the year under review is shown in Table 2-12.

Table 2-12: TAZAMA's performance against KPI's 2019-2020

No.	Indicator	KPI Target	Actual Performance		Comment
			2019	2020	
1	Throughput (Metric Tonnes)	650,000	664,339.69	354,808.96	Not Achieved
2	Operational days	315	317.7	170	Not Achieved
3	Pumping Rate (m^3/hr)	105	105.58	105.63	Achieved
4	Consumption and Losses (%)	1.20	0.92	0.80	Achieved
5	Safety, Health & Environment	0	14	2	Not Achieved

Due to the lack of petroleum feedstock, TAZAMA did not meet the target throughput and operational days as required by the KPI framework. However, the Safety, Health and Environment (SHE) targets were not met because of the 2 incidents that were recorded these incidences included one (1) pipeline leak on the 12" line at Km450, Ilula area in Tanzania caused by external corrosion. About 1,500 litres of crude oil was spilt within the way leave polluting an area of about 1,200m^2. The leak, although minor, caused soil pollution within the pipeline way leave.

2.12.5 Financial KPI Audits – TAZAMA

In 2020, the ERB conducted financial KPIs audits for TAZAMA. Table 2-13 shows the financial KPI performance of TAZAMA, during the period under review.

Table 2-13: TAZAMA's performance against KPI's - 2020

Indicator	KPI Target	Actual Performance	Comment
Current ratio	1.2	6.81	Achieved
Debtor days	15	92.00	Not achieved

TAZAMA managed to achieve the KPI target for current ratio but failed to achieve the target for debtor days.

2.12.6 INDENI Technical KPIs

In 2020, INDENI's performance on the technical KPIs is as shown in table 2-15.

Table 2-14: INDENI's performance against KPI's 2019-2020

No.	Indicator	KPI Target	Actual Performance		Comment
			2019	2020	
1	Throughput/MT	700,000	698,705	372,384	Not achieved
2	Operational days	315	318.64	175.43	Not achieved
3	Consumption and Losses (%)	8.50	7.25	122.51	Not Achieved
4	Quality compliance for Refined petroleum products (%)	100	100	100	Achieved
5	Safety Health & Environment/ No of incidents	0	15	8	Not achieved

During the period under review, INDENI did not meet the KPI targets on throughput due to lack of petroleum feedstock procured. Consequently, operational days were below the target of 315 days. On consumption and loss, INDENI did not attain the target of 8.5 percent having recorded a consumption and losses ratio of 122.51 percent. INDENI recorded four (04) gas leak incidents due to equipment failure, one (01) lost time injury and three (3) fire incidents.

Conversely, INDENI met the KPI target on quality compliance for refined petroleum products.

2.12.7 Financial KPI Audits - INDENI

During the period under review the ERB conducted financial KPIs audits for INDENI. Table 2-15 shows the financial KPI performance of INDENI, during the period under review.

Table 2-15: INDENI's performance against KPI's-2020

Indicator	KPI Target	Actual Performance	Comment
Current ratio	1.0	2.68	Achieved
Debtor days	15	86.77	Not achieved

The KPI audit results revealed that INDENI achieved the KPI target for current ratio but failed to achieve the target for debtor days.

2.12.8 TAZAMA Petroleum Products Limited- Technical KPIs

The performance of TPPL on the technical KPI's is shown in the Table 2-16.

Table 2-16 : TPPL's performance against KPI's

No.	Indicator	Product	Set KPI target (%)	ACTUAL PERFORMANCE		Comment
				2019	2020	
1	Throughput (m^3)	All	-	1,503,830	940,258	Monitored only
2	Unaccountable Losses (%)	Diesel	0.30	0.19	0.19	Achieved
		Petrol	0.50	0.39	1.39	Not Achieved
		Kerosene	0.30	0.12	0.15	Achieved
3	No. of Petroleum Product Quality Incidents	-	0	1	0	Achieved
4	No. of Safety Health and Environmental incidents	-	0	0	0	Achieved

Throughput volumes at all five government depots continued to be monitored but not scored. During 2020, TPPL only achieved the targets for product quality and SHE KPIs. The KPI for unaccountable losses was not met because of the high average storage losses recorded for petrol of 1.39 percent against the target of 0.50 percent.

2.12.9 TAZAMA Petroleum Products Limited – Financial KPIs

During 2020, the ERB undertook financial KPIs audits for TPPL. Table 2-17 shows the financial KPI performance of TPPL, during the period under review.

Table 2-17: Financial KPI performance of TPPL- 2020

Indicator	KPI Target	Actual Performance	Comment
Current ratio	1.2	2.09	Achieved
Debtor days	15	0	Achieved
Asset Turnover	2.0	1.61	Not achieved
Creditor days	90	74.52	Achieved

TPPL managed to achieve the KPI targets for debtor days, current ratio and creditor days but failed to achieve the targets for asset turnover. During the period under review TPPL experienced a significant drop in throughput activities which resulted in reduced expected revenue, as a result, the KPI target for asset turnover was not attained.

2.13 GOVERNMENT OWNED STORAGE DEPOTS FOR WHITE PRODUCTS

One of the objectives of the NEP 2019 is to ensure adequate, reliable and affordable supply of petroleum products and LPG in order to increase security of supply of petroleum products. Government intends to achieve this objective through the construction of fuel depots in all the ten provinces of Zambia.

Government commenced the construction of Mansa and Chipata fuel depots in 2018. Table 2-18 shows the status of Mansa, Chipata and Lusaka (phase 2) fuel depots as at 31st December, 2020.

Table 2-18: Status of the construction of GRZ owned storage depots for white products as at 31st December, 2020

No.	Fuel Storage Depot	Estimated Cost US$' million*	Status
1.	Mansa Fuel Depot	33	• Mansa Depot was 100 percent complete by the close of December 2020, and was only awaiting technical handover to TPPL. • The depot will have a total storage capacity of 6.5 million litres comprising 4 million litres of diesel, 2 million litres of petrol and 0.5 million litres of kerosene. • The depot is expected to be commissioned in 2021.
2.	Chipata Fuel Depot	38	• Construction works were underway during the period under review. Progress on the development of the depot was at 72 percent by close of December 2020. • The depot will have a capacity of 7.0 million litres with the following breakdown: 4 million litres Diesel; 2 million litres Petrol; 0.5 million litres Kerosene; and 0.5 million litres Jet A-1.
3.	Lusaka (Phase 2) Fuel Depot	124	• Construction works were underway during the period under review. Progress on the development of the depot was at 54 percent by close of December 2020. • The depot will have a capacity of 102 million litres with the following breakdown: 60 million litres Diesel; 40 million litres Petrol; and 0.2 million litres Kerosene

2.14 DEVELOPMENT OF TECHNICAL STANDARDS, GUIDELINES AND FRAMEWORKS

In terms of Section 4(h) of the Energy Regulation Act, the ERB is mandated to design technical standards with regard to the quality, safety and reliability of supply of energy products in collaboration with Zambia Bureau of Standards (ZABS). Further, all licensees are required to conduct their licenced activities in accordance with the applicable prescribed standards as provided under Section 31 of the Energy Regulation Act. In 2020, a total of three frameworks and guidelines were developed and revised.

The details of the frameworks and guidelines developed and revised are indicated in Table 2.19.

Table 2-19: Technical framework and guidelines revised and developed

Category	Sector	Description	Number
Frameworks	Petroleum	• Developed Lubricants Regulatory framework	01
Guidelines	Petroleum	• Revised Guidelines for Siting of Petroleum Infrastructure • Developed Guidelines for use of mobile phones and other portable electronic equipment at petroleum infrastructure	02
	Total		**03**

2.15 FUEL MARKING PROGRAMME

During the period under review, the ERB continued to implement the fuel marking programme which commenced in February 2018, following the promulgation of the Fuel Marking Statutory Instrument (SI) No. 69 the Energy Regulation (Petroleum Marking and Monitoring) of 2017. In that regard, diesel, LSGO, petrol and kerosene uplifts for domestic consumption from all Government depots were marked prior to distribution on the Zambian market. In addition, marking of fuel was also undertaken at designated OMC depots. A total of 1,582,319.39 m^3 of fuel was marked during the period under review.

Sampling and testing at operational service stations and identified consumer sites (including those at the mines) in all the ten provinces of the country was conducted in line with SI No. 69 of 2017. The results showed a marginal increase in the pass rate from an overall compliance of 96.97 percent in 2019 to an overall compliance of 97.21 percent in 2020. The increase in compliance can be attributed to the increased frequency of compliance inspections as well as enhanced awareness by industry players on the need to ensure that all fuel being retailed and distributed is marked appropriately in line with the regulations. The 97.21 percent pass rate implied that the fuel that was distributed in the country was from legitimate sources and of acceptable quality. Table 2-20 shows the results of the fuel marking sampling and testing exercise by province.

Table 2-20: Results of the fuel marking exercise by province

	2019 sampling and testing results		2020 sampling and testing results	
Province	**No. of samples collected**	**% Pass rate**	**No. of samples collected**	**% Pass rate**
Central	103	97.09	421	95.96
Copperbelt	314	97.13	1,395	97.06
Eastern	65	98.46	301	99
Lusaka	365	98.63	1,553	98.33
Southern	90	97.78	415	99.28
Western	28	96.43	132	98.48
Northern	31	96.77	173	97.11
Muchinga	32	100	135	97.78
Luapula	27	100	126	97.62
Total	**1,122**	**96.97**	**4,941**	**97.21**

2.16 CHALLENGES IN THE PETROLEUM SUB-SECTOR

2.16.1 Shortage of petroleum feedstock

During the period under review, the petroleum industry faced challenges of insufficient supply of petroleum feedstock by the MOE. As a result, TAZAMA and INDENI experienced an increased number of unplanned shutdowns.

2.16.2 Shortage of oil refinery production

There is a shortage of oil refining capacity as compared to total demand for petroleum products. Total refining capacity for the country stands at about 850,000 tonnes as compared to the total consumption of about 1.50 million tonnes of petroleum products in 2020. This has necessitated the increase in importation of refined products mostly petrol, diesel, LSG and LPG.

2.16.3 Concentration of service stations in urban areas

In 2020, there was a continued expansion of retail sites by OMCs in urban areas compared to rural areas. This resulted into inadequate roll out of service stations in rural areas thereby posing a challenge of illegal fuel vending in un-serviced areas and consequent safety concerns to the consumers and the fuel vendors.

2.16.4 Illegal fuel vending

In 2020, illegal fuel vending continued to pose a challenge in the petroleum sub sector. This was noted to be most widespread in some rural areas which were not serviced by retail service stations.

2.17 OUTLOOK IN THE PETROLEUM SUB-SECTOR

2.17.1 OMC importation waivers

In 2021, the Government through the MOE is expected to increase the participation of the private sector (OMCs) in the direct importation of petroleum products into the country through issuance import waivers. This will enable the participating OMCs to import petroleum products into the country directly without incurring a cost of 25% import duty so as to supplement Government efforts in maintaining security of supply of petroleum products for the country.

2.17.2 IPP Pricing for Jet A-1

The ERB through consultations with stakeholders held several workshops on implementation of the IPP framework (a market based pricing model) for Jet A-1, migrating from the current of the CPM. The proposed pricing model is expected to be implemented in 2021. The adoption and migration of IPP methodology is expected to help addressing the noted challenges identified in the pricing of Jet A-1.

2.17.3 Rural Filling Station

OMCs have continued to roll out filling stations in rural areas across the country. The establishment of filling stations in rural areas has enhanced service delivery to some districts that were not serviced by filling stations thereby reducing and eliminating illegal fuel vending.

2.17.4 Increased National Petroleum Storage Capacity

The construction of the Mansa Fuel Depot by end of 2020 was at near completion. The fuel depot is expected to be commissioned in 2021 and will increase the total national petroleum storage capacity. The total number of fuel depots across the country is five (5) namely, Ndola Fuel Terminal (NFT), Solwezi Fuel Depot, Lusaka Fuel Depot, Mongu Fuel Depot and Mpika Fuel Depot. In 2021, Mansa fuel depot will be commissioned increasing the total number of fuel depots across the country to six (6).

2.17.5 Guarantee of Fuel Quality of Fuel Through Fuel Marking

The ERB continued to implement the fuel marking program which began in 2018. An increased fuel marking compliance rate from the initial 79 percent in 2018 to 97.21 percent at the end of the fourth quarter of 2020 was recorded. This indicated a significant improvement in the legitimate fuel being sold on the Zambian market which subsequently translates into guaranteed fuel quality fully meeting the specified Zambian petroleum product quality standards. This is further evidenced by the increase in petroleum product quality compliance from about 85 percent at the start of the program to above 97 percent at the close of 2020 as well as a decrease in the number of petroleum product complaints lodged with the ERB.

3 ELECTRICITY SUB-SECTOR

Zambia's electricity sub-sector is vertically integrated and includes a public utility company, ZESCO, as the major player covering generation, transmission and distribution. It is supported by several IPPs that sell its power. Some other players are engaged in the transmission and supply of electricity to end use customers. This section discusses the performance, new developments, challenges and outlook in the electricity sub – sector.

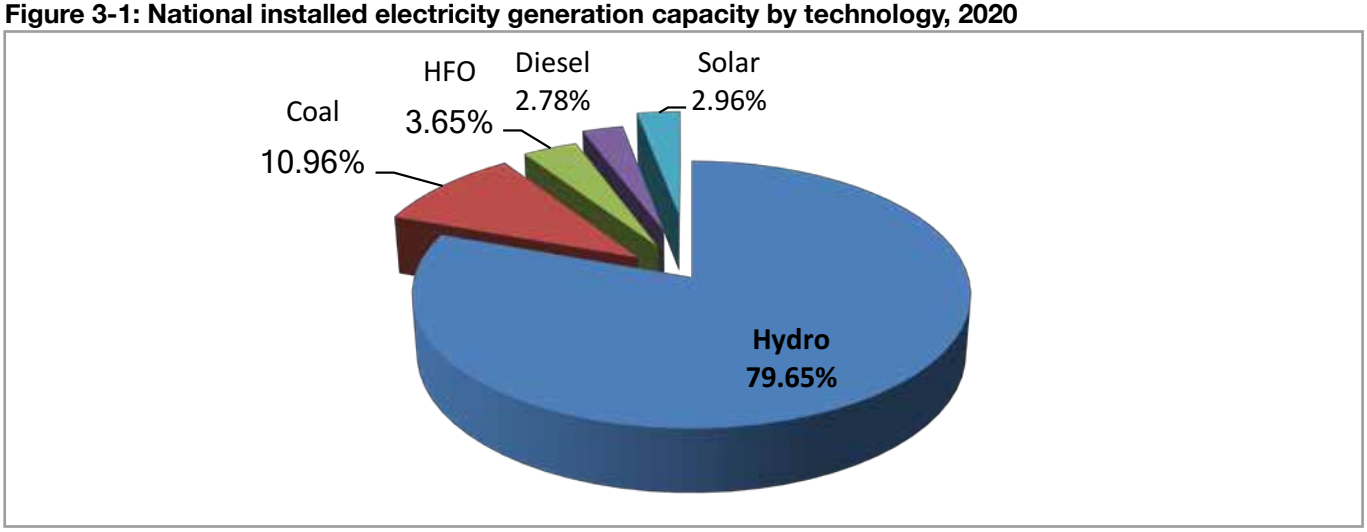
ZESCO Limited sub-station

3.1 Zambia's installed electricity generation capacity

In 2020, Zambia's installed electricity generation capacity was at 3,011.28 MW compared to 2,981.28 MW in 2019. The increase is attributed to Dangote's 30 MW connection to the national electricity grid. During 2020, the generation mix slightly changed as the sector slowly begun to have more clean energy. Solar energy contributed more to the increased installed electricity generation capacity (by 6.79 percent) compared to 2018 when solar energy only contributed 0.04 percent. Meanwhile, hydro power continues to account for a higher proportion of the generation mix at 79.65 percent; followed by coal at 10.96 percent; HFO at 3.65 percent; solar at 2.96 percent and diesel at 2.78 percent. Appendix 4 shows the installed electricity generation mix in Zambia during the year 2020.

According to the project developers, Kafue Gorge lower, a new power hydro station, is scheduled to be completed by mid –2021. This project will contribute significantly to the national installed electricity generation capacity. Figure 3-1 provides a summary of the contributions of generation technology to the national installed generation capacity.

Figure 3-1: National installed electricity generation capacity by technology, 2020

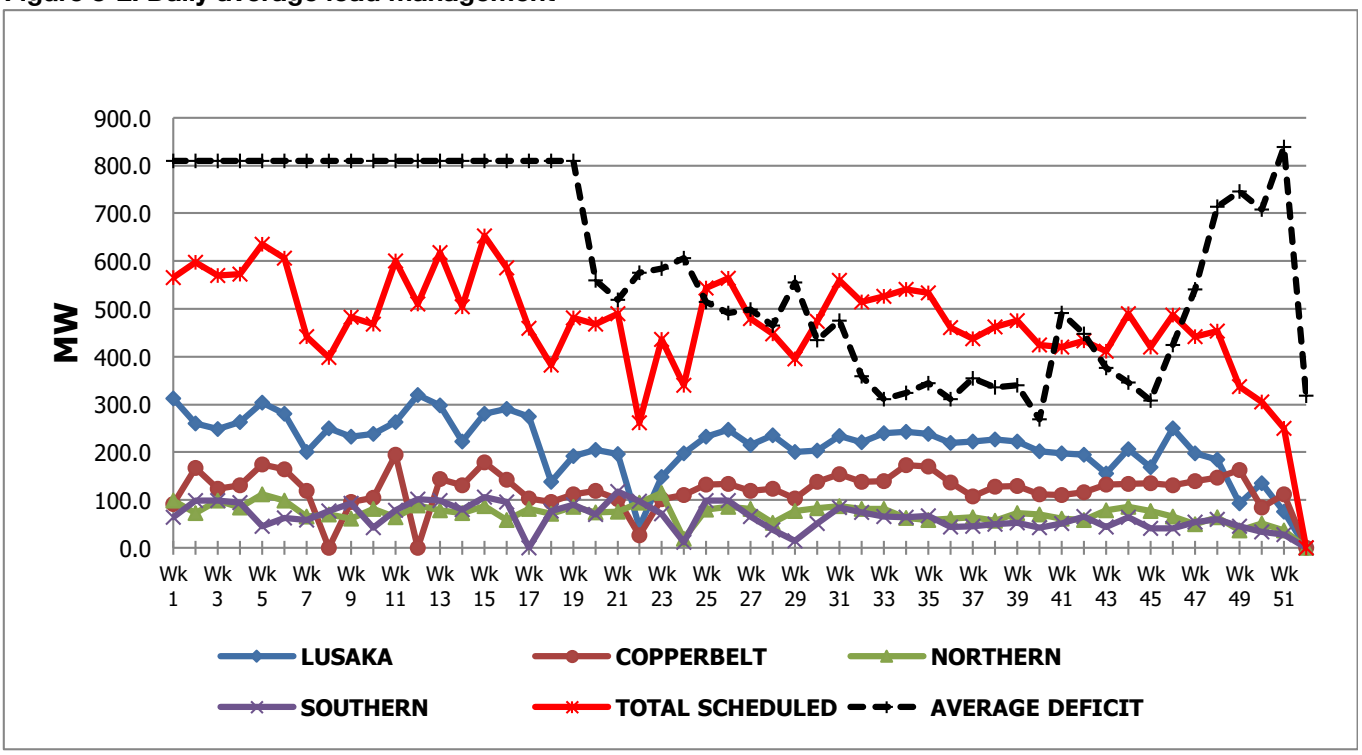


3.2 Power Deficit and Load Management

Zambia had a projected demand forecast of about 2,310 MW for the year 2020 against an average generation of about 1,500 MW. As at 2020, the highest power deficit was at 810 MW and was attributed to the reduced water levels in the main water reservoirs for power generation. The declared power deficit was distributed across ZESCO's four Divisions namely Lusaka, Copperbelt, Northern and Southern. During the year 2020, the total load shed in Lusaka Division was at a daily average of 213.83 MW while the Copperbelt Division shed a daily average of 120.57 MW. The Northern and Southern Divisions shed daily averages of 71.57 MW and 65.35 MW, respectively, giving a national total daily load shedding of 471.31 MW.

A comparison of the daily average load management carried out during the period under review is shown in figure 3-2.

Figure 3-2: Daily average load management



3.2.1 Hydrological Situation in Zambia

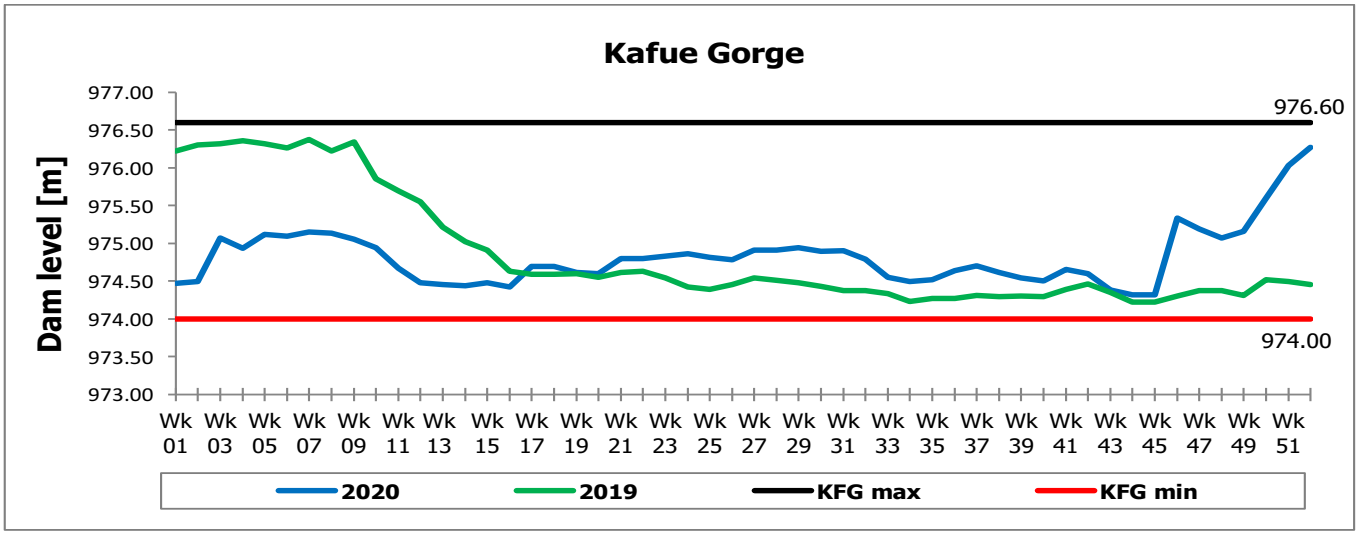
Zambia's power generation is predominantly hydro at 79.65 percent. Table 3.1 shows the dam levels for the main water reservoirs used for power generation at the beginning and end of the year under review, compared to the same period in 2019. The table also shows the design operational levels for the dams.

