ENERGY
REGULATION
BOARD

ENERGY
SECTOR REPORT

2017

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"

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ABBREVIATIONS

BSA	Bulk Supply Agreement
CEC	Copperbelt Energy Corporation Plc
CSO	Central Statistical Office
ERB	Energy Regulation Board
ESI	Electricity Supply Industry
GRZ	Government of the Republic of Zambia
HFO	Heavy Fuel Oil
IDC	Industrial Development Corporation
INDENI	INDENI Petroleum Refinery Limited
IPP	Independent Power Producer
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
MD	Maximum Demand
MoE	Ministry of Energy
NECL	Ndola Energy Company Limited
NFT	Ndola Fuel Terminal
NWEC	North Western Energy Corporation Limited
OMC	Oil Marketing Company
OPPPI	Office for Promoting Private Power Investments
PCP	Public Consultation Paper
PPA	Power Purchase Agreement
PQD	Power Quality Directives
PQMS	Power Quality Management System
PSA	Power Supply Agreement
REA	Rural Electrification Authority
SADC	Southern Africa Development Community
SAPP	Southern Africa Power Pool
UPP	Uniform Pump Price
TAZAMA	TAZAMA Pipelines Limited
ZABS	Zambia Bureau of Standards
ZEMA	Zambia Environmental Management Agency
ZPL	Zengamina Power Company Limited
ZESCO	ZESCO Limited

UNITS OF MEASUREMENT

bbl	Barrels of oil
GWh	Giga-Watt hour (1,000 MWh)
ZMW	Zambian Kwacha
km	Kilometre
kV	Kilo Volt
kVA	Kilo Volt Amperes (1,000 Volt Amps)
kW	Kilo Watt
kWh	Kilo Watt Hour
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 Metres
US$	United States of America dollar

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- Maamba Collieries Limited
- Ministry of Energy
- Ndola Energy Company Limited
- North Western Energy Corporation Limited
- Office for Promotion of Private Power Investment
- Oil Marketing Companies
- Rural Electrification Authority
- Southern African Power Pool
- TAZAMA Pipelines Limited
- TAZAMA Petroleum Products Limited
- Zengamina Power Limited
- ZESCO Limited

FOREWORD

Energy is said to be the engine of an economy. The security of supply in the provision of quality energy services and products is integral to economic growth and development. In 2017, the energy sector recorded significant progress in meeting our country's energy needs through diversified investments in the power supply and petroleum infrastructure. However, as a sector, we still experienced some challenges in supplying energy products and services. In our bid to overcome the challenges, the Energy Regulation Board (ERB), together with key industry stakeholders, implemented various programmes and projects to ensure the provision of efficient, reliable and affordable quality energy services and products.

This report therefore, continues to provide performance data and information necessary for conducting an autopsy of the sector in 2017. It highlights the various interventions implemented during the year. The report also gives a snapshot of the challenges experienced and the opportunities that exist going forward.

In the petroleum sub-sector, the ERB continued to ensure cost reflectivity in the pricing of petroleum products. This enabled the self-financing of the fuel procurement system and ensured that there was no over or under collection of profits and losses during the period under review. Following the completion of phase one of constructing fuel depots across the country, the Government embarked on the second phase of constructing fuel depots and the sites selected were Mansa, Chipata, Kabwe and Choma.

While having observed prominent