Table 3-1: Main Reservoir water dam levels-(1st January to 31st December,2020)

Main Water Reservoir	Dam Design Operational Levels [m]		Year 2020 Actual Dam Levels [m]		Year 2019 Actual Dam Levels [m]	
	Min. Dam Level	Max. Dam Level	Start Level [1st Jan]	End Level [31st Dec]	Start Level [1st Jan]	End Level [31st Dec]
KFGPS	974.0	976.6	974.45	976.27	976.12	974.45
KNBPS	475.5	487.71	476.69	478.39	483.32	476.64
VFPS	881.5	883.2	881.85	882.10	881.90	
ITPC	1,006.0	1,030.5	1,014.66	1,018.53	1025.20	1,012.19

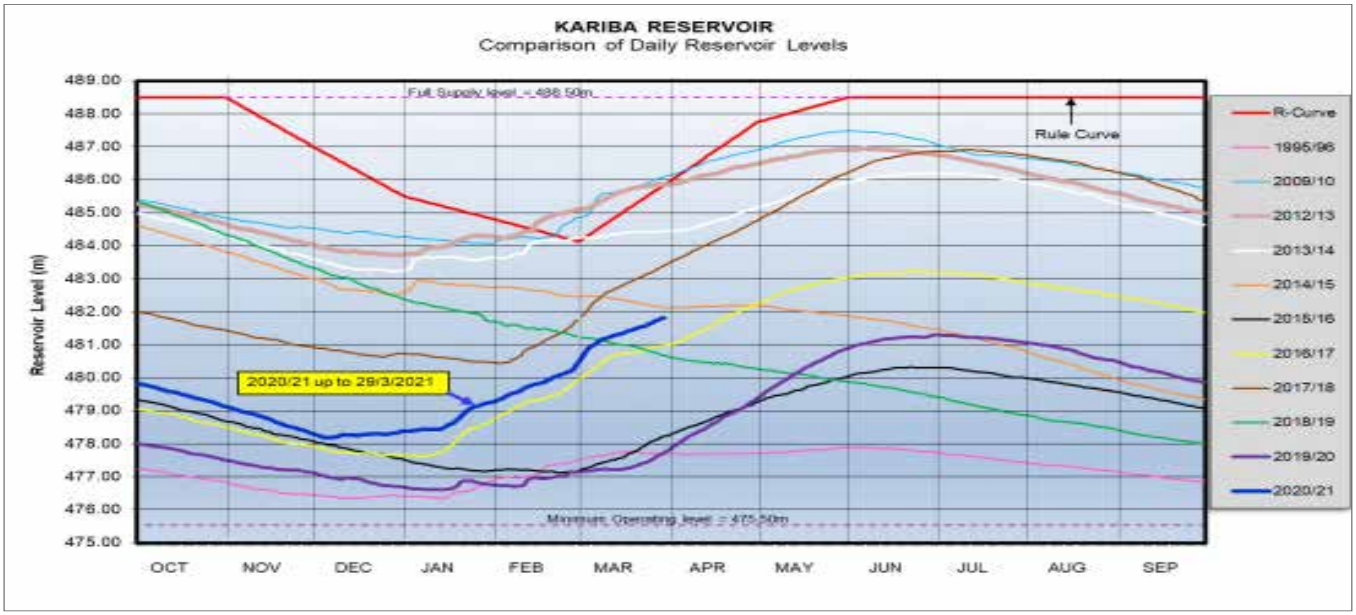
Further, Figures 3-3 to 3-6 show the weekly trend in the dam levels for the year 2020 compared to the same period in 2019.

Figure 3-3: 2020 trend analysis of dam levels at Kafue Gorge



The main water reservoir at Kafue Gorge is designed to operate at minimum and maximum levels of 974.00 m and 976.60 m respectively for hydropower generation. The dam level closed at 976.27 m equivalent to 87.31 percent of usable storage as at 31st December, 2020. In 2019, on the same date, the dam level was lower at 974.45 m equivalent to 17.31 percent of usable storage.

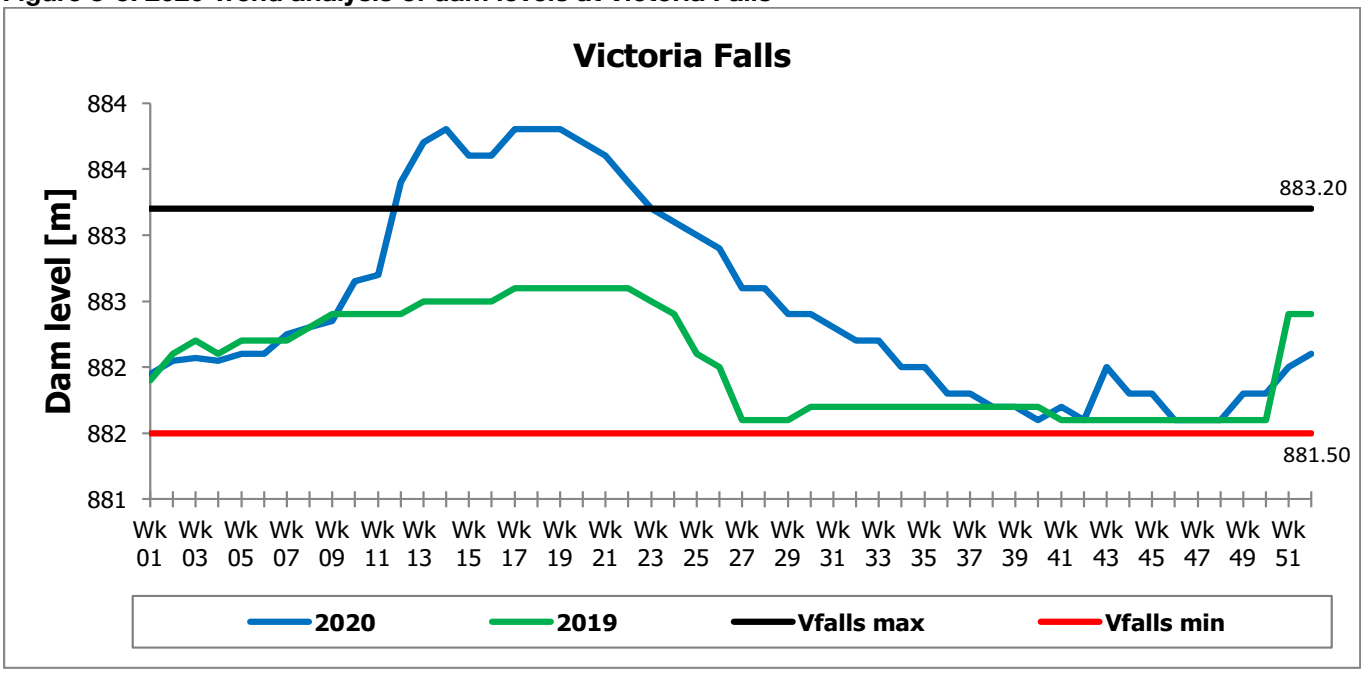
Figure 3-4: 2020 trend analysis of dam levels at Kariba Complex



Source: Zambezi River Authority website

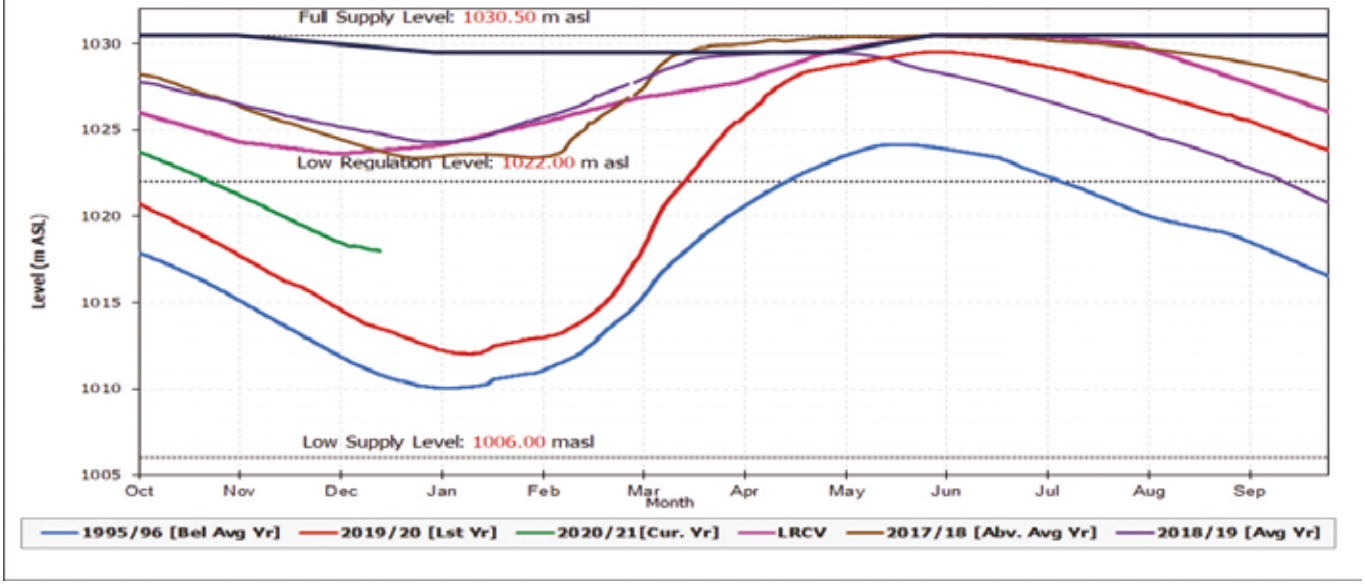
For optimum power generation, the Kariba dam is designed to operate between maximum and minimum levels of 475.50 m and 487.71 m respectively. On 31st December 2020, the dam level was at 478.38 m equivalent to about 20.08 percent of usable storage, while in 2019 on the same date, the dam level was at 476.67 m equivalent to 8.09 percent of usable storage.

Figure 3-5: 2020 Trend analysis of dam levels at Victoria Falls



For optimum hydro power generation, the main water reservoir at Victoria Falls is designed to operate between minimum and maximum levels of 881.50 m and 883.2 m respectively. On 31st December 2020, the dam level closed at 882.10 m equivalent to 35.29 percent of usable storage.

Figure 3-6: 2020 trend analysis of dam levels at Itezhi-tezhi



At Itezhi-Tezhi, the main reservoir for power generation is designed to operate between minimum and maximum levels of 1,006 m and 1,030.50 m respectively. On 31st December 2020, the dam level was at 1,018.53 m equivalent to 51.14 percent of usable storage, while, in 2019 on the same date, the dam level was at 1,012.19 m equivalent to 25.27 percent of usable storage. Itezhi – Tezhi dam is a primary storage facility for Kafue Gorge power station.

3.3 NATIONAL ELECTRICITY GENERATION

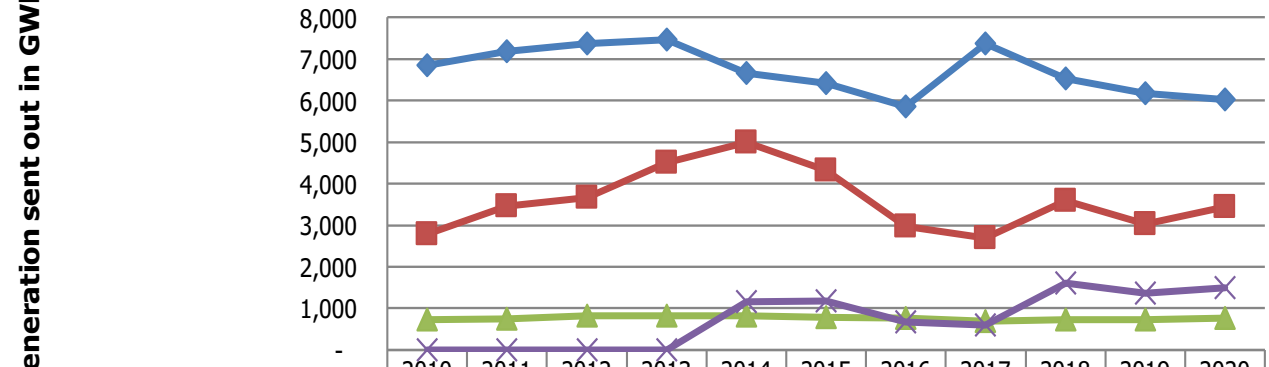
The national electricity generation recorded a marginal increase of 1 percent from 15,040 GWh in 2019 to 15,159 GWh in 2020. Electricity generation continued to be constrained by the low water levels in major water reservoirs for power generation. The increase in energy generation was attributed to significant energy generation at Maamba collieries as discussed in section 3.6.7.

3.3.1 Electricity Generation from Large Hydro Power Plants Owned by ZESCO

Kariba Dam

The large hydro power stations owned by ZESCO are: Kafue Gorge (990 MW), Kariba North Bank (KNB) (720 MW), Kariba North Bank Extension (KNBE) (360MW) and Victoria Falls (108 MW). During the year under review, generation sent out from ZESCO's large hydro power stations slightly increased from 11,274 GWh in 2019 to 11,716 GWh in 2020, representing a 4 percent increase. The increase was due to the slight improvement in the hydrological situation of the Zambezi and Kafue River Basins. Figure 3-7 shows the trend in ZESCO's large hydro power stations' generation sent out over a ten year period from 2010 to 2020.

Figure 3-7: Generation sent out by large hydro- power plants owned by ZESCO, 2010 to 2020



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Kafue Gorge	6,841	7,183	7,376	7,463	6,666	6,417	5,853	7,363	6,527	6,165	6,027
Kariba North Bank	2,777	3,451	3,668	4,507	4,999	4,316	2,964	2,689	3,597	3,021	3,431
Victoria Falls	724	747	810	810	811	785	754	684	723	725	764
Kariba North Bank Extension	-	-	-	-	1,162	1,179	672	599	1,611	1,363	1,494

As depicted in Figure 3-7 KNB, Victoria Falls and KNBE power stations, recorded marginal increases in generation sent out whereas a notable reduction was recorded in generation sent out from Kafue Gorge. This reduction was partly attributed to restricted power generation to facilitate downstream construction of KGL reservoir.

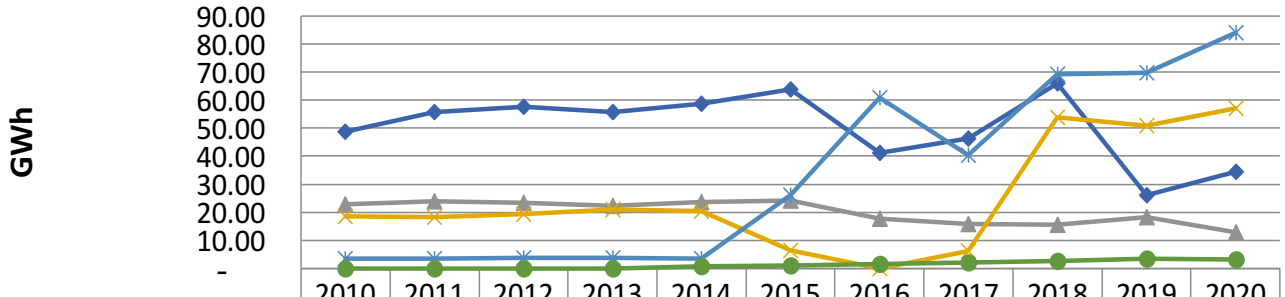
3.3.2 Electricity Generation from Small and Mini-Hydro Power Plants Owned by ZESCO

In 2020, the total electricity generation from small and mini-hydro power plants owned by ZESCO increased by 13.5 percent to 191.5 GWh in 2020 from 168.6 GWh in 2019.

The increase in generation sent out in 2020 is attributed to improved rainfall in the Northern parts of Zambia and the good performance of certain mini-hydro plants in comparison to the previous year. For instance the generation sent out from Lunzua mini-hydro increased from 69.7 GWh in 2019 to 84 GWh in 2020 representing a 21 percent increase, Musonda falls recorded an increase in generation of 11.76 percent from 51 GWh in 2019 to 57 GWh in 2020. Further, Lusiwasi recorded an increase in generation sent out from 26.2 GWh to 34.5 GWh, showing a 32 percent increase.

Conversely, Chishimba falls experienced a decrease in generation of 30 percent, from 18.4 GWh in 2019 to 12.8 GWh in 2020 mainly due to old infrastructure that is ear marked for rehabilitation and uprating. Figure 3-8 shows electricity generation sent out from small and mini hydro power plants owned by ZESCO for the period 2010 to 2020.

Figure 3-8: Trend in electricity generation by small and mini-hydro power plants owned by ZESCO

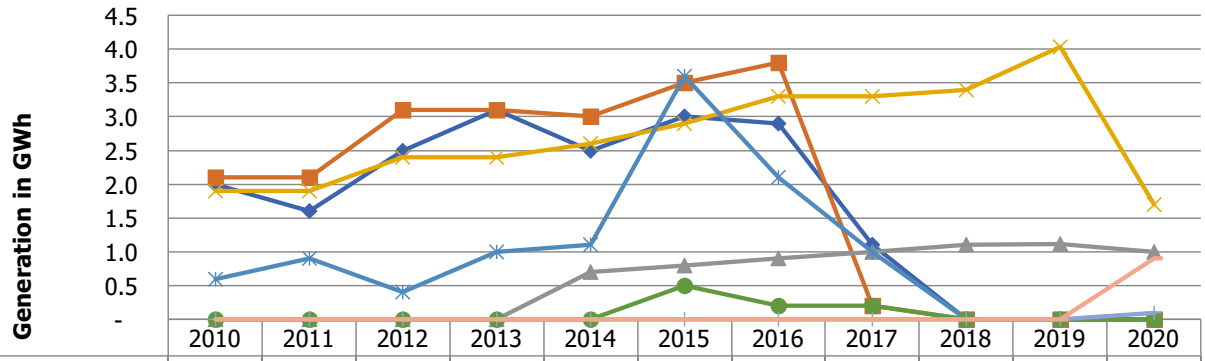


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Lusiwasi Lower	48.80	55.90	57.70	55.70	58.70	63.90	41.30	46.20	66.00	26.20	34.5
Chishimba Falls	22.80	23.80	23.50	22.20	23.70	24.20	17.80	15.80	15.70	18.40	12.8
Musonda Falls	18.50	18.40	19.40	21.10	20.50	6.40	-	6.10	54.00	51.00	57.0
Lunzua	3.30	3.50	3.70	3.80	3.50	26.00	60.90	40.40	69.30	69.70	84.0
Shiwang'andu	-	-	-	-	0.70	1.00	1.60	2.10	2.70	3.30	3.20

3.3.3 Electricity generation from diesel power plants owned by ZESCO

In the recent years, ZESCO continued to reduce on the number of diesel power plants. This was mainly due to the continued connections of some districts which were formerly serviced by diesel plants, to the national electricity grid. In 2020, generation sent out from diesel power plants reduced by 35 percent from 5.7 GWh in 2019 to 3.7 GWh in 2020. Zambezi, Kabompo, Chavuma Districts of North-Western Province have been connected to the national electricity grid and had their diesel power generators either decommissioned or transferred to Chama and Lundazi Districts in Eastern Province, which were previously supplied through low voltage power imports from the Electricity Supply Corporation of Malawi (ESCOM). Figure 3-8 shows electricity generation sent out from diesel power plants operated by ZESCO between 2019 and 2020.

Figure 3-9: Trend in electricity generation, from diesel power plants owned by ZESCO, 2010-2020

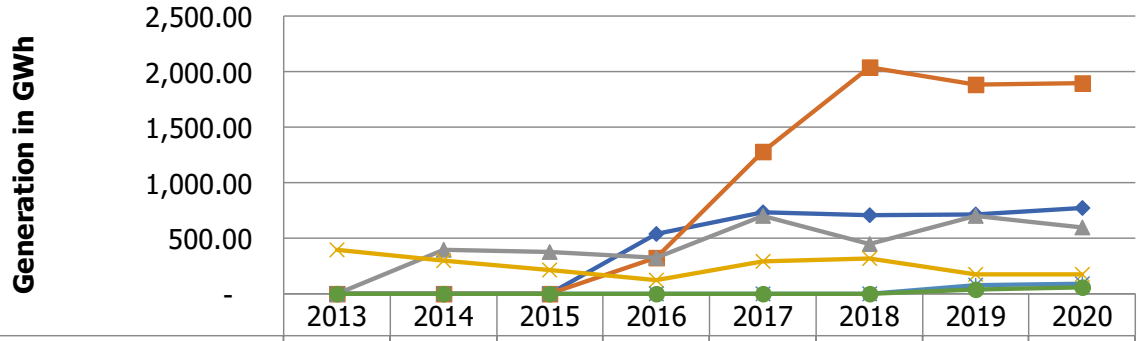


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Zambezi	2.0	1.6	2.5	3.1	2.5	3.0	2.9	1.1	-	-	-
Kabompo	2.1	2.1	3.1	3.1	3.0	3.5	3.8	0.2	-	-	-
Shangómbo	-	-	-	-	0.7	0.8	0.9	1.0	1.1	1.1	1.0
Luangwa	1.9	1.9	2.4	2.4	2.6	2.9	3.3	3.3	3.4	4.0	1.7
Chavuma	0.6	0.9	0.4	1.0	1.1	3.6	2.1	1.0	-	-	-
Itezhi Tezhi	-	-	-	-	-	0.5	0.2	0.2	-	-	-
Chama	-	-	-	-	-	-	-	-	-	-	0.1
Lundazi	-	-	-	-	-	-	-	-	-	-	0.9

3.3.4 Electricity generation from Independent Power Producers

There was a marginal reduction in the generation sent out by IPPs from 3,593.04 GWh in 2019 to 3,586.58 GWh in 2020, representing a 0.2 percent decrease. This was mainly arising from the 15 percent reduction in the generation sent out by Ndola Energy Corporation Limited (NECL) from 698.74 GWh in 2019 to 596.23 GWh in 2020. This was on account of reduced supply of fuel from INDENI refinery. The trend in generation from IPPs is depicted in figure 3-10.

Figure 3-10: Trend in electricity generation sent out from IPP's, 2013-2020



	2013	2014	2015	2016	2017	2018	2019	2020
Itehzi-tehzi Corporation Limited	-	-	-	536.70	735.40	709.21	715.80	772.18
Maamba Colleries Limited	-	-	-	326.40	1,279.40	2,040.47	1,886.93	1,895.61
Ndola Energy Corporation	0.03	393.40	380.00	323.60	698.80	451.02	698.74	596.23
Lunsemfwa Hydro Power Limited	398.40	297.00	216.50	121.90	292.60	318.56	174.01	172.41
Bangweulu Power Limited	-	-	-	-	-	-	77.06	92.15
Ngonye Power Limited	-	-	-	-	-	-	40.50	58.00

Generation sent out by Bangweulu Power Limited (BPL) was 92.15 GWh in 2020 from 77.06 GWh in 2019, representing a 20 percent increase. Similarly, generation sent out from Ngonye Power Limited (NPL) increased by 43 percent from 40.50 GWh in 2019 to 58.00 GWh in 2020. This was mainly on account of production of electricity throughout the year compared to 2019 when the plants only operated for less than 12 months. Itezhi-tezhi Corporation Limited (ITPC) generation sent out increased by 8 percent, while Maamba Collieries Limited (MCL) recorded a slight increase of 0.5 percent in generation sent out. However, NECL and Lunsemfwa Hydro Power Limited (LHPL) recorded decreases in electricity generation sent out by 15 and 1 percent respectively.

3.4 DOMESTIC AND REGIONAL POWER TRADING

3.4.1 Power Purchase and Supply Agreements

Section 4(j) of the Energy Regulation Act, mandates the ERB to approve, review and regulate Power Purchase Agreements (PPAs)[15] and Power Supply Agreements (PSAs)[16]. During the year 2020, the ERB reviewed and approved the PPAs/PSAs as shown in Table 3-2.

Table 3-2: Approved PPAs and PSAs in 2020

No.	Reviewed PPAs and PSAs	Contracted Capacity
1.	ZESCO Limited and China – Zambia Jin Xin Cement Limited	15 MVA
2.	ZESCO Limited and Societe Nationale D'electricite S.A	70 MW
3.	ZESCO Limited and Kariba North Bank Extension Power Corporation Limited (Addendum to PPA)	360 MW
4.	ZESCO Limited and Konkola Copper Mines	200 MW
5.	ZESCO Limited and Konkola Copper Mines (Nampundwe)	5 MVA
6.	ZESCO Limited and Sable Zinc Kabwe Limited	12 MVA

3.4.1.1 The Southern African Power Pool

The Southern African Power Pool (SAPP) was established in August 1995 through the signing of the Inter-Governmental Memorandum of Understanding (MOU) as a regional power trading block in Southern Africa. SAPP comprises 17 state power utilities in the Southern African Development Community (SADC) region. It exists to optimize the use of available energy resources in the region and support one another during emergencies. The vision of the SAPP market is to:

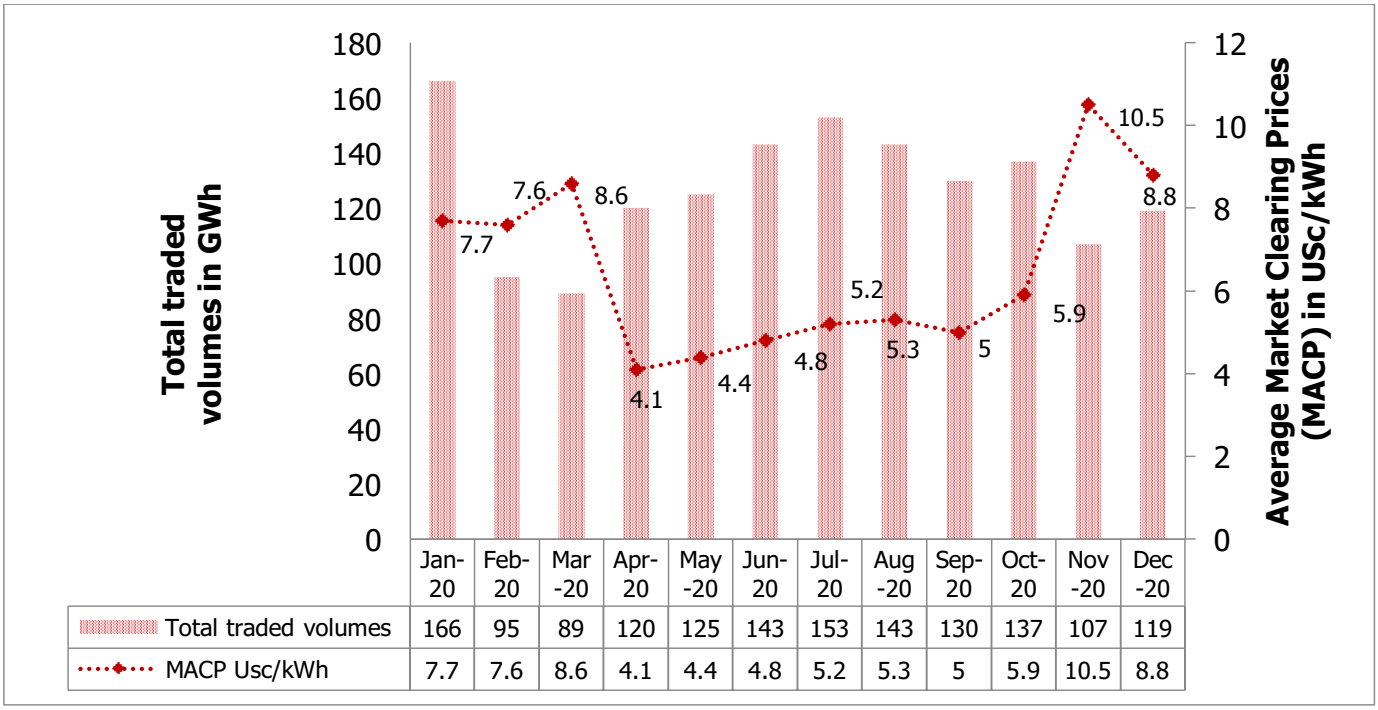
i. Facilitate the development of a competitive electricity market in the Southern African region;
ii. Give the end user a choice of electricity supply;
iii. Ensure that the Southern African Region is the region of choice for investment by energy intensive users; and
iv. Ensure sustainable energy developments through sound economic, environmental & social practices.

3.4.1.2 Trade on the Southern African Power Pool

The total traded volumes of energy on the SAPP market reduced by 28 percent from 2,132.42 GWh in 2019 to 1,527 GWh in 2020 due to power generation constraints from a number of SAPP member Utilities. Figure 3-11 shows the monthly traded volumes on the SAPP market with the average Market Clearing Prices (MACP) for the DAM in 2020.

[15] A contract entered into between or among entreprises for the sale and purchase of electricity
[16] A contract entered into between an enterprise and a non-retail consumer for the sale of electricity

Figure 3-11: Monthly traded volumes on the SAPP market with the average MACP for the DAM in 2020



	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
Total traded volumes	166	95	89	120	125	143	153	143	130	137	107	119
MACP Usc/kWh	7.7	7.6	8.6	4.1	4.4	4.8	5.2	5.3	5	5.9	10.5	8.8

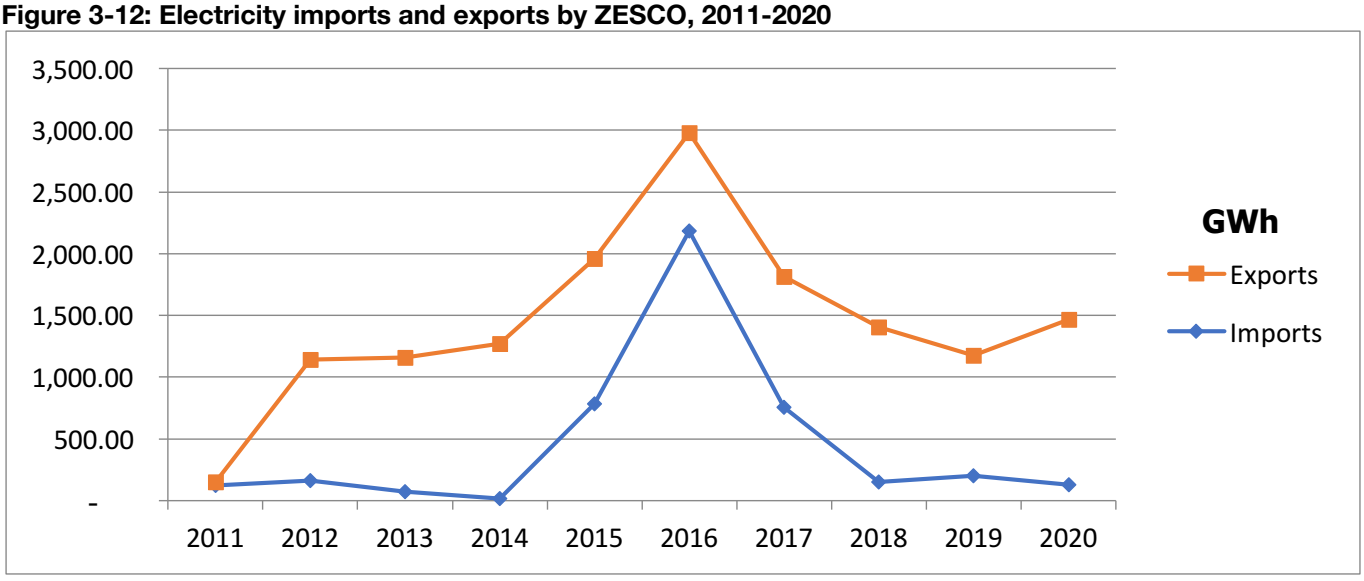
Trading on the Day Ahead Market (DAM) continued to dominate the SAPP market trade. The highest trade volumes recorded in 2020 was in January at 166 GWh whereas the average MACP were the highest in November 2020 at USc 10.5/kWh. For the rest of the year, traded volumes averaged 127 GWh at an average MACP of USc 6.49/kWh.

3.4.2 ZESCO Electricity Exports and Imports

In order to balance the supply and demand of electricity on its network, ZESCO engages in power trading as a member of the SAPP through its various trade protocols. During 2020, ZESCO recorded a 7 percent increase in exports from 1,250.4 GWh in 2019 to 1,339.53 GWh in 2020. However, ZESCO's imports decreased by 34.4 percent from 198.2 GWh in 2019 to 129.94 GWh in 2020.

Figure 3-12 shows the trend in ZESCO's electricity exports and imports over the past 10 years, from 2011 to 2020.

Figure 3-12: Electricity imports and exports by ZESCO, 2011-2020



3.5 NATIONAL ELECTRICITY ENERGY CONSUMPTION

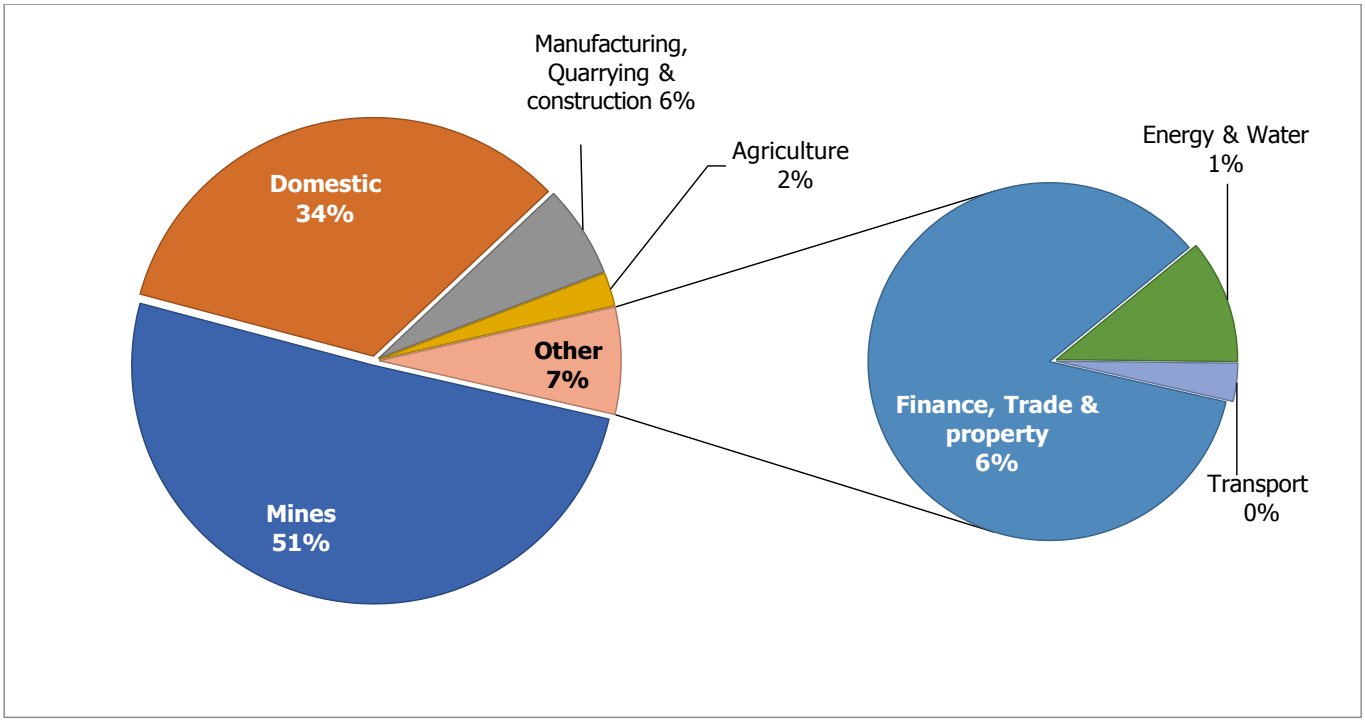
National electricity consumption fell by 8 percent from 12,526 GWh in 2019 to 11,481 GWh in 2020. There was notable reduction in electricity consumption from key sectors such as mining, manufacturing, quarrying & construction, agriculture, finance, trade and property. Table 3-3 shows the electricity consumption per economic sector.

Table 3-3: National consumption by economic sector, 2019 and 2020

	2020	2019	Movement (GWh)	Movement (%)
Mines	5,806	6,359	(553)	-9%
Domestic	3,867	4,023	(155)	-4%
Manufacturing, Quarrying & construction	716	892	(177)	-20%
Agriculture	261	313	(51)	-16%
Finance, Trade & property	710	825	(115)	-14%
Energy & Water	93	83	10	12%
Transport	29	31	(3)	-8%
Total	**11,481**	**12,526**	**(1,044)**	**-8%**

In terms of percentage share of consumption, in 2020, the mining sector continued to account for over 50 percent of electricity consumption, followed by the domestic customers at 34 percent and the rest accounting for less than 10 percent. Figure 3-13 shows the 2020 percentage share of national electricity consumption by economic sector.

Figure 3-13: National electricity consumption by economic sector, 2020



3.6 OPERATIONAL PERFORMANCE OF ELECTRICITY ENTERPRISES

This section discusses the performance of individual enterprises in the electricity sub-sector during the year 2020.

3.6.1 ZESCO Limited

ZESCO sub-station transformer

The ERB, monitors and reviews ZESCO's operational performance with specific focus on quality of service supply, financial management, commercial and technical operations through KPIs. In 2020, the ERB and ZESCO agreed on a new KPI framework to run from January 2020 to December 2022. The framework comprises 11 thematic areas which are summarised in Table 3-4.

Table 3-4 ZESCO's KPI framework January 2020 - December 2022

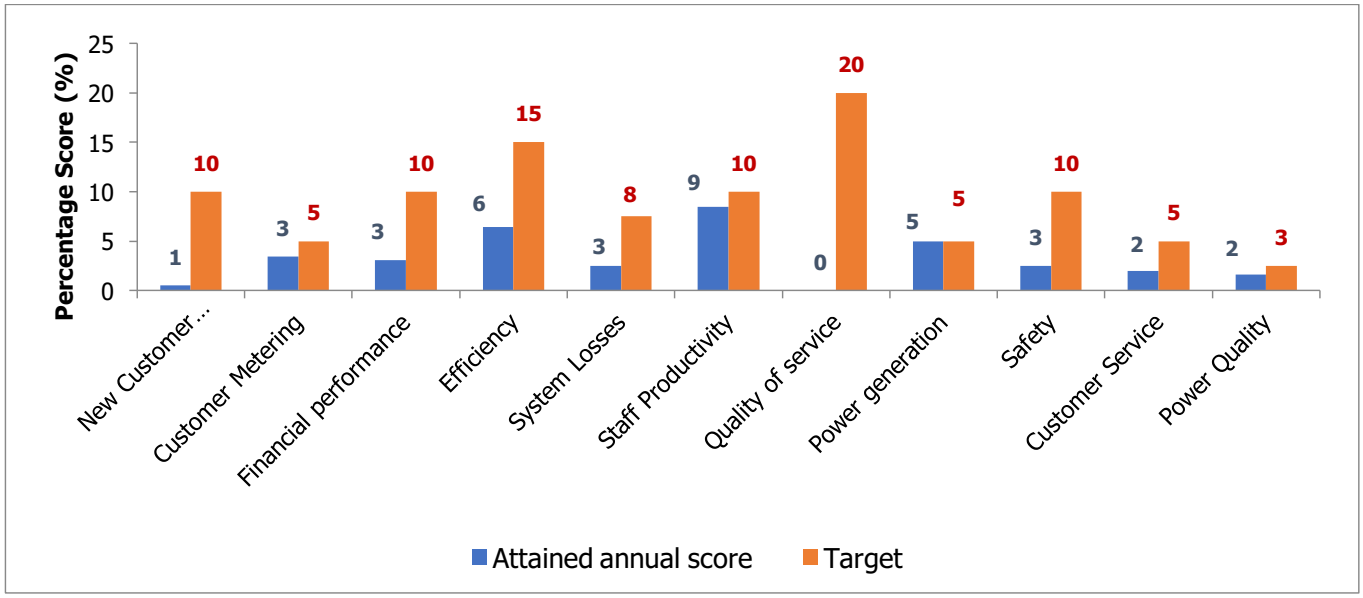
No	Key Performance Indicator (KPI) Thematic Area	Assigned score (%)
i.	New Customer Connections	10
ii.	Customer Metering	5
iii.	Financial performance	10
iv.	Efficiency	15
v.	System Losses	7.5
vi.	Staff Productivity	10
vii.	Quality of service	20
viii.	Power generation	5
ix.	Safety	10
x.	Customer Service	5
xi.	Power Quality	2.5
	Total	**100**
	Minimum required score	**75**

The framework is incentive based and is embedded in the tariff determination process. The agreed indicators are presented in Appendix 5. In addition, the framework can be used as a feedback mechanism to inform all stakeholders on ZESCO's operational performance.

As a regulatory requirement, the ERB undertakes assessments of ZESCO's operational performance on a quarterly basis. As per agreed KPI framework, ZESCO is expected to attain a minimum annual score of 75 percent. KPI score below 75 percent requires that ZESCO provides a detailed explanation before the ERB.

Figure 3-14 shows ZESCO's performance on the KPIs framework during the year 2020.

Figure 3-14: ZESCO's KPI performance during the year



As depicted in Figure 3-14, ZESCO did not meet the targets on a number of the KPIs. The Utility did not perform well on new customer connections, financial performance, efficiency, system losses, Quality of service, safety and customer service.

The overall total score of ZESCO on the KPI framework during 2020 was 34.8 percent, which was way below the minimum benchmark agreed score of 75 percent. The utility was engaged to explore means of improving its performance.

Technical Performance

In 2020, the ERB conducted technical inspections of ZESCO's electricity infrastructure country-wide. The overall average infrastructure compliance for all the facilities inspected across the country was at 80.0 percent compared to 81.0 percent in 2019. The overall percentage compliance was below the ERB set target of 91.0 percent by December 2020. The non-compliances noted were related to safety and maintenance. Table 3-5 depicts the average compliance from 2019 to 2020.

Table 3-5: ZESCO's percentage compliance 2019-2020

Type of Facility/Substation	2019 % Compliance	2020 % Compliance
Large Hydro Power Stations	93.0	95.0
Transmission Substations>33kV	82.0	86.0
Distribution Substations≤33kV	74.0	78.0
Mini Hydro Power Stations	94.0	98.0
Diesel generation stations	64.0	81.0
ZESCO Overall Average Compliance	81.0	80.0
ERB SBP Compliance Target for ESI	**89.0**	**91.0**

3.6.2 Rural Electrification Authority

3.6.2.1 Number of projects under implementation by type and by province

In 2020, the Rural Electrification Authority (REA) planned for the implementation and completion of 25 projects using various methods and technologies such as the extension of the national grids, solar mini-grids and mini-hydro's. These projects comprised of 20 projects that were carried over from 2019 for implementation in 2020 and five additional projects that commenced in the same year. However, as of 31st December 2020, 14 of the 25 Projects had been completed. The remaining 11 projects that were yet to be completed in 2020 would be carried over for implementation and completion in 2021. Table 3-6 below shows the summary of the projects that are still under implementation by type of technology and province.

Table 3-6: Summary list of projects under implementation by type and by province

No.	Project Name	Province	District	Type of Technology
1	Luano	Central	Luano	Grid Extension
2	Chunga	Central	Mumbwa	Solar Mini Grid
3	Lupani	Central	Chibombo	Grid Extension
4	Luswishi Farm Block	Copperbelt	Lufwanyama	Grid Extension
5	Luembe	Eastern	Nyimba	Grid Extension
6	Miponda-Shikamushile	Luapula	Samfya	Grid Extension
7	Lupososhi	Northern	Luwingu	Grid Extension
8	Jembo	Southern	Pemba	Grid Extension
9	Mpanta Grid Extension	Luapula	Samfya	Grid Extension
10	Lunga	Luapula	Samfya	Solar Mini Grid
11	Kalungu -Sasamwe	Muchinga	Isoka	Grid Extension

3.6.2.2 Prospects for Rural Electrification in 2021

The mandate to facilitate increased access to electricity in rural areas is vested with the REA which is a statutory body created through the Rural Electrification Act No. 20 of 2003. REA promotes the implementation of energy projects using various methods and technologies such as the extension of the national grids, solar home systems, solar mini-grids, mini-hydro and other renewable energy sources.

In 2021 the Kasanjiku Mini-Hydro in North Western Province is expected to be commissioned. REA's outlook includes the roll out of activities earmarked for implementation as enshrined in the Authority's SBP (2019 - 2021). Additionally, the Authority would continue with the implementation of activities under the ESAP as well as the IAEREP projects that are being funded by the World Bank (WB) and European Union (EU) respectively.

3.6.2.3 Electricity Services Access Project (ESAP)

REA, with the financial support from the World Bank (WB) commenced the implementation of the Electricity Services Access Project (ESAP) on 20th June, 2018. The objective of the project is to increase electricity access in Zambia's targeted rural areas. There are three components to the project, the first component being on-grid electricity access expansion, the second component is the off-grid electricity access expansion and the final component is the capacity-building and project implementation support. As at 31st December 2020, the Electricity Services Access Project (ESAP) last-mile subsidy connections under the Output-Based Aid (OBA) stood at 24,875. Out of the 24,875 recorded connections, 24,715 were gender titled -*(Recorded in the data system as either male or female)* connections while 160 were blank entries *(Entries recorded in the data system that was not specific to the type of gender).* Out of the 24,875 entered connections, 21,771 were metered residential and 3,104 were metered commercial. Out of the 21,771 metered residential 6,963 were Female-Headed Households whereas 14,808 were Male Headed Households. Further, of the 3,104 SMEs, 653 were female-owned whereas 2,451 were male-owned.

Meanwhile, nine (9) contracts for Grid Extension and Reinforcement covering Muchinga, Luapula, Eastern, North Western, Copperbelt, Western, Central and Northern Provinces were signed and implementation of the works was in progress.

3.6.3 Copperbelt Energy Corporation Plc

Copperbelt Energy Corporation (CEC) is a Transmission Network Service Provider (TNSP). CEC operates and owns high–voltage transmission and distribution systems that supply electricity to Zambia's mining companies based on the Copperbelt but also uses its transmission network to export/wheel electricity to the Democratic Republic of Congo (DRC). Further the company also supplies power to residential customers in the CEC village in Kitwe. Table 3-7 shows CEC's performance in the period 2016 – 2020.

Table 3-7: CEC's performance, 2016 to 2020

Business Element	2016	2017	2018	2019	2020
Electricity Sales to the mines	3,521 GWh	3,512 GWh	3,672 GWh	3,317GWh	2,432GWh
Power imports from SAPP	302.8 GWh	340.9 GWh	82.4 GWh	-	-
Transmission losses	3.60%	3.00%	2.27%	2.10%	2.18%
Stand-by Generation Capacity	80 MW	80 MW	80 MW	80MW	80MW
Energy from Standby diesel generators	8.16 GWh	12.67 GWh	13.84 GWh	9.31GWh	6.36GWh
Solar Plant Capacity	-	-	1 MW	1 MW	1MW
Generation from Solar Plant	-	-	0.93 GWh	1.4 GWh	1.6GWh

During the period under review, CEC sold 2,432 GWh of electrical energy to its mining customers representing a 36 percent decrease in energy sales in comparison to the 3,317 GWh that was sold in 2019. Meanwhile, the transmission losses increased from 2.10 percent in 2019 to 2.18 percent in 2020 while its standby generation capacity stood at 80 MW.

In 2021, CEC intends to continue implementing the planned investments in renewable power generation projects such as the ongoing GETFit Solar project. Within 2021, CEC also intends to purchase a 20 MW stand-by power generator.

Technical performance

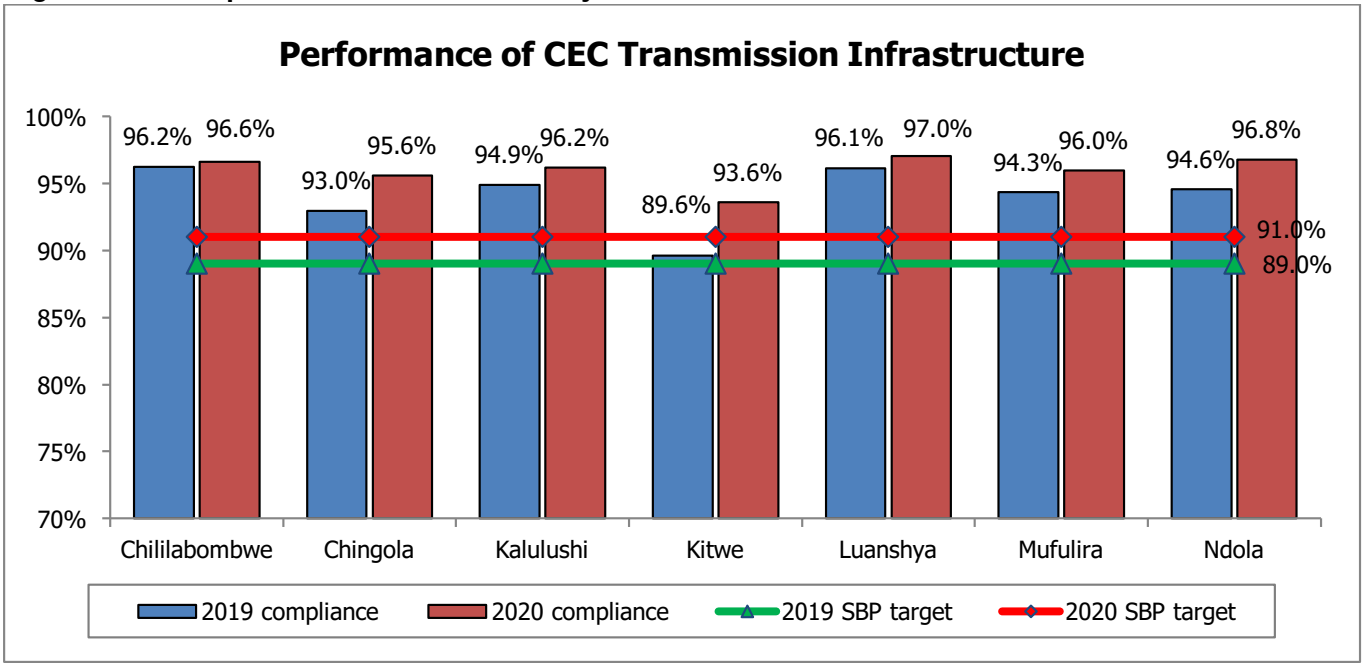
In 2020, ERB conducted technical inspections of CEC electricity infrastructure covering the transmission and Gas Turbine Alternators (GTAs). The average compliance for the transmission facilities was found to be 96.0 percent in 2020 compared to 94.6 percent in 2019 while the GTAs were at 100 percent in 2020 compared to 99.5 percent in 2019. The overall percentage compliance was above the ERB set target of 91.0 percent by December 2020. The non-compliances noted were related to safety and maintenance. Table 3-8 depicts the average compliance from 2019 to 2020.

Table 3-8: CEC's percentage compliance 2019-2020

Type of Facility/Substation	2019 % Compliance	2020 % Compliance
CEC Transmission – Chililabombwe	96.2	96.6
CEC Transmission – Chingola	93.0	95.6
CEC Transmission – Kalulushi	94.9	96.2
CEC Transmission – Kitwe	89.6	93.6
CEC Transmission – Luanshya	96.1	97.0
CEC Transmission – Mufulira	98.1	96.0
CEC Transmission – Ndola	94.5	96.8
CEC Gas Turbine Alternators (GTAs) 80MW	98.0	100.0
ERB SBP Compliance Target for ESI	**89.0**	**91.0**

Figure 3-15 shows the graphical representation of the compliance levels of CEC electricity infrastructure for 2020 in comparison to 2019.

Figure 3-15: Compliance levels CEC electricity infrastructure for 2020



3.6.4 Ndola Energy Company Limited

Ndola Energy Company Limited is an IPP that owns and operates a 110 MW HFO power plant located in Ndola next to INDENI. NECL has a long-term PPA with ZESCO as the sole off-taker.

Technical Performance

In 2020, the ERB conducted technical audits of NECL's electricity generation infrastructure. The average compliance levels for both NECL's phase I and phase II generating plants was 96.4 percent in 2020 compared to 100 percent in 2019 (see Table 3-9).

Table 3-9: NECL percentage compliance 2017-2020

Type of Facility/Substation	2017 % Compliance	2018 % Compliance	2019 % Compliance	2020 % Compliance
Phase I Plant	96.7	100.0	100.0	95.6
Phase II Plant	-	100.0	100.0	97.1
NECL Overall Average Compliance Level	96.7	100.0	100.0	96.4
ERB SBP Compliance Target for ESI	**85.0**	**87.0**	**89.0**	**91.0**

3.6.5 Lunsemfwa Hydro Power Company Limited

Mulungushi hydro power stations

Lunsemfwa Hydro Power Company (LHPC) has two large hydro power plants with a total combined installed capacity of 56 MW namely Mulungushi Power Station (MPS) 32 MW and Lunsemfwa Power Station (LPS) 24 MW. LHPC has off-take agreements with ZESCO and CEC.

Technical performance

In 2020, the ERB conducted technical audits of LHPC's electricity infrastructure. The audit covered the two generation power stations, namely Lunsemfwa and Mulungushi, part of LHPC 66 kV Line A and B infrastructure at Converter 66/33/11 kV Substation, Transformer T5 and its accessories at 88 kV Kabwe Step Down Substation. Table 3-10 depicts the percentage compliance of audited infrastructure from 2019 to 2020.

For the period under review, LHPC's compliance level was 91.8 percent compared to 92.8 percent recorded in 2019 indicating a 1.0 percentage point decrease. This compliance level was above the 2020 SBP KPI target of 91 percent for electricity infrastructure compliance level.

Table 3-10: LHPC's percentage compliance 2019-2020

Type of Facility/Substation	2019 % Compliance	2020 % Compliance
Converter 66/33/11KV	93.0	86.0
Kabwe Step Down 66/88kV	88.0	93.0
Mulungushi Power Station	93.0	96.0
Lunsemfwa Power Station	93.0	96.0
LHPC Overall Average Compliance	91.8	92.8
ERB SBP Compliance Target for ESI	**89.0**	**91.0**

3.6.6 Maamba Collieries Limited

Maamba Collieries plant

Maamba Collieries Limited (MCL) is the largest IPP operating coal fired power plant with 300 MW installed capacity (2 x 150 MW units) in Zambia. MCL has a long-term PPA with ZESCO as a sole off-taker.

Technical performance

In 2020, the ERB conducted a compliance audit of MCL electricity generation at Maamba thermal power station and transmission switch-yard. MCL's overall average compliance level was 97.5 percent in 2020, compared to 95.4 percent in 2019. Thus, MCL's average compliance for 2020 was above the ERB target of 91.0 percent compliance level by December 2020 as depicted in the Table 3-11.

Table 3-11: MCL's percentage compliance 2019-2020

Type of Facility/Substation	2019 % Compliance	2020 % Compliance
Maamba thermal power station	95.4	97.0
330kV switchyard	95.4	98.0
MCL Overall Average Compliance Level	95.4	97.5
ERB SBP Compliance Target for ESI	**89.0**	**91.0**

3.6.7 North-Western Energy Corporation Limited

North Western Energy Corporation Limited (NWEC) is a Distribution Network Service Provider (DNSP) which owns and operates a distribution system that purchases power in bulk from ZESCO for onward distribution to the non-mining load of the Lumwana, Kalumbila and Kabitaka mining townships.

In 2020, the Company purchased 43.8 GWh of electricity compared to 39.7 GWh in 2019 representing a 10 percent increase in power purchases from ZESCO. Total revenue from the sale of electricity rose by 27 percent.

Technical performance

In 2020, the ERB conducted a technical audit of NWEC's electricity distribution and supply infrastructure. NWEC recorded the average compliance of 84.1 percent in 2020 compared to 88.1 percent in 2019. The Overall performance of NWEC infrastructure was below the ERB compliance target of 91 percent for 2020 as depicted in the Table 3-12.

Table 3-12 NWEC's percentage compliance 2019-2020

Type of Facility/Substation	2019 % Compliance	2020 % Compliance
Kabitaka	78.1	88.5
Lumwana	94.2	82.3
Kalumbila	92.0	81.5
NWEC Overall Average Compliance	88.1	84.1
ERB SBP Compliance Target for ESI	**89.0**	**91.0**

3.6.8 Itezhi Tezhi Power Corporation

Itezhi-Tezhi Power Corporation (ITPC) is a joint-venture IPP company with 120 MW installed capacity (2 x 60 MW units) located on the Kafue River in Itezhi-Tezhi District in Central Province. ITPC has a long term PPA with ZESCO.

Technical performance

In 2020, the ERB conducted a technical inspection on the electricity infrastructure for ITPC. The compliance level was at 95 percent in 2020 compared to 93.50 percent in 2019 indicating a 1.5 percentage point increase. The overall performance of ITPC's infrastructure was above the ERB compliance target of 91 percent for 2020 as depicted in Table 3-13.

Table 3-13: ITPC's percentage compliance 2019-2020

Infrustructure/ Target	2019 % Compliance	2020 % Compliance
ITPC Overall Average Compliance Level.	93.5	95.0
ERB SBP Compliance Target for ESI	**89.0**	**91.0**

3.6.9 Zengamina Power Limited

Zengamina Power Limited (ZPL) owns and operates a 0.75 MW off-grid mini-hydro power plant in Ikelenge District of North-Western Province. Since its commissioning in 2007, the Company has supplied electricity to over 800 customers that includes households, hospitals, schools, and small businesses.

In 2020, the ERB approved a tariff adjustment of ZPL's electricity tariffs to be implemented over a 3 year period. The adjustment was awarded to enable the Utility to attain cost reflective tariffs in line with the aspirations of the National Energy Policy. A phased approach was adopted in order to avoid the negative social impact that a drastic significant one-off increase might have on the consumers and the community at large.

In addition, ERB also approved the revision of ZPL's connection fees policy from charging a standard fixed fee to charging a fee that considers the prospective customers proximity to the nearest connection point.

Technical Performance

In 2020, the ERB conducted a technical inspection on the electricity infrastructure for Zengamina. The compliance level was at 91.0 percent for 2020 compared to 78.2 percent in 2019. The Overall performance of Zengamina infrastructure was above the ERB compliance target of 91.0 percent for 2020.

3.6.10 Dangote Industries Zambia Limited

Dangote Industries Zambia Limited (Dangote) owns and operates a 30 MW thermal power plant that supplies electricity to its cement production plant. Dangote's power plant consists of a two 15 MW boilers, one turbine and one generator.

Dangote Cement Thermal Boilers Plant

Dangote has a PSA with CEC for the excess power amounting to 8 MW. In 2020, Dangote finalised the US$ 6.6 million grid connection project which involved construction of the following:

i. A 66 kV Dangote line bay at Ndola Refinery 66/3.3 kV substation;
ii. A 15.5 km 66 kV overhead transmission line from Ndola Refinery to the new 66/11 kV 30 MVA Dangote Substation;
iii. A 0.5 km 11 kV overhead tie-line between CEC Dangote substation and the Cement power plant; and
iv. Installation of a new 11 kV grid incomer panel at Dangote Cement power plant board.

3.7 Engie Power Corner

Engie Power Corner (EPC) is an access to energy initiative under the ENGIE Group designed to develop and operate smart solar mini-grids for rural populations that are not served by the national grid across Sub-Saharan Africa. On a continental level, EPC has to date, a total of 13 operational mini- grid facilities, 12 in Tanzania and 1 in Zambia with over 2,600 connections in the 2 countries.

EPC's mini-grid facility is located in Chitandika Village of Chipata District, Eastern Province. It was launched on 3rd April, 2019. The solar mini-grid has a generation capacity of 28.35 kW made up of 105 panels of 270 Watts. EPC's storage unit houses 48 V lead carbon technology batteries of 2 V each giving a storage of 96 kW, the batteries have a life span of 5 to 10 years. The Company has three invertors with a capacity of 15 kV each.

During the year, a total of 153 connections were made covering households, commercial and industrial facilities. EPC has a 9.8 km distribution and supply line network.

3.8 OPERATIONAL PERFORMANCE OF THE INTERCONNECTED POWER SYSTEM

ZESCO holds a system operators licence issued in 2016 by the ERB. The licence obligates ZESCO to operate the Interconnected Power System (IPS) in a manner that ensures a high level of system reliability, safety and security.

In 2020, the IPS experienced a total of 27 major system disturbances and faults compared to 87 disturbances recorded in 2019. The details of the interruptions are depicted in Appendix 7.

Major supply interruptions are defined in ZS 387 Part 2 under Clause B.5.1 as:

i. Any single event that leads to loss of supply to a 1,000 consumers or large end-user consumer; and
ii. Forced interruption index greater than five system- minutes[17]

3.9 NETWORK EXPANSION

In 2020, the network expansion projects included the following:

a. Kasompe Project

Under Kasompe project in Chingola, ZESCO intends to establish a bulk supply point to enable it to meet the growing demand in electricity following the demarcation of residential, commercial and industrial plots and also for public institutions such as schools and health centres. This substation will be supplied by, 132kV transmission line from CEC's Luano 330/220/66kV substation. The proposed Kasompe substation will increase capacity in Kasompe Township and surrounding areas and also improve security of supply to Chingola district.

The scope of works for the project covers the following;

i. Transmission Line Works *to* cover the construction of 20km, single circuit on self-supporting steel lattice towers, 132 kV transmissions line from existing Luano 330/220/66kV substation to Kasompe 132-66/11kV Substation.

ii. Substation Works to cover the construction of 66kV bay at CEC's Luano Substation and the proposed 132/11kV Kasompe substation comprising 2 x 26MVA 66/11kV transformers

b. Kasama – Nakonde Transmission Project

The project is aimed at securing power supplies to Muchinga Province. It is also a further step in the development of the ZTK interconnector which is part of the identified projects under PIDA in the energy sub-sector of the NEPAD/AU initiative.

The scope involves construction of a 228km 330 kV transmission line from Kasama to Nakonde and another 159km 330kV line to Mporokoso. There is also a 170km 132 kV line to be charged at 66kV from Kasama Substation for the electrification of Mungwi district. The substation works will include extension of the Kasama 330/66 kV substation, new Nakonde 400/330/132-66kV substation, new Mporokoso 330/132-66kV substation and the Mungwi 132-66/33 kV substations.

The contractor has carried out some preliminary works such as survey of the transmission lines and geotechnical investigations. ZESCO engaged a consultant to assess the required reactive power compensation on the ZTK corridor.

c. Pensulo to Mansa Transmission Project

The aim of the Pensulo- Mansa transmission project is to increase the transmission capacity to Luapula Province in order to support the foreseen large mining and agricultural loads. The line will also provide an evacuation path for the hydropower schemes on the Luapula River. The scope includes 300 km of 330 kV transmission line, 62 km of 132 kV transmission line, 330/132 kV substation in Mansa and 132/33 kV substation in Samfya.

[17] System Minutes = Energy not supplied in MWh/ Power at Peak

d. Kabwe Step-down to Pensulo Transmission Line Project

This project will increase power transfer capacity and provide security of supply to Eastern, Northern, Muchinga and Luapula Provinces and facilitate gate ways for regional power interconnection infrastructure.

The project scope include;

i. Construction of 300km, 330kV single circuit Transmission line from the existing Kabwe Step-down substation to Pensulo substation (using 668 towers).
ii. Installation of Repeater at Mkushi Central for regeneration of signals

Substations: installations of;

i. (Extension) 330kV double busbar at Kabwe Step-down Substation;
ii. 330kV line bay at Kabwe Step-down substation including associated protection, control and metering systems;
iii. 330kV, 40MVar line reactor at Kabwe and Pensulo substation respectively, include supplying and installation of Neutral earthing reactors;
iv. 330kV line bay at Pensulo substation including protection, control and metering systems;

Support Infrastructure: Construction of;

i. Six staff houses and renovation of four staff houses at Kabwe Step-down substation.
ii. Four staff houses at Pensulo substation.
iii. 10 roomed Guest House at Pensulo Substation.
iv. Regional Office and warehouse in Kabwe

e. Evacuation of Power from Ndola Energy Phase II

The project scope includes 1.3 km of 66 kV line diversion and rehabilitation of Bwana Mkubwa 66/33 kV substation and construction of a new control building and guard house at Bwana Mkubwa.

The following was the status of works at Bwana Mkubwa 66/33kV substation:

- Equipment foundations for spare 66kV line bay equipment 100% complete;
- Erection of 66kV spare bay equipment 80% complete;
- Control building is 90% complete;
- Guard House is 90% complete;
- Transformer Bund Walls 50% complete;
- 33kV circuit Breaker foundations 57% complete; and
- Transmission Line works 15% complete.

Works at Ndola Energy and Mushili 66/11kV substation are yet to start.

f. Msoro and Kabwe Step Down Reactors

The objective of this project is to provide means of over voltage control at Kabwe step down substation for black start and Msoro Substation on the 330kV network. The contract was not effective as at end of 2020.

g. Construction of the Bulk Substation and Transmission Line at Copperbelt International Airport (CIA)

The main objective of the project is to provide secure power supply to the new Copperbelt International Airport which is under construction. The project is financed by the Government of the Republic of Zambia. The project scope includes a new 66/11 kV substation and 1.6 km of 66 kV line.

h. Power Supply to Kafubu Water and Sewerage Company Limited (KWSC)- Kafulafuta Water Supply System Project

The project involves construction of 15 km of 132 kV transmission line from the CEC Roan 66/33 kV substation in Luanshya to a new 132-66/11 kV substation and the construction of a 33/11 kV substation at the booster pumping station.

i. Power Supply To Manganese Smelters in Serenje District

There are seven (07) client driven power supply projects in Serenje each with power demand of about 7-10 MVA. They are all for manganese smelters. A total of 28 – 40 MVA of load is expected to be added at Pensulo Substation in 2021 for the purpose of securing this investment.

3.10 NETWORK CONSTRAINTS

In 2020, the performance of the IPS was generally satisfactory; however, the network experienced the following constraints:

i. Regulating reserve deficit hours

During the period under review, the monthly deficit hours were between 2 to 7 percent, mainly during peak times of the day and this was attributed to the energy supply demand deficit. The SAPP reserve margin/ requirement for ZESCO control area was 101.9 MW (85.1 MW ZESCO and CEC 16.8 MW).

ii. (N-1)[18] constraint

During the period under review, the network continued to experience the N – 1 constraints on the Kabwe – 330kV Pensulo line. However, construction of the second line to mitigate this constraint had commenced and is expected to continue in 2021.

iii. Restricted Generation

Under generation, the following were the constraints during the period under review:

- Restricted water allocation for power generation at Kariba Complex;
- Limited supply of HFO for NECL; and
- Forced shutdown of MCL full generation due to resource constraints among others.

3.11 POWER QUALITY MANAGEMENT SYSTEM

In accordance with the SBP, the ERB set a minimum compliance target of 70 percent to power quality standards by all licenced entities for the year 2020. In order to achieve this, the ERB continued to monitor, manage and implement the Power Quality (PQ) monitoring guidelines in the year 2020.

During the period under review, seven licensees submitted PQ quarterly reports to the ERB. During the year under review, 220 sites were monitored for PQ against the total of 352 sites representing 62.5 percent sample size compared to 216 sites (60 percent) in 2019 as depicted in Table 3-14. Out of a total of 352 sites, 132 sites were not monitored because they lacked recorders to allow for the monitoring process.

Table 3-14: Implementation of the power quality management system and power quality directives

Licensee	Total Number of Recorders/ Sites required to be monitored	Total number of Sites monitored as at 31st December 2018	Total number of Sites monitored as at 31st December 2019	Total number of Sites monitored as at 31st December 2020
ZESCO	161	38	38	40
CEC	172	115	163	164
LHPC	11	8	8	8
NECL	3	3	3	3
MCL	2	2	2	2
ITPC	2	-	2	2
BPC	1	-	-	1
Total	**352**	**166**	**216**	**220**

[18] N-1 constraint technically referred to as a provision of backup infrastructure for redundancy

3.11.1 Power Quality Performance

The ERB continued to monitor the PQ performance of Zambia's ESI which decreased from 77.1 percent in 2019 to 75.3 percent as at 31st December 2020. However, the overall performance was above the ERB set minimum compliance target of 70 percent for the year 2020. Table 3-15 shows the status of Power Quality Performance from 2019 to 2020 of the IPS.

Table 3-15: Status of power quality performance 2019-2020

Year	Voltage Harmonics	Voltage unbalance	Voltage Dips	Interruptions	Voltage Regulation	Frequency	Average
2020 % Compliance	94.7	96.1	44.5	88.4	56.6	57.2	**75.3**
2019 % Compliance	93.6	95.9	49.3	82.4	66.9	37.2	**77.1**

3.12 LOW POWER FACTOR SURCHARGE MECHANISM

The Electricity (Grid Code) Regulations SI 79, 2013 provides that the power factor at the point of supply or connection shall be 0.92 lagging or better, unless otherwise agreed to in an existing contract between the participants.

During the year, the ERB received a report from the Grid Code Technical Committee (GCTC) on modalities for the implementation of Low Power Factor Surcharge mechanism. It is envisaged that this surcharge mechanism will be implemented in 2021.

3.12.1 Power Factor Surcharge

A utility company supplies not only "Active power" (kWh) to the users but also "Reactive power" (kVAr). Low Power Factor is generally caused by facilities with large fans and induction motors and equipment with a high number of transformers which require high reactive power (KVAR). Facilities with low power factor, causes the utility company to increase its generation and transmission capacity in order to handle this extra demand. Thus, a utility company shall charge customers an additional surcharge when their power factor is less than 0.92. However, customers can avoid this additional surcharge by increasing power factor.

3.13 THE ELECTRICITY (GRID CODE) REGULATIONS AND DISTRIBUTION GRID CODE REVISION

In 2013 and 2016, respectively, the ERB established the GCTC and Distribution Grid Code Review Panel (DGCRP). The GCTC maintains the Grid Code, while the DGCRP maintains the Distribution Grid Code.

In December 2018, DGCRP and GCTC commenced the process of revising the Distribution Code and Grid Code, respectively. To achieve this, DGCRP and GCTC, in 2018, formed the Joint Technical Work Group for Renewable Energy Integration (JTWG-REI) tasked with two (02) broad objectives of:

(1) Drafting the Renewable Energy connection requirements for inclusion in the Zambian Grid Code and enhancing the Distribution Code; and,

(2) Conducting Grid Impact Studies to determine the extent of penetration of renewable energy on the Zambian interconnected power system.

The JTWG-REI with the support of City Infrastructure Growth (CIG) Zambia, finalisd the initial draft of the codes (Transmission and Distribution Grid Code) as at December 2020, the codes were subjected to public consultation and the review process is envisaged to be completed in 2021.

In 2020, the consultant (CESI) finalised the Grid Impact studies to determine the extent of penetration Variable Renewable Energies studies (VRES) and this report has been adopted by the Government. The Study proposes that an installed capacity of up to 1,176 MW from PV and 1,200 MW from wind can be integrated by 2025; these capacities can be increased up to 1,376 MW from PV and 1,400 MW from wind by 2030.

Further, in 2020 the GCTC and DGCRP continued to meet on a quarterly basis for smooth implementation of the Codes.

3.14 IMPLEMENTATION OF WIRING OF PREMISES STANDARD – ZS 791

The objective for developing ZS 791:2014 Standard was to ensure compliance in the manner the wiring of dwelling places and general buildings was being undertaken in Zambia. The Standard provides rules for design, selection, testing, inspection and assembly of electrical installations. The rules are intended to provide for the safety of persons, livestock and property against dangers and damage which may arise from reasonable use of electrical installations, and to provide for proper functioning of these installations. The Standard applies to electrical installations such as those of; residential, commercial, public, industrial, agricultural and horticultural premises.

However, even after the Standard was approved, the challenges for which it was developed to address have not abated. The safety statistics from the electricity supply industry show that, there has been an increase in electricity related incidents/accidents resulting from poor quality of materials and substandard workmanship.

In 2020, the working group established by the ERB comprising ESI stakeholders for the implementation of ZS 791 Standard: Wiring of Premises – Code of Practice continued to work on the development of a Practical Guide for easy application of the Standard. Nonetheless, it would remain legally difficult for mandated stakeholders to implement the Standard because compliance to the Standard in its current state is not mandatory. To this regard, the ERB with consultation of the working group considered making ZS 791:2014 Standard mandatory by submitting request to Zambia Compulsory Standards Agency (ZCSA). It is envisaged that once the Standard is made mandatory it would increase compliance and result in reduction of electricity related incidents and or accidents, because of the Standard being enforceable.

3.15 KEY PERFORMANCE INDICATORS FRAMEWORK FOR NON-STATE OWNED ENTERPRISES

In 2020 the ERB continued to implement on a pilot basis, the KPIs for Non-State Owned Entities (NSOEs) with NWEC and ZPL which serve end-use customers. The KPIs framework for NSOE comprises nine KPIs which include among others; customer metering, provision of ancillary customer services, customer complaints resolution, outage management and service restoration. These are depicted in Table 3.16.

Table 3-16: Performance of NWEC and ZPL on the KPI framework

No.	Scope/Thematic area	Weight	Specific KPIs
1.	Financial performance indicators (ratios)	N/A	Monitoring the following financial ratios: i. Liquidity ratios ii. Profitability ratios iii. Solvency ratios iv. Efficiency/Cost management v. Sustainability ratios
2.	System Losses	**5%**	Maintain distributional losses (10%)
3.	Customer Metering	**15%**	i. All customers to be metered; i. Percentage of customers on pre-paid meters; ii. Replacement of faulty meters; iii. Billing complaints received
4.	Customer Service Office	**5%**	i. Existence of customer service office and officer(s), and a dedicated contact number; ii. Information/Tariff display; iii. Complaint resolution Procedure.
5.	Customer Complaints Resolution Rate	**20%**	i. Complaint resolution rate; and ii. Complaints escalated to the regulator.

No.	Scope/Thematic area	Weight	Specific KPIs
6.	Number and Frequency of outages	**25%**	Maintain the following power indices: i. SAIDI at 27 hrs and 36 hrs for Dry & wet seasons respectively. ii. SAIFI at 5 times and 5.5 times for Dry & wet seasons respectively. iii. CAIDI 5 hrs and 7 hrs for Dry & wet seasons respectively. iv. ASAI at 90% or better.
7.	Service Restoration Time	**10%**	i. Licencee required to restore service within 6 hours.
8.	Replacement of faulty equipment (Asset Reliability)	**10%**	i. Replaced meters as a percentage of installed meters; ii. Replacement of distribution/supply transformers as a percentage of the total number of transformers.
9.	Safety	**10%**	i. Maintain zero fatality on a quarterly basis; ii. Maintain zero Lost Time Injury (LTI) on a quarterly basis.

The ERB will in 2021, undertake a revision of the KPIs for NSOEs framework to address the challenges faced during the pilot phase by the two licensees prior to full implementation.

3.16 COST OF SERVICE STUDY

The ERB entered into a contract with Energy Market and Regulatory Consultants (EMRC) to undertake the Cost of Service Study (CoSS) on 31st December, 2019. The Study is financed by the African Development Bank (AfDB).

The objectives of the study are twofold: firstly, to set electricity tariffs to promote economic efficiency of production and consumption and ensure financial viability of the electricity sector, while taking into account social and equity considerations; and, secondly, to provide a basis of strategy formulation for the gradual transition from existing financial-cost based tariffs to economic cost-based tariffs, setting of targeted life-line tariffs and associated subsidy mechanism while at the same time maintaining the household consumer category level economic-cost based tariff.

The study is expected to be completed in 2021 and will attain the following outcomes:

i. ***Review Of The Structure And Conduct Of The Power Sector Including The Legal And Regulatory Framework***: This involves the review of the performance of the electricity sector. It includes reviewing the energy policy, legal and regulatory framework (Review of Electricity and Energy Regulation Acts) and the technical and financial performance of the electricity sector as well as provide recommendations accordingly to enhance the performance of the sector.

ii. ***Electricity Load Forecast:*** This involves reviewing the current electricity demand forecasts prepared by ZESCO and prepare revised demand forecasts under the three scenarios (low, base and high cases) for the next 20 years up to 2040 for both maximum demand, and energy (all customer categories).

iii. ***Determination Of Medium To Long-Term Development Programmes:*** Based on the Base-case scenario of electricity load forecast, the fourth task requires determining the long-term least-cost expansion programs for generation, transmission and distribution to meet the projected peak demand over the next 20 years up to 2040.

iv. ***Determine Economic Cost of Supply, Structure and Level of Tariffs:*** On the basis of the medium to long-term least-cost expansion plans, the subsequent task is to develop the following:

a) The Long-Run Marginal Cost (LRMC) of generation, the Average Incremental Cost (AIC) of transmission, and the AIC of distribution and supply of unit of capacity addition to the power system at the peak period by main voltage levels;
b) The Short-Run Marginal Cost (SRMC) (energy and other variable O&M costs) at generation, transmission, distribution and supply ; and

c) the economic cost of supply, expressed as:
   i. capacity cost (cost/kw/year);
   ii. energy and other variable O&M cost (cost/kWh); and
   iii. as a composite of (a) and (b) cost/kWh at generation, at transmission, at distribution and supply.

On the basis of the foregoing, the Consultant is required to determine for each main class of consumer category, using the applicable characteristics, the appropriate structure and level of tariff for each consumer category/class reflecting the economic cost of supply to the category.

v. ***Life-Line Tariff Mechanism:*** Based on the determined economic cost of supply, and utilizing available information in Zambia on poor household uses of electricity for basic needs from consumer household surveys, and/or drawing on international experience, the study will:
   a) Determine the level of electricity requirement for poor households in Zambia for basic needs, clearly defining what the basic needs are, the linkage between household incomes, and expenditures on electricity consumption, and propose a tariff level for poor household consumers, including the appropriate quantity of electricity usage for basic needs;
   b) Determine the income/electricity expenditure ratio for low income households in Zambia, and propose a tariff level for low income household consumers, including the appropriate quantity of electricity required for basic needs; and
   c) Determine the economic cost differential of the proposed life-line tariff and the economic cost of supply to the household consumer category, and provide recommendations on alternative options by which the life-line tariff subsidy could be administered, and the preferred option.

vi. ***Review Of The Financial Performance Of ZESCO And Other Electricity Companies on The Interconnected Power System And Preparation Of Projections:*** The study shall carry out a detailed review of ZESCO's revenue and cost structures and review the efficiency performance indicators established by the ERB and other best practices KPIs.

Further, the Study shall provide a forecast of the financial performance of ZESCO to demonstrate the impacts of the economic cost-based tariffs. The forecast should take into consideration the proposed expansion programmes of the supply infrastructure of ZESCO over the period of the forecast.

The Consultant is also required to carry out a detailed financial review of each of the other electricity companies on the Zambian IPS (i.e CEC, NWEC, MCL, NECL, ITPC, Kariba North Bank Extension Power Corporation limited (KNBEPL), and LHPC. The purpose of the financial review is to establish the viability of their operations, prudence of their cost structure, technical and operational efficiency and undertakes benchmarking with other similar electricity companies.

vii. ***Transmission and Wheeling Charges:*** In order to operationalise the open access regime the study shall develop a methodology for determining transmission use of system and wheeling charges.

viii. ***Review of the ERB Tariff Adjustment Methodology:*** The Study will undertake a detailed review of the current ERB's methodology (Revenue Requirement) and provide recommendations on improvements.

ix. ***Tariff Adjustment Roll-Out Strategies:*** The Study will provide a comprehensive roll-out plan that outlines alternative strategies for gradual adjustments (migration path) in existing tariffs ultimately to the economic cost of service for each consumer category. The Study will also devise a communication plan drawing on experience on best practices that are implemented in other jurisdictions in Africa.

x. ***Capacity Building:*** The Consultant will design and implement a capacity building programme in the study to include training in:
   a) Load forecast;
   b) Generation expansion model and its application;
   c) Preparation of transmission and distribution expansion plans;
   d) Use of computerised models for the estimation of LRMC of generation and AIC of transmission and distribution; and
   e) Tariff determination modelling and tariff design.

xi. ***Stakeholder Engagements:*** The Study will also include stakeholder engagements to get inputs from industry key gatekeepers and also disseminate the findings of the Study.

The duration of the study was one year and was originally scheduled to be completed on 31st December, 2020. However, the completion date was extended to August 2021 owing to the adverse effects of Covid-19 pandemic on the Study. At the close of 2020, the inception report, Market review and load forecast reports had been finalised and approved by both the ERB and the financier, AfDB.

3.17 OUTLOOK IN THE ELECTRICITY SUB-SECTOR

3.17.1 Open Access Regime

Given the promulgation of Open Access Regime under the Electricity Act, the ERB has commenced the development of the regulatory tools for its operationalization and implementation. The Open Access Regime will enhance intra power trading among players. This is expected to enhance the liberalisation of the sector and it is envisaged that this development will spur private investment into the ESI. The ERB in collaboration with the Government has appointed a Consultant to come up with an appropriate market design to operationalise the Open Access Regime.

3.17.2 Cost of Service Study

The ERB is expected to finalise the CoSS in the third quarter of 2021. The Study will determine the efficient cost of generating, transmitting and distributing electricity. The completion of the Study is an important step into migrating tariffs to cost reflective levels. Therefore, going forward the electricity tariffs are expected to gravitate to cost reflective levels.

3.17.3 Generation Capacity

Zambia's electricity generation is predominantly hydro therefore posing a challenge of power shortages during the period of droughts. The Government with support from its cooperating partners has embarked on the promotion of renewable energy. Therefore, going forward, the share of electricity generation from renewable energy sources is expected to increase. This is especially with the expected development of 600 MW solar power-plants by ZESCO.

3.17.4 Investment in Hydro Power Generation

Kafue Gorge Lower

The Government, through ZESCO in November 2015 initiated the construction of the 750 MW KGL hydroelectric power station located in the Kafue Gorge which is about 53 km upstream of the confluence of the Kafue River and the Zambezi River and 6 km downstream of the existing Kafue Gorge Upper (KGU) hydroelectric power station tail-race. ITT and KGU are located upstream of the proposed KGL dam. The ITT reservoir, has been operating since 1978, provides annual storage while the KGU reservoir, has been operating since 1972, provides monthly storage. The proposed KGL reservoir will provide storage sufficient for the KGL operation for about 10 hours at an output of 750 MW. The KGL project will harness the water flow regulated by the three reservoirs (ITT, KGU and KGL) to generate hydropower.

By the close of 2020, the construction of dam wall, water intake, tunnel and pen-stokes had been completed. The surface power house was completed and successfully impounded. Installation of generation units was also in progress. The first 150 MW Unit was scheduled to be commissioned by the end of 2020 but had been delayed owing to the adverse effect of the Covid-19 pandemic on the Project. The project is expected to be fully operational in 2021.

3.17.5 Batoka Gorge Hydro Electric Scheme

Batoka Gorge

The Batoka Gorge Hydro Electric Scheme (BGHES) project is being sponsored by the Zambezi River Authority (ZRA) which is an inter-governmental organisation owned by Zambia and Zimbabwe and is charged with the responsibility of managing the Zambezi River Basin. BGHES is located in the Batoka Gorge on the Zambezi River bordering Zambia and Zimbabwe. The dam site is proposed to be located 47 km downstream of the Victoria Falls and approximately 118 km up stream of the planned Devils Gorge Hydro Power Station.

There are two large water reservoirs built downstream of the proposed BGHES, on the Zambezi River, Kariba and Cahora Bassa. Upstream, there is the existing Victoria Falls Power Station on the Zambian side and the planned Ngonye Falls Hydro power Plant.

The proposed total installed generation capacity of the BGHES is 2,400 MW with 1,200 MW on either side of the River. In July 2019, ZRA appointed a consortium of CHINAPOWER and General Electric (GE) as project developers. In 2020, CHINAPOWER and GE continued investigations on the BGHES to update the feasibility studies undertaken prior to award and optimise the scheme. According to the project developers, the studies were negatively affected by the Covid-19 pandemic travel restrictions. The investigations are expected to be finalised and negotiations concluded in 2021 in preparation for commencement of project construction in 2022.

4 RENEWABLE ENERGY SUB-SECTOR

Amidst an impending climate crisis and aided by briskly advancing progress in technology, a lean towards the large-scale development of renewables is being observed around the world. This trend holds many benefits, particularly for countries that are susceptible or defenseless to the effects of climate change, such as Zambia. Renewable energy development in Zambia is supported not only by a number of strategies that promote low emissions, but also the implementation of sustainable practices regarding land management.

With an assortment of potential sources of renewable energy, such as its abundant water resources for hydropower generation, (accounting for 79% of the country's total installed capacity), useful energy continues to be harnessed from renewable and carbon neutral sources like sunlight, with keen interest on generation from wind, biomass and geothermal heat being exhibited.

Wider development objectives, social, economic and environmental concerns are largely affected by access to reliable energy, making economic growth synonymous to energy access. Zambia has an abundance of renewable energy resources such as forests and agricultural land to support bioenergy production, abundant wind to support wind energy generation as well as intense hours to support solar energy generation. Despite this scenario, traditional wood fuels still dominate the energy markets. According to the Zambia Statistics Agency, 32.8 percent of the population had access to electricity, with 67.2 percent in urban areas and 8.1 percent in rural areas.

In order to support this transition and facilitate the increased access to energy services to respond to different development needs and meet the challenges of achieving access to reliable, sustainable and affordable energy services, the National Energy Policy of 2019 has a specific objective of increasing exploitation of renewable energy to diversify the Country's energy mix. The NEP aims to achieve this through strengthening capacity for research in renewable energy, promoting a wider usage of renewable energy technologies and to enhance coordination among key stakeholders for effective implementation.

In a quest to ensure the implementation of the National Energy Policy 2019 renewable energy objective, a number of strides have been made that include:

i. Enactment of the Energy Regulation Act No. 12 of 2019;
ii. Enactment of the Electricity Act No. 11 of 2019;
iii. Enactment of SI 42 of 2021-Energy Regulation (Licensing) Regulations;
iv. Development of a Renewable Energy Strategy;
v. Development of the Renewable Energy Regulatory Framework;
vi. Development of Mini-grid Regulatory Framework;
vii. Development of the web portal; and
viii. Technical Standards and Codes.

Row of solar panels

4.1 GETFiT RENEWABLE ENERGY PROGRAMME

The GET FiT Programme which is expected to generate 120 MW had experienced a few challenges during 2020 due to the impact of the Covid-19 pandemic on the global economy. Given the travel restrictions imposed, the programme was compelled to delay the issuing of the Request for Proposals (RfP) for small hydropower (SHP) projects, initially targeted for March 2020. The second window for the application of feasibility studies had however, progressed and was concluded by April 2020, with MOE issuing a further five feasibility study rights to potential sites. By the end of 2020, 39 sites had been issued feasibility study rights, to the pre-qualified developers, under the GET FiT programme.

The issuance of the RfP for the first round of the SHP programme, for 50 MW, will only be issued once the financial close on the Solar PV projects is achieved. The revised timelines will be communicated to pre-qualified developers in advance.

The programme also conducting a feasibility study for the tender of the 5 MW Solar PV programme, which is aimed at majority owned Zambian firms.

4.2 RENEWABLE ENERGY MINI-GRID REGULATORY FRAMEWORK AND NET-METERING REGULATIONS

After the road-testing of the mini-grid regulations, developed with the support from the EU through the IAEREP project, with the industry in 2019, the ERB finalized and approved the mini-grid regulatory framework in February 2020. The framework consists of the legal, grid encroachment, economic regulations, and technical requirements. This is another significant milestone of the project that ensures security for the mini-grid investors and developers and provides protection for the consumers in the country.

The approval of the mini-grid regulatory framework coincided with the adoption by Government of the Electricity Act and Energy Regulation Act in 2020. The new legislation impacts the mini-grid licencing processes, and introduces other changes, especially concerning feasibility studies, tariffs, construction, monitoring and enforcement. Therefore, the ERB and IAEREP project team embarked on the process to align the approved mini-grid regulations with the new laws.

In 2020, the ERB and IAEREP continued collaborating on operationalizing the net-metering regulations and the possible integration of the regulations into the DGC. It is envisaged that the net-metering regulations will be developed during 2021.

Further, the cooperation between ERB and IAEREP stretches to review and enhance the renewable energy licensing processes in Zambia.

4.3 Bangweulu Power Company

Bangweulu Power Company Limited (BPCL) was commissioned on 11th March 2019. The Company is jointly owned by Industrial Development Corporation (IDC) and Neoen S.A.S of France. BPCL operates a 54.3 MW grid connected solar power plant located in the Lusaka South Multi-Facility Economic Zone (LSMFEZ). Further, the Company has a 25 year PPA with ZESCO. During the year under review, BPCL generated 92.2 GWh of energy representing 0.5 percent of total energy produced at national level. The average performance ratio[19] was at 83.87 percent while plant availability[20] was 99.35 percent during the year under review.

Due to the Covid-19 pandemic, some challenges experienced by BPCL included the increased cost of insurance due to operational uncertainties, lead-time[21] for spares and expenditure to cater for Covid-19 mitigation measures.

4.4 Ngonye Power Company

Ngonye Power Company Limited (NPCL) was commissioned on 19th May, 2019 and is jointly owned by IDC and Enel Green Power S.P.A of Italy. NPCL operates a 34 MWp grid connected solar power plant in the Lusaka South Multi Facility Economic Zone (LSMFEZ). During the period under review, NPCL supplied a total of 58,002.8 MWh of electricity to ZESCO Limited, under an existing 25 year PPA. The average performance ratio and the average plant availability were at 82.74 and 91.93 percent, respectively.

4.5 Developments in the renewable energy sub-sector

In 2020, the ERB developed the regulatory framework for renewable energy stand-alone mini-grids. The regulatory framework includes the following rules and regulations that will govern the issuance of licences to mini-grids;

i. Rules for determining tariffs by mini-grid operators;
ii. Guidance on the tariff implementation parameters; and
iii. Technical requirements for mini-grids.

The regulatory tools were approved by the Board and are undergoing further re-alignment following the enactment of the Electricity Act and Energy Regulation Act.

The Africa Clean Energy Technical Assistance Facility (ACETAF), funded by UK Government Department for International Development (DFID) is assisting governments in 14 Sub-Saharan African countries to put in place appropriate policies and regulation. The project which runs over a period of four years, will also support market development activities and improve quality of solar products through development of appropriate standards.

The ACETAF supported the review and adoption of standards for stand-alone solar home systems. To achieve this process, ERB, through the Renewable Energy Unit, constituted a Technical Committee, to undertake the review that lead to the adoption of the solar home system standards. The standards reviewed for purposes of adoption included the following:

i. IEC 62257-9-5: Integrated Systems –Laboratory Evaluation of Stand-Alone Renewable Energy Products for Rural Electrification-Test Methods; and

ii. IEC 62257-9-8: Integrated Systems –Laboratory Evaluation of Stand-Alone Renewable Energy Products for Rural Electrification-Technical Specifications

This process was undertaken in 2020, and is expected to be gazette in 2021.

4.6 CHALLENGES IN THE RENEWABLEENERGY SUB-SECTOR

The sub-sector has ever revolving technology that requires standards to be continuously developed and revised. The sub-sector relies heavily on electronics, making every license holder a potential generator of electronic waste. This then requires a clear electronic waste management policy, which seems very unclear to a number of players. Whist the sector boasts of having efficient devices on the market, it has been noted that

[19] Refers to the ratio of the actual and theoretically possible energy outputs
[20] Refers to the amount of time that a power plant is able to produce electricity over a specific period
[21] Refers to the time it takes for spares to arrive

there is over utilization of devices such as LEDs because of their aesthetic beauty. Over and above, the pre-approvals and license requirements for players engaged in generation of electricity, leading to a lengthened process. It is also further noticed that the general public feel that grid power is better than mini-grid power.

Other challenges are as listed below:

i. Weather conditions and time of day affect the generation of energy (energy storage needed);
ii. Most people supplied with power in the rural areas have no constant income,it is mostly seasonal, thereby posing a risk to the implementation of cost reflective tariffs;
iii. Few people trained in Renewable Energy or any specific technology;
iv. Fragmented supply of renewable energy products in the country. Most are profit oriented and focused along the line of rail;
v. Information on renewable energy is scattered amongst so many institutions (i.e. grid stability);
vi. Pilfering of energy generation infrastructure experienced at some mini grids;
vii. Challenges in communities socially accepting new technologies;
viii. Inadequately drafted applications for licenses;
ix. Lower cost of traditional methods when compared with new technologies;
x. Safety challenges of biofuel (gas or liquid) and supporting infrastructure;
xi. Lack of financing mechanisms for small players in the market (financial institutions are biased towards big entities, resulting in less favorable platforms for SMEs to invest; and
xii. Lack or limited knowledge on taxes and applicable incentives by small scale traders.

5.0 LICENSING IN THE ENERGY SECTOR

Section 30(a) of the Energy Regulation Act enables ERB to regulate the provision of energy products and services in the country. This is primarily achieved through the issuance of specialised licences.

5.1 TYPES OF LICENCES ISSUED BY ERB

The energy sector is made up of three sub-sectors namely; electricity, petroleum and renewable energy. In this regard, the electricity sub-sector has eight licence types, fourteen licence types in petroleum and two in renewable energy. The tenure for each of these licences have different validity periods depending on the licensed activity. Table 5-1 provides the different licence types per sub-sector and their respective validity period.

Table 5-1: Types of licences issued by the ERB and their durations

S/N	Licence Type	Duration (Years)
	ELECTRICITY	
1	Generation of Electricity	30
2	Transmission of Electricity	30
3	Supply of Electricity	5
4	System Operators Licence	5
5	Generation, Distribution and Supply of Electricity to a Local System	20
6	Generation of Electricity for Own Use	5
7	Embedded Generation of Electricity for Own Use	5
8	Distribution of Electricity	15
	PETROLEUM / FOSSIL FUELS	
10	Importation of Petroleum Feedstock	5
11	Pipeline Transportation of Petroleum Feedstock	5
12	Refining of Petroleum Feedstock	15
13	Terminal storage of Petroleum Products	10
14	Combined Licence to Distribute, Import and Export Petroleum Products	5
15	Retail of Petroleum Products	5
16	Road Transportation of Petroleum Products	3
17	Distribution, Importation, Blending and Packaging of Lubricants	5
18	Wholesale marketing of Petroleum Products	1.5
19	Retail of Liquefied Petroleum Gas	5
20	Combined Licence to Distribute, Import and Export Liquefied Petroleum Gas	5
21	Filling of LPG in Cylinders	5
22	Transportation of Coal	5
23	Construction Permit	2
	RENEWABLE ENERGY	
23	Manufacture, Supply, Installation and Maintenance of Energy Generating Equipment	5
24	Production and Blending of Bio-fuels	5

5.2 PERFORMANCE OF LICENSING

During 2020, 182 applications were duly lodged where 149 were initial and 33 were renewal licences.

5.2.1 PROVISIONAL LICENCES AND CONSTRUCTION PERMITS

To streamline the licensing process, provisional licences are issued to aspiring investors to enable them to commence operation valid for a period of six months this is depicted in Table 5.2. Further, the provisional licence is issued after due diligence[22] is conducted to ascertain legal, technical and financial compliance. Once a provisional licence is issued, it is gazetted for 14 days to allow the public to provide commentary if need be. Following no valid objection and approval from the Board, a standard licence is issued.

In addition, entities that intend to construct an energy facility, its installation or become a common carrier shall apply for a construction permit.

Table 5-2: Provisional licences issued 2019 - 2020

S/N	Provisional Licence/Temporary Permit	2019	2020
1	Distribution, Importation, Blending and Packaging of Lubricants	25	26
2	Distribute, Import and Export Petroleum Products	19	45
3	Electricity Supply	0	0
4	Generate, Distribute and supply Electricity(Off-Grid Electricity Licence)	0	1
5	Distribute, Import and Export Liquefied Petroleum Products	43	33
6	Generation of Electricity	3	0
7	Manufacture, Supply, Installation and Maintenance of Energy Generating Equipment	25	38
8	Retail of Liquefied Petroleum Gas (LPG)	27	0
9	Retail of Petroleum Products	1	8
10	Retail site inclusions	6	0
11	Road Transportation of Petroleum Products	18	44
12	Construction Licences	0	43
	Total Issued	**167**	**238**

5.2.2 STANDARD LICENCES

A total of 227 Standard Licences were issued in the year 2020 and were as follows: 1 in electricity, 37 in renewable energy and 189 in the petroleum sub-sector.

Table 5-3: Standard licences per type 2019 - 2020

S/N	Type of Licences	2019	2020
1	Distribute, Import and Export of Petroleum Products	21	41
2	Distribute, Import and Export of Liquefied Petroleum Gas	09	01
3	Inclusions of Retail sites to Existing Retail Licences	23	21
4	Generation, Distribution and Supply of Electricity for an Off-Grid Electricity System	03	01
5	Distribution, Importation, Blending and Packaging of Lubricants	38	31
6	Manufacture, Supply, Installation and Maintenance of Energy Generating Equipment	28	37
7	Export of Liquefied Petroleum Gas	26	43
8	Retail of Petroleum Products	05	8
9	Road Transportation of Petroleum Products	24	44
	Total Issued	**179**	**227**

[22] Refers to the process or effort to collect and analyse information before making a decision

5.3 REGULATIONS TO BE ENACTED FOR THE ENERGY REGULATION ACT NO.12 OF 2019 AND ELECTRICITY ACT NO. 11 OF 2019

The Energy Regulation Act Chapter 436 of the laws of Zambia and the Electricity Act Chapter 433 of the laws of Zambia ("Repealed Acts") were replaced with the Energy Regulation Act, 2019 ("Energy Act") and Electricity Act, 2019 ("Electricity Act") respectively. The Acts have retained there regulatory structure under which the Energy Regulation Board (ERB) and the Minister of Energy are still key regulators of the energy sector. In addition to this, their functions have been redefined and expanded. Following the enactment of these provisions of law, one of the requirements that followed was the development of Regulations to operationalize some of the provisions of the Acts. To this end, ERB has engaged services of a private drafter to develop the said Regulations. Below is a summary of the Regulations that are expected to be promulgated:

UNDER THE ENERGY REGULATION ACT NO.12 OF 2019

i. Licensing Regulations
ii. Consumer Affairs Council Regulations
iii. Administration of the Fund Regulations
iv. Tribunal Regulations
v. The form and manner of making applications for Licences and the fees payable on that application;
vi. Standards with regard to the quality, safety and reliability of supply of energy and related installation;
vii. The maintenance of stability of supply of energy within the Republic;
viii. The securing of safety of the public from personal injury or damage to property arising from regulated activities under the energy sector;
ix. Reporting of and carrying inquiries into accidents involving the operation of any licensee or associated plant, equipment or vehicles;
x. The fees payable under this Act.

SUMMARY OF THE PROPOSED REGULATIONS UNDER THE ELECTRICITY ACT NO.11 0F 2019

i. Sale and Purchase of Electricity outside Zambia Regulations
ii. Declaration of Emergency Regulations
iii. Rights of Consumer Regulations
iv. Maintenance of security of supply of electricity within the Republic;
v. Grant of permits for feasibility studies and the rights of permit holders;
vi. Preventing damage to property arising from the generation, supply or use of electricity;
vii. Standards of quality of supply and service;
viii. Determination of tariffs;
ix. Functions of a system operator;
x. Development and use of renewable energy resources for the generation of electricity;
xi. Promotion of efficiency by licenses in the supply of electricity and by consumers in the use of electricity;
xii. Protection of consumers and the terms and conditions for the supply of electricity by licenses;
xiii. Protection of the public and property from dangers arising from the supply of electricity including-
    i.) the safety of the public from personal injury, fire and otherwise;
    ii.) (the protection of persons and property by reason of contact with or the proximity of, or by reason of the defective or dangerous condition of, any electric line or other element of an electrical system used in the supply of electricity or any appliance or other electrical installation in any premises;
    iii.) the reporting and investigation of electricity related accidents, damage and other matters concerning the safety of electrical systems and for failures to supply electricity; (iv) the prevention of any electronic communications or other line, or the current or other signals in those lines, from being injuriously affected by any electricity utilised in the supply of electricity;
xiv. Rates charged for the supply of electricity and any other service associated with the supply of electricity by any licensee and the rates payable by a licensee to self-generators who provide excess electricity from their electricity generation capacity to the licensee;
xv. Information that licensees and self-generators must provide to the ERB under this Act and by licensees to consumers;

xvi. Open access framework;

xvii. Declaring that a portion of electricity or power produced from any power station be determined by the Minister so as be reserved for retail consumers including institutions that render public social services;

xviii. Metering and other forms of consumption of electricity; and Classes of consumers and licenses; and

xix. Regulation of Mini-grids and tariff rules.

5.4 OUTLOOK ON LICENSING

The provisions of the new Energy Regulation Act no. 12 of 2019 and the Electricity Act no. 11 of 2019, came into effect in February of 2020, they are intended to enhance efficiency in the energy sector. Among the salient provisions of the Energy Regulation Act is the consideration and grant of licence by the ERB. The Law has facilitated the business process by stipulating that the ERB shall, within sixty days of receipt of a complete duly lodged application, grant or reject the application and inform the applicant of its decision. Otherwise the licence shall be deemed to have been granted on failure to inform the applicant of ERBs decision on an application for a licence. The licensing process is illustrated in Appendix 8.

5.4.1 Salient Provisions under the Energy Regulation ACT No.12 of 2019

Grounds for Refusal to issue Licence:

i. Undischarged bankruptcy;
ii. If any person employed by or associated to the applicant was convicted, whether in the Republic or elsewhere, of an offence involving fraud or dishonesty or an offence under this Act;
iii. is not a fit and proper person to be granted a licence as prescribed; or
iv. is unable to meet minimum financial, solvency and liquidity requirements or other criteria that may be prescribed.

Note: Refusal to grant a license should be upon any of the grounds listed and the applicant should be informed of the reason

Variation of Licence:

i. The ERB can on its own motion vary a license upon carrying out investigations of the activities of the Licensee. Provided a notice is given to the Licensee.
ii. ERB may also approve amendment to licence on the licensee's request.

Suspension of Licence:

The following are the grounds for suspension of Licence:

i. obtained the licence on the basis of fraud, false information or statement or misrepresentation;
ii. Fails to comply with a term or condition of the licence;
iii. Has ceased to fulfil the eligibility requirements under the Act;
iv. enters into receivership or liquidation or takes up an action for voluntary winding up or dissolution;
v. is the subject of an order that is made by a court for compulsory winding up or dissolution; and
vi. in the public interest.

Note: ERB shall not suspend or revoke a licence under this section if the licensee takes remedial measures to the satisfaction of the ERB within the time given

Arrest with Warrant

An inspector may arrest a person without a warrant if the inspector reasonably believes that person:

i. has committed an offence under the Act;
ii. is about to commit an offence;
iii. Is willfully obstructing an inspector in the execution of the inspector's duties.

Appeals

i. A person who is aggrieved with any decision of the Energy Regulation Board may appeal to the Minister within 30 days of decision in the prescribed manner and form.
ii. Minister shall within 7 days of receipt of an appeal set up an adhoc appeals tribunal.
iii. The tribunal has 14 days to inform the appellant of its decision.
iv. Appeals against the decision of Tribunal lie to the High Court (30 days)

Duty to Furnish the ERB with Information

A licensee shall be required to provide to the ERB, information or reports concerning the licensed activity of the licensee, financial, technical or any other information prescribed by the ERB.

Failure to do so is an offence warranting conviction, fine and/or suspension of licence.

Compounding of Offences

The ERB now has power to compound certain offences with the consent of the DPP in lieu of prosecution. Provided the offender admits the offence.

Administrative Penalty

The ERB may impose and administer a penalty where a person commits and admits that he has contravened a provision of the Act, which is not an offence.

Enforcement of Directives

Where the ERB issues a directive against an activity being operated in contravention of the Act and the directive is not implemented, the ERB can proceed to enforce the directive and recover the cost for doing so from the offender.

Regulation

The Minister may make regulation to provide for the following:

i. The form and manner of making applications for licences and the fees payable on that application;
ii. Standards with regard to the quality, safety and reliability of supply of energy and related installation; and
iii. The maintenance of stability of supply of energy within the Republic.

5.4.2 Information Management System

Information Management System (IMS) will be used to automate and streamline licence processing, complaints handling and enhance submission of returns. It is envisaged that the automation shall enhance the carrying out of business activities and also provide a seamless link with other collaborating government agencies such as Zambia Revenue Authority, Patents and Companies Registration Agency to name a few. Further, the IMS shall provide basis for implementing the Single licensing system which is also among the provisions of the Energy Regulation Act.

5.4.3 Single Licensing System

The single licensing system governed by the Business Regulatory Act No.3 of 2014 will enhance facilitation of compliancy with multiple licensing requirements by multiple regulatory bodies (such as PACRA, ZRA) through a single regulatory point (The ERB). Its full operationalization is envisaged beyond 2020.

6 CONSUMER AND PUBLIC AFFAIRS

Pursuant to Section 4 (e) of the Energy Regulation Act No. 12 of 2019, the ERB is mandated to receive and investigate complaints from consumers arising from services and products provided by licensees operating in the Energy Sector.

6.1 COMPLAINTS HANDLING

The Energy Regulation Act mandates the ERB to receive, investigate and determine complaints from energy consumers and licensees. Specifically, the Act provides for the following:

i. Handle matters on tariffs and charges provided by a licensee;
ii. Complaints related to the quality of energy services and products provided by enterprises; and
iii. Matters concerning the location or construction of energy facilities or works by a licensee.

6.1.1 Platforms used for Lodging in of Complaints

Consumers who are aggrieved as a result of the products and services offered by Licensees may lodge their complaints to the ERB through the following platforms:

i. ERB offices in Lusaka, Kitwe, Livingstone and Chinsali;
ii. Through letters and e-mails;
iii. Through the Mobile Office; and
iv. Via telephone and the ERB Toll Free Line No.**8484**.

Upon receipt of a complaint from an aggrieved consumer, the ERB is expected to acknowledge receipt of the matter within two (02) days and thereafter institute investigations. With regard to service level agreements, the ERB is expected to resolve complaints within a period of 22 days and if not resolved within the said period then a meeting may be convened involving the aggrieved party and the enterprise being complained against as part of investigations. A complaint is considered resolved under the following circumstances;

i. When addressed by the licensee to the satisfaction of the complainant;
ii. When the complainant withdraws the complaint;
iii. When the ERB makes a determination or an amicable agreement has been reached between the complainant and the licensee;
iv. When enforcement action has been instituted against the licensee in order to address the complaint; and
v. When a complaint falling outside the mandate of the ERB is referred to responsible institution.

Arising from the mandate referenced above, 447 complaints were received and investigated, out of which 254 were resolved. This represents an overall resolution rate of 56.8 percent against the institutional performance target of 85 percent. A complaint may be considered resolved if the aggrieved party is satisfied with the outcome of an investigation. Further, if after conducting investigations and a licensee is not found liable for the grievance, then the complaint may be considered resolved. This is despite it being unsatisfactory to the complainant. It should be noted that complainants who are dissatisfied with an outcome of an investigation or consider the ERB's determination inconclusive are at liberty to seek redress from other avenues such as competent Courts of Law.

Table 6-1 shows a summary of the consumer complaints received and resolved in 2020.

Table 6-1: Complaints received and resolved according to type - 2020

Sub-Sector	Type of Complaint	Received	Resolved	Resolution Rate %	Target Re solution Rate %
Electricity	Delayed Service Connection	270	105	38.8	85
	Faulty Meters	19	17	89.4	85
	Electrical Faulty	5	5	100	85
	Power Outage	28	28	100	85
	Delayed Meter Installation	1	1	100	85
	Delayed Meter Separation	3	2	66.6	85
	Load Shedding	13	13	100	85
	Compensation Claim	12	6	50	85
	Other Electricity	34	27	79.4	85
Petroleum	Cross Product Contamination	2	2	100	85
	Fuel Contamination	23	18	78.2	85
	Underthrowing	7	6	85.7	85
	Illegal Fuel Vending	4	4	100	85
	Pricing of LPG	2	1	50	85
	Other Fuel	21	16	76.1	85
	Other Renewable Energy	3	3	100	85
	TOTALS	**447**	**254**	**56.8**	

As depicted in Table 6-1, it is worth noting that most complaints handled by the ERB stemmed from the electricity sub-sector. In that regard, delayed connections accounted for the majority of unresolved complaints with a resolution rate of only 38.8 percent.

In order to facilitate resolution of the outstanding complaints, the ERB held meetings with the concerned licensees and the complainants. While most complaints were resolved out of this process some complaints remained unresolved beyond the set service level agreement due to failure by ZESCO to facilitate for service connections after receipt of connection fees from applicants. The meetings are one of the interventions employed to speed up the resolution of complaints.

Table 6-2 depicts the number of complaints heard and resolved following meetings held in 2020.

Table 6-2: Complaints mediation meetings held in 2020

Sub-sector	Complaints Heard	Complaints Resolved after Arbitration Hearing
Electricity	72	62
Petroleum	10	8
Renewable Energy	0	0
Total	**82**	**70**

The table below shows the number of complaints received and resolved according to the sub-sectors.

Table 6-3: Complaints resolution rate per sub-sector

Sub-sector	Received	Resolved	Pending	Resolution Rate (%)
Electricity	385	204	181	52.9
Petroleum	57	46	11	80.7
Renewable Energy	05	04	01	80
Total	**447**	**254**	**193**	**56.8**

6.2 SALIENT PROVISIONS FROM REVISED LEGISLATION

It is worthwhile to acknowledge that the new Acts have given the ERB an enhanced mandate. With respect to complaints handling there are salient features that require to be specifically highlighted. The ERB derives its authority to handle energy related complaints from the Energy Regulation Act No. 12 and Electricity Act No. 11, both of which were enacted in 2019. The majority of unresolved complaints relate to delayed service connections. In order to enhance efficiency by licensees, Section 39(7) of the Electricity Act requires the service provider to refund the consumer a capital contribution in the event that the connection period is exceeded. This measure is expected to improve resolution rates for complaints relating to applications for connection to electricity supply, which constitute the bulk of outstanding complaints.

Further, the Energy Regulation Act in Section 30 (1) mandates the ERB to set up Consumer Councils (CCs), in selected parts of the country, whose objectives include complaints handling and consumer education programmes. The CCs would be operated by volunteers mainly in districts where there is no ERB presence. The CCs would handle complaints on behalf of the ERB and provide a platform on which the public would have access to some services provided by the regulator.

It is envisaged that in the long run the interventions highlighted above would help to streamline the ERB complaints handling process and go a long way in safeguarding consumer interests.

6.3 MEDIA ENGAGMENTS

The ERB is mandated to inform and educate the public on its mandate and also the value it adds to national security of supply of regulated energy products and services. The mandate calls for information provision as is spelt out under the new acts namely, the Energy Regulation Act No 12 of 2019, Part II Section 4 (d) which provides for dissemination of information.

In view of the above, the ERB maintains sound media relations in order to collaborate with the media for information dissemination. The main media platforms used include television, radio, social media and newspapers and the website among others.

Against this background, awareness messages for 2020 focused on key issues such as changes in fuel prices as well as the electricity tariff adjustment for 2020. The ERB undertook a countrywide community radio sensitisation campaign in January 2020 after price changes were effected on 26th December 2019 for fuel and 1st January 2020 for electricity.

Other topical issues in the year were the anticipated fuel price change following a drop in international oil prices in the wake of the COVID 19 pandemic. ZESCO prepaid meters was another issue that attracted a lot of public attention leading to a flurry of complaints from around the country. There was also a notable increase in the number of social media fake reports surrounding fuel pricing and procurement of feedstock which the ERB had to correct and clarify.

The ERB also undertook a media tour to Ngonye PV power plant located at the Lusaka Multi facility Economic Zone as well as to Maamba Collieries in Southern Province. The tour objective was to sensitise the media on the energy mix and to showcase national efforts to promote alternative power generation initiatives which have diversified energy sources. Participating media were drawn from Lusaka and Southern Province.

As is customary, an end of year media briefing to highlight key regulatory issues for the year 2020 was conducted. The third ERB media awards ceremony was held side by side with the press briefing. Journalists were awarded for outstanding energy articles in television, print and radio. The 2020 awards were extended to include prizes for the second position.

Table 6-4: Media Activity Comparison in 2019 and 2020

No	Month	Media Activity	No. of Activities 2019	No. of Activities 2020
1.	Quarter 1	Media Engagements	24	10
		TV/Radio Program	18	41
2.	Quarter 2	Media Engagements	37	45
		TV/Radio Program	05	03
3.	Quarter 3	Media Engagements	69	42
		TV/Radio Program	27	13
4.	Quarter 4	Media Engagements	59	21
		TV/Radio Program	24	04
Total			**263**	**179**

A total of 179 media engagements were undertaken.

6.3.1 Social Media

Besides the traditional media, the ERB hosts a Facebook page. The initiative is based on the findings in the ERB Awareness and Perception Study conducted in 2019, which recommended social media as one of the platforms for the ERB to explore for purposes of information sharing. The ERB uploaded 36 posts on its Facebook and recorded 116,446 views for the various posts that were uploaded on the page in 2020 thereby enhancing the visibility of the institution.

6.4 OUTLOOK ON CONSUMER AFFAIRS

The ERB commenced the process of developing regulations which are expected to enhance the resolution rate for consumer complaints. The ERB will continue to make available information to consumers regarding energy products and services on platforms such as the website, Facebook, Toll Free Line and website, among others.

Furthermore, the ERB shall set up CCs in selected parts of the country where there is no ERB presence to enhance the complaints handling function of the ERB. The Councils will also be responsible for educating the public on their rights and obligations as they participate in the energy sector.

In order to heighten compliance levels to the set licence conditions, the ERB will continue to impose enforcement action on erring licensees.

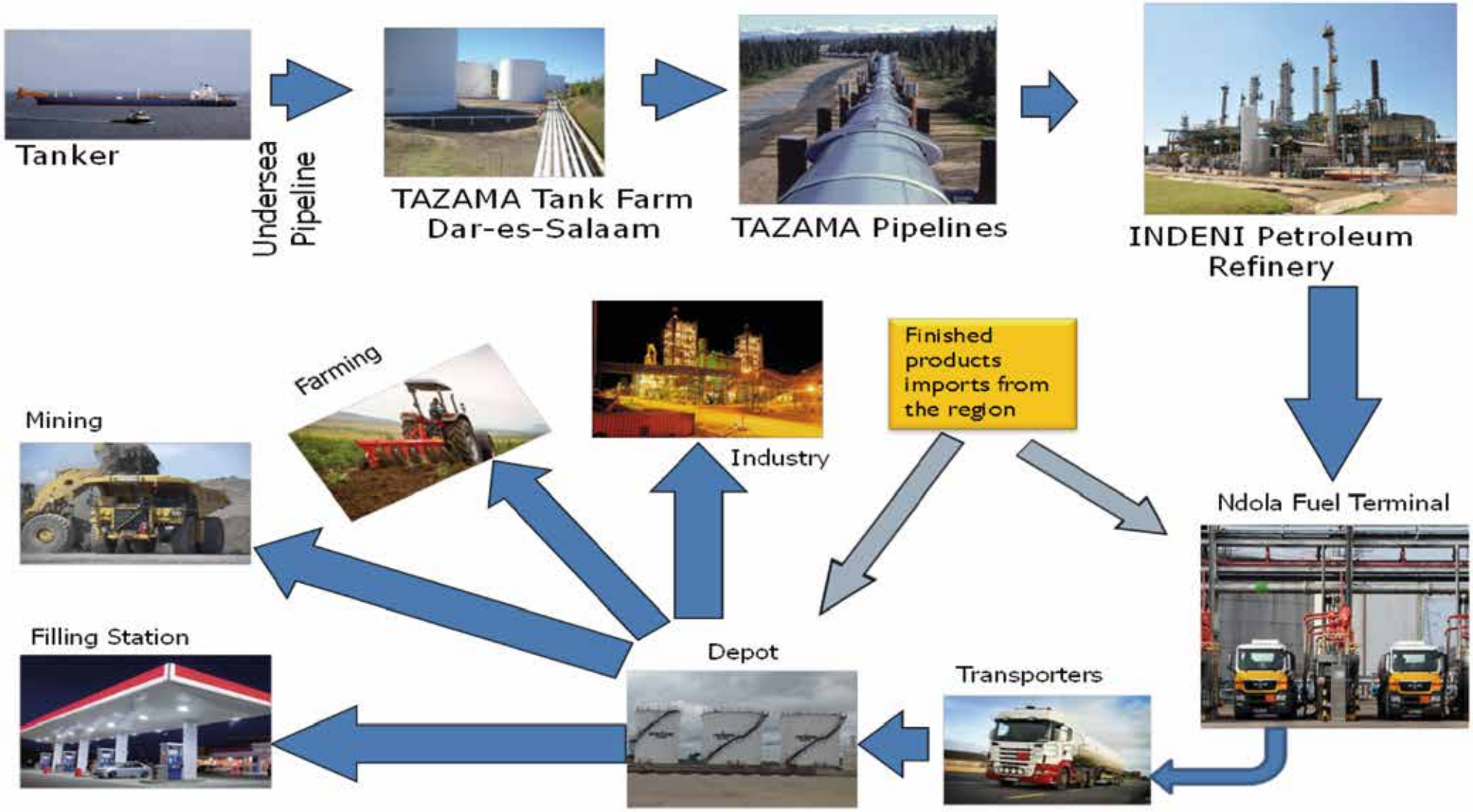
LIST OF APPENDICES

Appendix 1 Retail sites as at December 2020

	Provinces										
OMC/Dealer	Province	Central	Copperbelt	Eastern	Luapula	Lusaka	Muchinga	Northern	Northwestern	Southern	Western	Grand Total
Alpha			1									1
Asharami						1						1
Collum Lunm Tian Petroleum						1						1
Eco Petroleum Ltd			2		1		1	1	1			6
Endrone Petroleum								2				2
Engen		1	7	1	1	21		4	1	3	1	40
Hass			2			2					1	5
Hitco			1									1
Japawa Filling Station							1					1
Lake Petroleum Ltd		3	9			11	1		1	1		26
LBM Investments Limited			1		1		1	3				6
Luapula Oils Ltd					1							1
Lukulu Service Station											1	1
Mon Fuel And Oil Investments Limited									1			1
Mount Meru Petroleum Zambia Ltd		8	8	2	1	21	1	1	4	5	1	52
Oasis Oil Ltd				5		3						8
Oilbay (Z) Ltd		1										1
Oryx Oil Zambia Limited			6	2	1	7				2		18

	Provinces										
OMC/Dealer	Province	Central	Copperbelt	Eastern	Luapula	Lusaka	Muchinga	Northern	Northwestern	Southern	Western	Grand Total
Petroda Zambia Ltd			6			17			1			24
Petrolink									2			2
Prime Oil Ltd			1									1
Ravasia						1						1
Refuel											1	1
Rubis Zambia Ltd		5	12	2		10				5	1	35
SGC Investments			15	1		8	1	2	2	2		31
Simba Energy Ltd		3	1			1	2					7
Simba Oil Company						1						1
Sino Petroleum						1						1
Spectra Oil Corporation		1				3						4
Star Oil Company Ltd			1									1
Total Zambia Limited		7	18	1	1	25	2	1	2	3	1	61
Tribute									2			2
Ufuel		1										1
Wada Chovu			1									1
Zacks Hardware		1					1					2
Puma Energy Zambia		3	15	6	1	21	1	1	3	6	3	60
Zamfuel				1		1						2
Zhongkuang Zambia Services Co. Ltd			1									1
Grand Total		34	108	21	8	156	12	15	20	27	10	411

Appendix 2: Petroleum value chain



Appendix 3 Components of the Cost Plus Model in 2020

a. ***The Wholesale Price Build up***

Since 2008, the ERB uses the CPM to determine wholesale and pump prices for petrol, diesel, low sulphur gasoil and kerosene. The model operates in such a way that all the attendant costs incurred along the petroleum supply chain from the port of discharge in Dar-es-salaam to INDENI refinery where the feedstock is processed up to the NFT where the product is stored and sold are taken into account. The different cost elements up to the wholesale price include:

i. Cost-Insurance-Freight

The Cost-Insurance-Freight (CIF) of the petroleum feedstock cargo is the landed cost of the cargo at the port of Dar-es-Salaam. The quantities of the constituent components of the petroleum feedstock, which include crude oil, condensate, naphtha and diesel, are multiplied by the unit costs to derive the total monetary cost of the feedstock.

The information is obtained from the supplier invoices which is based on the contract between Government and the oil supplier and ultimately used to develop a profitability statement.

ii. Ocean Losses

The normally acceptable loss incurred in the loading and offloading of petroleum feedstock and petroleum products from a vessel are set to 0.00%.

iii. Wharfage

The Tanzania Harbour Authority levies a statutory charge on the importation of petroleum products. At present, this is 1.25% of the CIF Dar-es-Salaam cost.

iv. Insurance

The insurance costs are set at 0.11% of CIF. The insurance covers the cost of insuring the feedstock from the Dar-es-Salaam to Ndola.

v. TAZAMA Storage Fee

TAZAMA charges US$2/MT to the importer for any petroleum feedstock quantities that are stored at the Dar-es-Salaam tank farm on the last day of the month. The amount was agreed upon between TAZAMA and Government.

vi. TAZAMA Pumping Fee

TAZAMA charges US$49.00/MT to the importer for transporting petroleum feedstock through the pipeline from the Dar-es-Salaam tank farm to the Refinery in Ndola.

vii. TAZAMA Pipeline Losses

Consumption and losses for TAZAMA are currently set at 1.00%.

viii. Agency Fee

The Government appointed TAZAMA as agent to discharge specific duties in the procurement of petroleum feedstock. The Agency fee is currently US$5/MT, the fee is agreed between the Government and agent. The key function of the agent, amongst others, is to ensure compliance by the supplier to the terms and conditions of the supply contract.

ix. Processing Fee

INDENI charges a processing fee of US$55.38/MT to the importer for refining (processing) petroleum feedstock.

x. Refinery Losses

Some petroleum feedstock quantities are lost during the refining process due to:

a. Normal processing losses;

b. Consumption, as some quantities are consumed as fuel in the process; and

c. The consumption and losses figure are set at 5.0%.

xi. Terminal Losses

These are terminal losses as prescribed by international norms. A loss level of 0.5% is allowed for petrol whilst a loss level of 0.5% has been allowed for kerosene and jet A-1, 0.3% for diesel and Heavy Fuel Oil (HFO) covering handling and storage losses. A loss of 1% is provided for liquefied petroleum gas (LPG).

b. The Retail Pump Price Build-up

The specific cost elements of the pump price as at 31st December, 2019 are discussed below:

i. Terminal Fee

The NFT charges a fee of K0.063/litre on petrol, diesel and kerosene uplifts at the terminal.

ii. ***Marking Fee***

The price of petrol, diesel, kerosene and LSG incorporates a cost line referred to as the Marking Fee of K96.99/M^3 or 9.70 ngwee/litre. The Marking Fee covers the cost of the chemicals used to mark petroleum products, the taxes on the chemicals and the staff costs of implementing the fuel marking programme.

iii. Excise Duty

The applicable excise duties inclusive of road levy are K2.07/litres on Petrol, K0.66/litre on Diesel, K0.66/litre on LSG and 0% on Kerosene.

iv. Transport Cost

The transport cost is the transport charge that is applied in all towns to equalize the pump prices to the national uniform pump price.

v. OMC Margin

The ERB determines the OMC margin. This refers to the amount of money an OMC can make on each unit of petrol, diesel, kerosene and LSG they distribute. The OMC margin covers the costs of the OMC and allows the OMC to earn a reasonable return on its assets. The current ERB determined OMC margin is K0.89/litre. The OMC margin is reviewed on a regular basis by the ERB using the revenue requirement methodology i.e. a regulatory best practice for regulation of utilities.

vi. Dealer Margin

The ERB determines the dealer margin. This refers to the amount of money a service station owner can make on each unit of petrol, diesel, kerosene and LSG they retail. The dealer margin covers the costs of the dealer and allows the dealer to earn a reasonable return on its assets. Currently, the ERB determined dealer margin is K0.65/litre. The dealer margin is reviewed on a regular basis by the ERB using the revenue requirement methodology i.e. a regulatory best practice for regulation of utilities.

vii. Strategic Reserves Fund

The Strategic Reserves Fund (SRF) cost-line of K0.15/litre is currently applicable to petrol, diesel and kerosene. The SRF cost-line is collected from consumers through OMCs for the purpose of:

a. Stabilizing fuel prices.

b. Purchasing of Strategic Petroleum Reserves (SPRs). However, the SPRs have never been procured due to inadequate storage infrastructure. The MoE is currently building fuel depots.

c. Developing petroleum infrastructure particularly, construction of storage depots for the SPRs.

viii. ERB License Fees

The ERB licence fees are set at 0.7% of the OMC's turnover. The fee has in the past been the principal source of funding for the ERB, however the funding mechanism was changed as the institution is now funded through Government grants effective from 1st January 2013. Licence fees are collected from Licencees through a remittance form to which the licencee is required to fill in and submit to the ERB on a monthly basis.

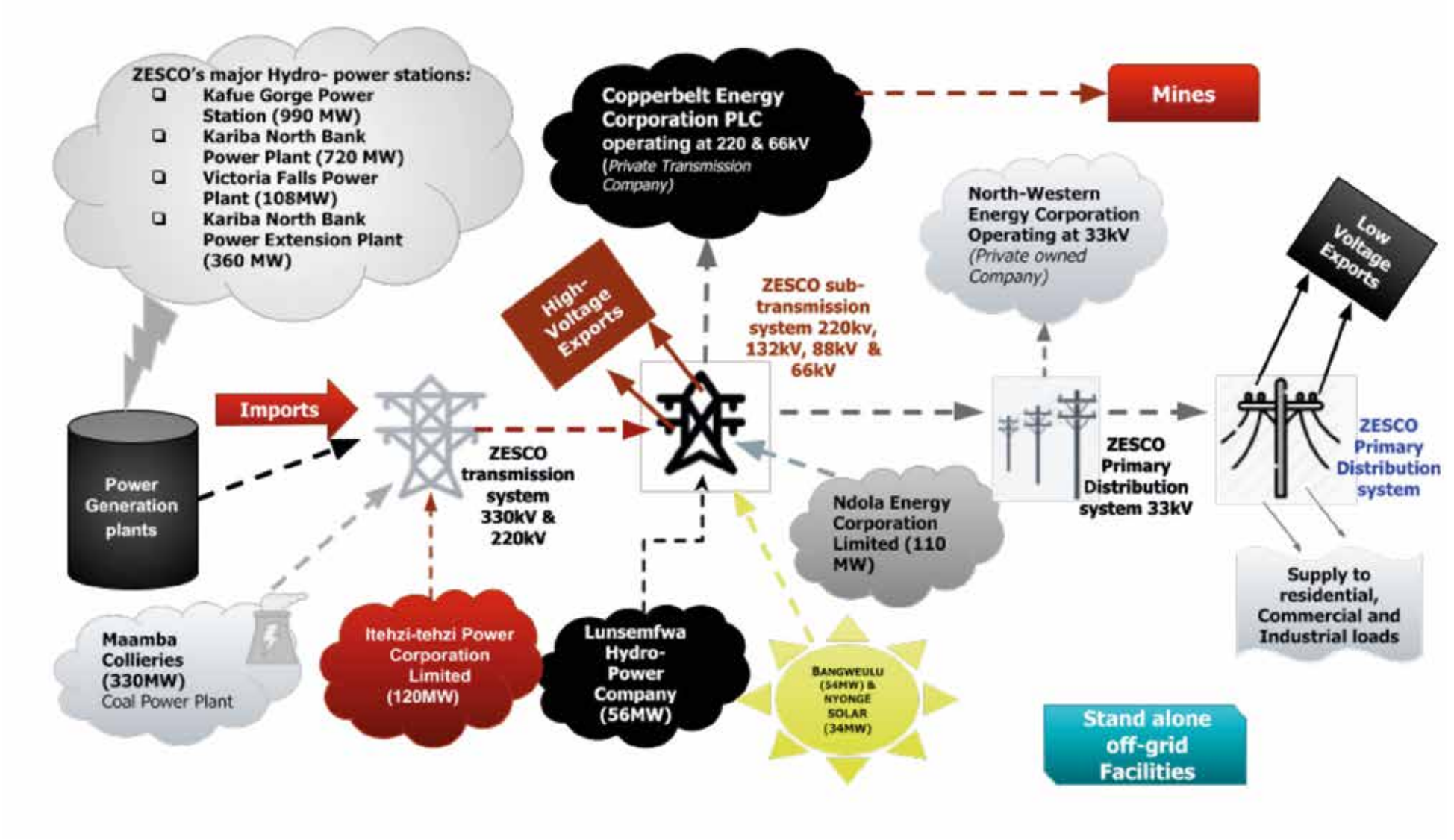
ix. Value Added Tax

The current applicable Value Added Tax (VAT) on petrol and diesel is 16%. There is no VAT applied on domestic kerosene

Appendix 4 Installed electricity generation mix in Zambia in 2020

Licensee's Name	Station	Technology	Installed Capacity (MW)
ZESCO Limited	Kafue Gorge	Hydro	990.00
	Kariba North	Hydro	720.00
	Kariba North Extension	Hydro	360.00
	Victoria Falls	Hydro	108.00
	Lunzua River	Hydro	14.80
	Lusiwasi	Hydro	12.00
	Chishimba Falls	Hydro	6.00
	Musonda Falls	Hydro	10.00
	Shiwang'andu	Hydro	1.00
Itezhi-tezhi Power Corporation	Itezhi-tezhi	Hydro	120.00
Zengamina Limited	Ikelengi	Hydro	0.70
Lunsemfwa Hydro Power Company	Mulungushi	Hydro	32.00
	Lunsemfwa	Hydro	24.00
	Total Hydro		**2,398.50**
Maamba Collieries Limited	Maamba Power Plant	Coal	300.00
Dangote Cement Zambia Limited	Dangote Thermal Power Plant	Coal	30.00
	Total Coal		**330.00**
Copperbelt Energy Corporation Generation Plants	Luano	Diesel	40.00
	Bancroft	Diesel	20.00
	Kankoyo	Diesel	10.00
	Maclaren	Diesel	10.00
ZESCO Limited Generation Plants	Luangwa	Diesel	2.60
	Shang'ombo	Diesel	1.00
	Total Diesel		**83.60**
Ndola Energy Generation Plants	Ndola	Heavy Fuel Oil	110.00
	Total Heavy Fuel Oil		**110.00**
Rural Electrification Authority Generation Plants	Samfya	Solar	0.06
Copperbelt Energy Corporation	Kitwe	Solar	1.00
Muhanya Solar Limited	Sinda Village	Solar	0.03
Ngonye Power Limited	LSMFEZ	Solar	34.00
Bangweulu Power Company Ltd	LSMFEZ	Solar	54.00
Solera Power	Luangwa bridge	Solar	0.01
Standard Microgrid	Kafue	Solar	0.02
Mugurameno	Chirundu	Solar	0.01
	Total Solar		**89.13**
Grand Total			**3,011.23**

Appendix 5 Structure of Electricity Supply Industry in Zambia



Appendix 6 ZESCO's KPI for the year 2020- 2022

No.	Thematic areas	Sub indicators	Rationale	Proposed Weight
1)	New Customer connections	i. Maintain Ratio of paid up quotations to new connections at 1:2 ii. Connect all new standard applications within 20 days from the date of payment of the quotation iii. Connect all new non-standard application within 60 days from the date of payment iv. 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%
2)	Efficiency	i. 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 ii. 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. iii. Debtor Days ▪ Reduce mining debtor days to not more than 60 days ▪ Reduce export debtor days to not more than 60 days ▪ Reduce domestic debtor days to not more than 60; and ▪ Reduce GRZ debtor days to not more than 90. iv. 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%

No.	Thematic areas	Sub indicators	Rationale	Proposed Weight
3)	Staff productivity	i. Number Generation staff to total energy generated per generation station ii. Maintain one (1) Technical Transmission staff per seven (7) kilometer of transmission line iii. Maintain one (1) Technical Distribution Staff per 10 kilometres of distribution line iv. Maintain one (1) Distribution Staff per 120 customers v. Maintain 30 percent Staff Costs as proportion of total O&M Costs *(Excluding. Dep and Purchases from IPPs)* vi. 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%
4)	Quality of Service	i. 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; ii. Maintain the DS System Average Interruption Frequency Index (SAIFI) of 5 times or less and WS-SAIFI 5.5 times or less; iii. Maintain the DS-Customer Average Interruption Duration Index (CAIDI) at 5 hours or less and WS-CAIDI at 7 hours or less; and iv. Maintain the Average System Availability Index (ASAI) at 90% or better.	To encourage ZESCO improve its quality of service through the reduction of outage duration and its frequency	20%
5)	Power Quality	i. Install 123 power quality meters by 2021 ii. 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%
6)	Power Generation	i. Plant Capacity Factor for each generation plant (monitoring) ii. Maintain the Unit Capability Factor (UCF) for large hydro plants at 80% or better. iii. Maintain the UCF for Mini hydro plants at 60% or better per quarter. iv. Planned Loss factor v. 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%

No.	Thematic areas	Sub indicators	Rationale	Proposed Weight
7)	Safety	i. Maintain Zero fatality per quarter ii. Maintain Zero Life Threatening Injuries (LTI) per quarter. iii. Number of high potential Misses per employee (monitoring) iv. 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	i. Maintain outage complaints resolution rate at 90% ii. Maintain Non-Outage complaints resolution rate at 87% iii. Resolve outage complaints within 24 hours from the date the complaint is logged iv. Resolve Non-outage complaints within 30 days from the date the complaint is logged v. 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	5%
9)	Meter maintenance and reading	i. Replacement of faulty Meters must be done within 3 days after a complaint is lodged ii. 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 lessen inconvenience to the affected customers. Also to ensure bills are dispatched in good time to reduce debt age	5%
10)	Financial KPIs	i. Liquidity ▪ Maintain Current Ratio of one (1) and above ▪ Maintain Quick ratio of 0.5 or above ii. Profitability (monitoring) ▪ Calculation of a ROCE ▪ Calculation of Gross profit margin ▪ Calculation of Net profit margin ▪ Calculation of the Asset turnover ratio iii. 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 iv. Sustainability ▪ Average capital expenditure to net asset value (monitoring) ▪ Maintain Total O&M Cost to Revenue ratio of 60%	To encourage ZESCO to maintain a health Liquidity, solvent and financial viability and sustainability.	10%
	Total			**100%**

Appendix 7 Major System Disturbances recorded in 2020

No.	Date	Cause	Affected Circuits	Protection Indications	Effect on System
1.	▪ 21st November 2020, 21:34Hrs.	▪ The disturbance was due to the loss of load at Kansanshi Mine due to lightening.	▪ 330kV Kansanshi – Lumwana line. ▪ 33kV Smelter 1 & 2.	▪ Overvoltage.	▪ ZESA tie line power flow swung from 17.2MW import to 134.7MW export. The 220kV CEC - SNEL interconnectors, power flows decreased from 122MW export to 112MW export. ▪ System frequency went from 50.07 Hz to 49.88Hz and settled at 49.95Hz. ▪ The system voltage as monitored at Kitwe substation on the 330kV bus bar dropped from 322kV to 252kV and rose to 329kV. System was normalised at 21:38hrs.
2.	▪ 17th November, 2020, 17:33hrs.	▪ CEC: The disturbance was due to the tripping of the 220kV Michelo-Karavia line 1 & 2 and Luano - Karavia line.	▪ 220kV Michelo -Karavia line 1 & 2 and Luano - Karavia line.	▪ Main protection.	▪ The 220kV CEC -SNEL interconnectors, power flows decreased from 180MW export to 0MW export. ▪ ZESA tie line power flow swung from 49MW import to 177MW export. ▪ System frequency went from 50.02Hz to 50.Hz then settled at 49.97Hz. ▪ The system voltage as monitored at Kitwe substation on the 330kV bus bar initially dipped from 310kV to 329kV. ▪ System was normalised at 17:38hours
3.	▪ 6th November 2020, 19:23hrs.	▪ The unit tripped on Pins Rupture Guide blade due to punctured Shear Pin Limit Switch power cable. The cable got punctured by guide vane (when fully opened) that hit it against the deformed the steel support for Turbine Pit Walkway.	▪ KNB G4.	▪ Pins Rupture Guide blade.	▪ The deformed steel support was replaced. ▪ Restored at 21:35hrs after removing a damaged cable to guide vane # 1 limit switch Loss of about 160MW of generation support.
4.	▪ 5th November, 2020, 16:52Hrs.	▪ SNEL: The disturbance was due to the blocking and deblocking of Converter number 1 at Kolwezi, in the SNEL network.	▪ 220kV Michelo-Karavia line 1 and 2 and Luano - Karavia line.	▪ Main Protection.	▪ The 220kV CEC -SNEL interconnectors, power flows decreased from 162.8MW export to 0MW export. ▪ ZESA tie line power flow swung from 50.2MW import to 113.713MW export. ▪ System frequency went from 50.09Hz to 50.219 Hz then settled at 49.97Hz. ▪ The system voltage as monitored at Kitwe substation on the 330kV bus bar initially dipped from 317kV to 328kV then rose to 324kV. ▪ System was normalised at 16:59hours.
5.	▪ 4th November 2020, 19:59hrs.	▪ CEC: The disturbance was due to the tripping of 220kV Michelo-Karavia line 1 & 2 and Luano-Karavia line on main protections.	▪ 220kV Michelo -Karavia line 1 and 2 and Luano - Karavia line.	▪ Main Protection.	▪ 220kV CEC - SNEL interconnectors, power flows decreased from 123MW export to 0MW export. ▪ ZESA tie line power flow swung from 49.9MW export to 425MW export. ▪ System frequency went from 49.95Hz to 50.213Hz then settled at 50.186Hz. ▪ The system voltage as monitored at Kitwe substation on the 330kV bus bar went from 314kV to 326kV. ▪ System was normalised at 20:05hrs.

No.	Date	Cause	Affected Circuits	Protection Indications	Effect on System
6.	▪ 27th October, 2020, 09:55Hrs.	▪ SNEL: The disturbance was caused by a lightning strike on the 500kV DC Inga – Kolwezi line which lead to the tripping of the converters 1 and 2 at Kolwezi and all units at Inga Power Station, in SNEL network.	▪ 500kV HVDC Converters 1 and 2 between Inga and Kolwezi.	▪ -	▪ The 220kV CEC -SNEL interconnectors, power increased from 177.2MW export to about 339.2MW export. ▪ ZESA tie line power increased from 177.2MW export to about 339.2MW export. ▪ System frequency went from 49.948Hz to 49.723Hz then increased to 50.3Hz and settled at 50.08Hz. ▪ The system voltage as monitored at Kitwe substation on the 330kV bus bar went from 315kV to 230.36kV and rose to 356.69kV. ▪ System was normalised at 10:31hrs.
7.	▪ 20th October, 2020, 16:00Hrs.	▪ SNEL: The disturbance was due to the loss of generation (9 Generators Total=1400MW) at Inga 1&2 Power stations in the SNEL network.	▪ -	▪ -	▪ The 220kV CEC -SNEL interconnectors, power increased from 91.3MW export to about 280MW export. ▪ ZESA tie line power flow swung from 50MW import to 473MW export ▪ System frequency went from 50.22Hz to 49.78Hz the settled at 49.91Hz. ▪ The system voltage as monitored at Kitwe substation on the 330kV bus bar went from 313.7kV to 200.8kV and risen to 342.2kV. ▪ System was normalised at 16:10hrs.
8.	▪ 08th October, 2020, 20:17Hrs.	▪ SNEL: The disturbance was due to the tripping of 220kV Michelo-Karavia line 1 & 2 and Luano-Karavia line on main protections 1 & 2.	▪ 220kV Michelo-Karavia line 1 & 2 and Luano - Karavia line.	▪ Main Protection.	▪ The 220kV CEC -SNEL interconnectors, power flows decreased from 130MW export to 0MW export. ▪ ZESA tie line power flow swung from 60MW import to 120MW export. ▪ System frequency went from 49.92Hz to 50.188Hz then settled at 49.967Hz. ▪ The system voltage as monitored at Kitwe substation on the 330kV bus bar went from 314kV to 326kV. ▪ System was normalised at 20:25hrs. Karavia lines restored by 21:00hrs.
9.	▪ 2nd October, 2020, 21:18Hrs.	▪ SNEL: The disturbance was due to the blocking and deblocking of Converter number 1 at Kolwezi, in the SNEL network.	▪ -	▪ -	▪ The 220kV CEC -SNEL interconnectors was invalid. ▪ ZESA tie line swung from 8.67MW import to 545.324MW export. ▪ System frequency went from 49.882Hz to 49.796Hz and rose 50.25Hz ▪ The system voltage as monitored at Kitwe substation on the 330kV bus bar initially dipped from 312.058kV to 218.725kV then rose to 361.905kV. ▪ IPS normalised at 21:34hrs.

No.	Date	Cause	Affected Circuits	Protection Indications	Effect on System
10.	▪ 1st October, 2020, 01:15Hrs.	▪ SNEL: The disturbance was due to the blocking and deblocking of Converter number 1 at Kolwezi, in the SNEL network.	▪ -	▪ -	▪ The 220kV CEC -SNEL interconnectors, power flows decreased from 156MW export to 103.3MW export before tripping. ▪ ZESA tie line power increased from 77.9MW import to 538.6MW Export then swung to 16.6MW import. ▪ System frequency went from 50.07Hz to 50.309Hz then settled at 50.02Hz. ▪ The system voltage as monitored at Kitwe substation on the 330kV bus bar initially dipped from 317.8kV to 273.04kV then rose to 325kV. ▪ System was normalised at 01:38hours.
11.	▪ 29th September, 2020, 17:46Hrs.	▪ SNEL: The disturbance was caused by a DC line fault on the 500kV Kolwezi - Inga Converter number 1 in the SNEL network. This resulted in the blocking, deblocking and tripping of the 500kV Kolwezi - Inga Converter and resulted in the tripping of generators at Nseke and Nzilo Power Station.	▪ 500kV Kolwezi - Inga Converter number 1 in the SNEL network.	▪ -	▪ The 220kV CEC -SNEL interconnectors, power flows increased from 151.2MW export to 255.23MW export and swung to 100.82MW import before tripping. ▪ ZESA tie line power increased from 13.7MW Export to 442MW Export then swung to 89.06MW import System frequency went from 50.01Hz to 49.78Hz to 50.205Hz then settled at 50.07Hz. ▪ The system frequency increased from 49.867Hz to 51.698Hz. ▪ The system voltage as monitored at Kitwe substation on the 330kV bus bar initially dipped from 314.12kV to 280.51kV then rose to 357.8kV. ▪ System was stabilised by 18:01hrs and normalised at 18:45hours.
12.	▪ 24th August, 2020, 06:30Hrs.	▪ Due to the tripping of the 533kV DC Songo – Apollo lines 1 & 2 in the Eskom network.	▪ -	▪ -	▪ CEC – SNEL interconnector increased from 136MW export to 150MW export. ▪ ZESCO - ZESA tie line increased from 30MW import to 309MW import. ▪ System frequency went from 49.93Hz to 49.6Hz to 50.3Hz then settled at 50.02Hz. ▪ System voltage at Kitwe went from 315.9kV to to 317kV. ▪ The IPS normalised 07:00hrs.
13.	▪ 19th August, 2020, 15:42Hrs.	▪ Due to the tripping of converter No. 1 and 2 at Kolwezi in the SNEL network.	▪ 220kV Michelo – Karavia line 1.	▪ -	▪ CEC – SNEL interconnector increased from 152MW export to 357MW export. ▪ ZESCO - ZESA tie line increased from 165MW import to 273MW import then swung to 301.21 exports. ▪ System frequency went from 49.93Hz to 50.23Hz to 49.43Hz then settled at 50.01Hz. ▪ System voltage at Kitwe went from 315kV to 262kV then increased to 343kV. ▪ The IPS normalised 16:07hrs.

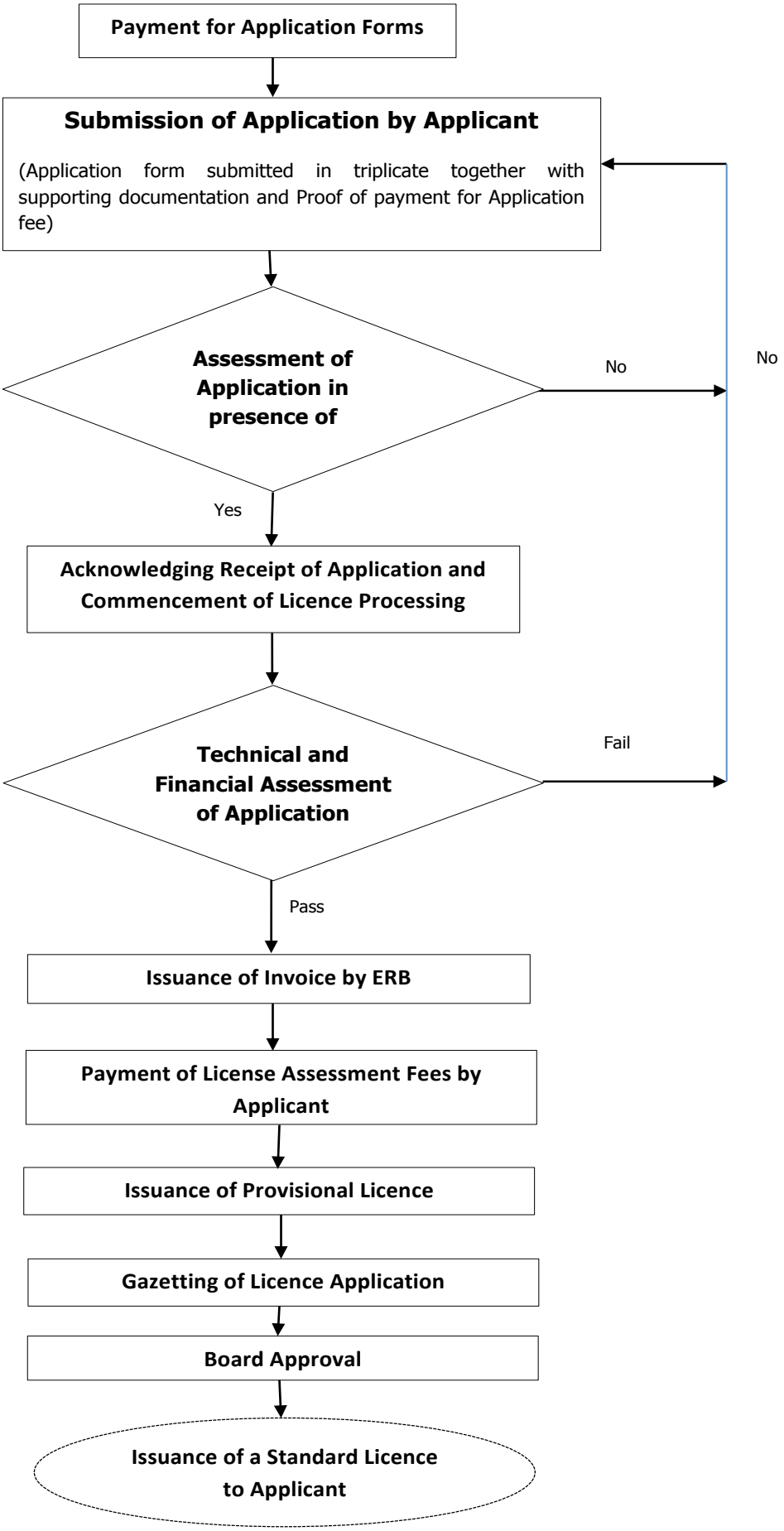
No.	Date	Cause	Affected Circuits	Protection Indications	Effect on System
14.	▪ 14th August, 2020, 4:57Hrs.	▪ Due to the tripping of the 220kV Fungulume – Panda line on main protection, in the SNEL network.	▪ -	▪ -	▪ CEC – SNEL interconnector power flow swung from 38MW export to 68MW import. ▪ ZESCO - ZESA tie line power flow swung from 108MW import to 3.7MW export. ▪ System frequency went from 50.09Hz to 50.15Hz then settled at 50.16Hz. ▪ System voltage at Kitwe went from 319kV to 326kV. ▪ The IPS normalised 15:15hrs.
15.	▪ 13th August 2020, 12:57Hrs.	▪ Due to the tripping of the Due to the blocking and deblocking of converter no.1 at Inga, in the SNEL network.	▪ -	▪ -	▪ CEC – SNEL interconnector increased from 120MW export to 282MW export then swung to 221MW import. ▪ ZESCO - ZESA tie line power flow swung from 94MW import to 270MW export. ▪ System frequency went from 50.04Hz to 49.52Hz to 50.194Hz then settled at 50.07Hz. ▪ System voltage at Kitwe went from 321kV to 275.2kV then increased to 335kV. ▪ The IPS normalised 13:06hrs.
16.	▪ 8th August, 2020, 11:46Hrs.	▪ Due to the blocking and deblocking of converter no.1 at Kolwezi, in the SNEL network.	▪ -	▪ -	▪ CEC – SNEL interconnector power flow swung from 161MW export to 112MW import. ▪ ZESCO - ZESA tie line power flow swung from 59MW import to 191MW export. ▪ System frequency went from 50.0Hz to 50.23Hz then settled at 49.99Hz. ▪ System voltage at Kitwe went from 321kV to 330kV. ▪ The IPS normalised 12:00hrs.
17.	▪ 4th August, 2020, 12:12Hrs.	▪ SNEL: Due to the tripping of converter No. 21 at Inga in the SNEL network.	▪ 220kV Michelo – Karavia line 1 and 220kV Luano – Karavia line	▪ Main Protection.	▪ CEC – SNEL interconnector increased from 149MW export to 415MW export then swung to 260MW import. ▪ ZESCO - ZESA tie line power flow swung from 67MW import to 495MW export. ▪ System frequency went from 50.01Hz to 49.78Hz to 50.205Hz then settled at 50.07Hz. ▪ System voltage at Kitwe went from 319kV to 267kV then increased to 344kV. ▪ The IPS normalised 12:19hrs.

No.	Date	Cause	Affected Circuits	Protection Indications	Effect on System
18.	▪ 20th July, 2020, 13:27Hrs.	▪ Due blocking and deblocking of Converter 1 & 2 at Kolwezi in the SNEL network.	▪ -	▪ -	▪ SNEL Tie line swung from 120.8MW export to 147.2MW export, then to 119.2MW import and settled around 159.7MW export. ▪ ZESA Tie line swung from 156.9MW import to 154.8MW export and finally settled around 178.2MW import. ▪ Voltage monitored at Kitwe dipped from 311kV to 289.7kV and went up to 324.1kV. ▪ Experienced 16 system frequency oscillations within 48 seconds with the highest at 50.31Hz and lowest at 49.76Hz. Finally settled at 49.83 Hz. ▪ IPS normalised at 14:16hrs.
19.	▪ 7th July, 2020, 02:50Hrs.	▪ Due to tripping of 220kV Fungulume-Kolwezi line # 2 in the SNEL network where there was a report of copper conductor theft.	▪ 220kV Michelo-Karavia lines 1 & 2 and 220kV Luano - Karavia line.	▪ Over Voltage Protection.	▪ ZESA Tie line swung from 51.9MW import to 287.5MW export and settled around 139.8MW export. ▪ SNEL Tie line swung from 57.8MW export to 267MW export and then dropped to 0MW. ▪ Voltage as monitored at Kitwe dipped from 322.4kV to 286.5kV and then settling at 344.2kV. ▪ Frequency remained within the dead band. ▪ ZESCO & CEC mines lost 91MW and 90MW respectively. ▪ IPS normalised by 02:57hrs.
20.	▪ 4th July, 2020, 14:47Hrs.	▪ Due to DC line fault in SNEL network.	▪ 220kV Michelo -Karavia lines 1 and 2 ▪ 220kV Luano Karavia line. ▪ 400kV Insukamini-Phokoje. ▪ At Pensulo s/s 66kV B/C CB 1WO. ▪ At Kansanshi – 330/33/11kV Tx T3 and T4. ▪ At Msoro – 330kV Chipata west line.	▪ Main protection. ▪ Over Voltage. ▪ Power Swing. ▪ Under Voltage. ▪ Over Voltage. ▪ Over Voltage	▪ ZESA Tie line swung from 117MW import to 498MW export and settled around 271MW export. ▪ SNEL Tie line swung from 100MW export to 267MW import and then dropped to 0MW. ▪ Frequency went up from 50.03Hz to 51.45Hz and settled at 50.32Hz. ▪ Voltage monitored at Kitwe dipped from 316kV to 187.6kV and then rose to 354kV. ▪ ZESCO & CEC mines lost 209MW and 180MW respectively. ▪ MCL generation ramped down from 267.28MW to 28.77MW then ramped up to 243.6MW. ▪ IPS normalised at 14:58hrs

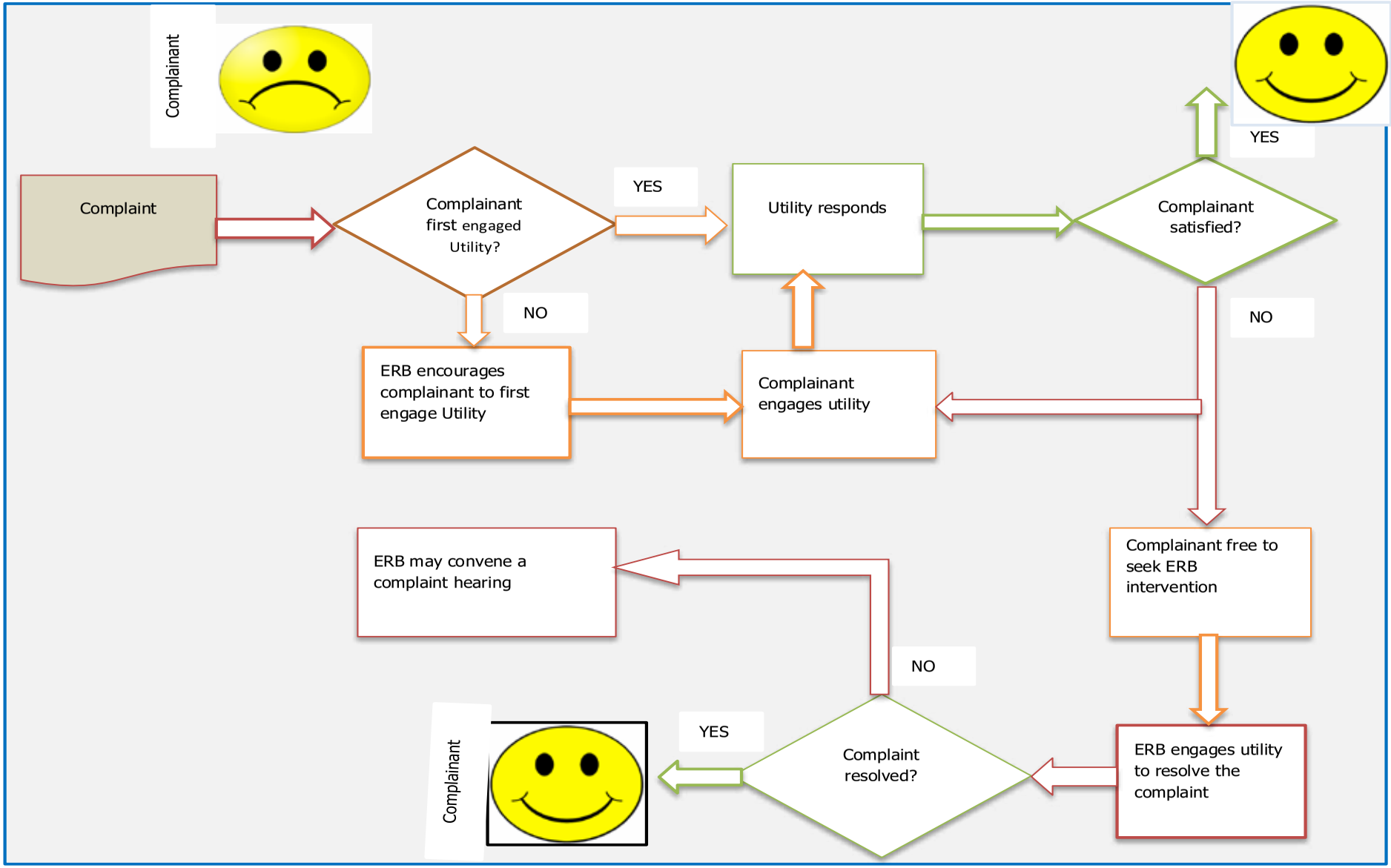
No.	Date	Cause	Affected Circuits	Protection Indications	Effect on System
21.	▪ 4th July, 2020, 00:18hrs.	▪ This was due to an Earth fault on 66kV Stadium-Kabundi line in CEC network where an aerial earth (OPGW) was reported to have cut and touched the line.	▪ -	▪ -	▪ The voltage as monitor at Kitwe substation dipped from 318.3kV to 287.9kV. ▪ Lumwana mine and CEC (including Konkola copper mine) lost 49MW and 50MW respectively, on under-voltage. ▪ The voltage monitored at Kitwe substation rose to 333kV resulting into further loss of load on O/V protection with Kansanshi mine losing about 37MW of load. ▪ Total load lost was about 136MW. ▪ Frequency rose from 49.82Hz to 49.916Hz and stabilised at 49.873Hz. ▪ ZESA Tie line swung from 51.1MW import to 89.6MW export then settle around 98MW export. ▪ SNEL interconnector dropped from 127MW export to 99.3MW export. ▪ IPS normalised at 00:23hrs
22.	▪ 2nd July, 2020, 13:23Hrs.	▪ Due to the tripping of 120kV RO – Kiyava 1 and 2 lines in the SNEL network,.	▪ -	▪ -	▪ SNEL Tie line swung from 105.5MW export to 139.8MW import and settled around 143MW import. ▪ ZESA Tie line swung from 128.8MW import to 112.4MW export and settled around 60MW export. ▪ Voltage monitored at Kitwe dipped from 319kV to 304kV and rose to 317kV. ▪ Frequency went up from 50.124Hz to 50.21Hz and settled at 50.16Hz IPS normalised at 13:33hrs.
23.	▪ 05th February, 2020, 11:56Hrs.	▪ Due to the tripping of generators 1, 2, 3 and 4 machine circuit breakers on differential protection at Kafue Gorge Power Station. Tripping occurred after closing 330kV bus coupler CB130 at KFG switchyard.	▪ Emergency load management implemented as the result of loss of generation at KGPS.	▪ Differential protection.	▪ ZESCO - ZESA tie line power flow swung from 4MW exports to 550MW imports. ▪ CEC – SNEL tie line decreased from 68MW exports to 63MW exports. System frequency went from 50.013Hz to 49.654Hz then stabilised at 49.98Hz. ▪ System voltage at Kitwe rose from 317kV to 320kV. IPS normalised at 12:34hrs.
24.	▪ 3rd February, 2020, 02:47Hrs.	▪ Due to loss of load at Kansanshi and Lumwana mine of about 200MW caused by termination failure on the 33kV cable at Kansanshi mine.	▪ 330kV Msoro - Chipata West line. ▪ 132kV Lumwana -Mumbezhi line. ▪ 132kV Mumbezhi - Lukulu line.	▪ Overvoltage. ▪ Overvoltage. ▪ Overvoltage.	▪ ZESCO - ZESA tie line power flow swung from 57MW imports to 91MW exports. ▪ The CEC - SNEL tie line remained within schedule. ▪ System frequency went from 49.97Hz to 50.18Hz then stabilised at 50.12Hz. ▪ System voltage at Kitwe rose from 323kV to 335kV. IPS normalised at 03:07hrs.

No.	Date	Cause	Affected Circuits	Protection Indications	Effect on System
25.	▪ 31st January, 2020, 23:43Hrs.	▪ Due to the tripping of the 220kV Michelo – Karavia line 1, 220kV Luano – Karavia line and 220kV Luano – Michelo line 2 on main protection on the CEC network.	▪ 220kV Michelo – Karavia line 1. ▪ 220kV Luano – Karavia line. ▪ 220kV Luano – Michelo line 2.	▪ Main protection.	▪ CEC – SNEL interconnector power flow swung from 79MW exports to 220MW imports. ▪ ZESCO - ZESA tie line power flow swung from 137MW imports to 497MW exports. ▪ System frequency went from 50.04Hz to 50.43Hz and settled at 50.076Hz. ▪ System voltage monitored at Kitwe went from 321kV to 334.2kV. ▪ The IPS was normalised at 00:05hrs.
	▪ 4th January, 2020, 15:04Hrs.	▪ Due to the tripping of the 33kV Mining feeder at Kansanshi substation following a lightning strike. Total mining load lost at Kansanshi was 198MW.	▪ -	▪ -	▪ ZESCO - ZESA tie line decreased from 269MW imports to 120MW imports. ▪ CEC – SNEL interconnector decreased from 123MW exports to 102MW exports. ▪ System frequency rose from 49.86Hz to 49.79Hz and stabilised at 50.02Hz. ▪ System voltage monitored at Kitwe went from 323kV to 337kV. ▪ The IPS was normalised at 16:27hrs.
26.	▪ 3rd January 2020, 09:35Hrs.	▪ Due to the tripping of the 33kV Smelter 1 & 2 lines due to an earth fault at Kansanshi mine.	▪ -	▪ -	▪ ZESCO - ZESA tie line decreased from 198MW imports to 24MW imports. ▪ CEC – SNEL interconnector decreased from 133MW exports to 124MW exports. ▪ System frequency rose from 49.85Hz to 50.175Hz and stabilised at 49.97Hz. ▪ System voltage monitored at Kitwe went from 323kV to 263kV then increased to 336kV. ▪ The IPS was normalised at 09:48hrs.
27.	▪ 3rd January 2020, 17:07Hrs.	▪ Due to the tripping and A/R of the Michelo – Karavia line 2 and Luano – Karavia line on main protection on the CEC network.	▪ -	▪ -	▪ CEC – SNEL interconnector decreased from 122MW export to 102MW exports. ▪ ZESCO - ZESA tie line decreased from 190.26MW imports to 125MW imports. ▪ System frequency rose from 49.9Hz to 50.17Hz then stabilised at 50.0Hz. ▪ System voltage at Kitwe rose from 325kV to 334.2kV. ▪ The IPS normalised at 17:15hrs.

Appendix 8 ERB Licensing Process flow chart



Appendix 9 ERB complaints handling procedure



Appendix 10: Approved Tariff Schedule for 2020

Customer category	Tariff components	Approved Tariffs Effective 1st January 2020
1. METERED RESIDENTIAL (Prepaid) (capacity 15 kVA)		
R1 – Consumption from 1 - 100 kWh in a month	Energy charge/kWh	0.47
R2 – Consumption between 101kWh - 300 kWh in a month	Energy charge/kWh	0.85
R3 – Consumption above 300kWh	Energy charge/kWh	1.94
	Fixed Monthly Charge	Abolished
2. Commercial Tariffs (capacity 15kVA)		
C1 – Consumption up to 200kWh	Energy charge/kWh	1.07
C2 – Consumption above 200kWh	Energy charge/kWh	1.85
	Fixed Monthly Charge	Abolished
3. Social Services		
Schools, Hospital, Orphanages, churches, water pumping & street lighting	Energy charge K/kWh	1.19
	Fixed Monthly Charge	203.73
4. Maximum Demand Tariffs		
MD1- Capacity between 16 - 300 kVA	MD Charge (K/kVA/Month)	42.79
	Energy Charge (K/kWh)	0.61
	Fixed Monthly Charge (K/Month)	419.02
	Off Peak MD Charge (K/KVA/Month)	21.39
	Off Peak Energy Charge (K/kWh)	0.46
	Peak MD Charge (K/KVA/Month)	53.48
	Peak Energy Charge (K/kWh)	0.77
MD2- Capacity 301 to 2,000 kVA	MD Charge (K/kVA/Month)	80.03
	Energy Charge (K/kWh)	0.53
	Fixed Monthly Charge (K/Month)	837.97
	Off Peak MD Charge (K/KVA/Month)	40.01
	Off Peak Energy Charge (K/kWh)	0.39
	Peak MD Charge (K/KVA/Month)	100.03
	Peak Energy Charge (K/kWh)	0.66
MD3- Capacity 2,001 to 7,500kVA	MD Charge (K/KVA/Month)	126.39
	Energy Charge (K/kWh)	0.43
	Fixed Monthly Charge (K/Month)	1,755.17
	Off Peak MD Charge (K/KVA/Month)	63.2
	Off Peak Energy Charge (K/kWh)	0.32
	Peak MD Charge (K/KVA/Month)	157.99
	Peak Energy Charge (K/kWh)	0.54
MD4-Capacity 7500kVA to 25,000 kVA	MD Charge (K/KVA/Month)	127.39
	Energy Charge (K/kWh)	0.36
	Fixed Monthly Charge (K/Month)	3,510.39
	Off Peak MD Charge (K/KVA/Month)	63.55
	Off Peak Energy Charge (K/kWh)	0.27
	Peak MD Charge (K/KVA/Month)	158.88
	Peak Energy Charge (K/kWh)	0.45
Bulk Distributors tariff	Maximum Demand customers - MD Charge/KVA/month	58.6
(Purchasers of Power for distribution)	Retail customers – Energy charge / kWh	0.49

Annex 1 ERB Electricity Tariff Determination Methodology

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 2 ERB Mini Grid Tariff Rules and Regulation

	0-100 kW Category I	100 kW - 1 MW Category II	> 1 MW Category III
Tariffs	• No requirement for a formal tariff review; • Submit to ERB data on investment costs, O&M costs and sales; • ERB can only impose a tariff if within 20 Business Days of 'duly lodged' notification it finds tariffs unreasonable or 50% of customers complain during implementation	• By default, ERB does not commence a detailed tariff review for Category II Mini-Grids; • Developers are asked to provide 5-year tariff levels and escalation rates to be applied to Mini-Grid customers; • ERB uses an in-house modelling tool to check the reasonableness of tariff request; • Once tariffs are approved they stay fixed, in real terms, for the duration of the "regulatory period" of 3 years, not adjusted if changes are within a "materiality threshold"; • ERB may trigger a detailed tariff review for Category II Mini-Grids, if it considers tariffs unreasonable.	• Tariffs regulated in 5-year regulatory periods during Periodic Reviews. • Allowed revenues calculated according to the building-block approach (sum of depreciation, allowed revenues, operating and maintenance costs); • Allowed revenues include working capital, collection debt and allowed losses; • The reasonable return is calculated based on weighted average cost of capital, which sets cost of debt equal to the actual rate of financing; • Interim review can be triggered under exceptional circumstances, depending on a "Materiality threshold".
Tariff level	• Cost-reflective	• Cost-reflective	• Cost-reflective
Wholesale purchase price	• Unregulated but as specified in the license; • Mini-grid operators disclose the production price.	• By default, unregulated, mini-grid operators disclose the production price. • If ERB triggers a price review, on the grounds that prices are unreasonable, then price set is either competition price (for solicited bids) or cost-plus methodology for unsolicited bids or when ERB considers competition ineffective.	• For solicited bids the price is the award price in the competitive process. If ERB considers competition insufficient it sets generation price according to Cost Plus; • For unsolicited bids the price is set according to tariff methodology.
Tariff structure	• Unregulated	• ERB sets principles only. • Operators apply for tariff levels/service charges	• ERB sets principles only. • Operators apply for tariff levels/service charges

Annex 3: Consumer rights and Obligations

All consumers have the right to:

1. Access to reliable and safe electric power consistent with industry standards is your right as a consumer;
2. Receiving advance notification about interruption of power supply from service provider (power company) is your right as a consumer;
3. Access fair, courteous and expeditious complaint resolution mechanisms to have their grievances addressed; and
4. Access information about service connection, quality of service, service problems, service charges, price structure, complaints procedures, disconnection and termination of service, and pay points.

Consumer Responsibilities

5. Consumers have a responsibility to pay electricity bills in full, promptly and honestly
6. It is the consumer's responsibility not to use electricity unlawfully *via* illegal connections, meter tampering or any other device that interferes with normal connections
7. Consumers have a responsibility to use only qualified electricians registered with Engineering Institute of Zambia
8. Energy Regulation Board has a Toll Free Line (TFL) 8484 that operates from Monday to Friday, from 08:00 to 13:00 hours and from 14:00 hours to 17:00 hours
9. Any person or consumer may seek the Energy Regulation Board's intervention if they are not satisfied with the way their complaint has been handled by an energy utility or they consider the outcome inconclusive
10. Complaints to the Energy Regulation Board may be channeled through letters, e-mail, telephone, Mobile Office and/or in person at any ERB Office.

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We safeguard your interests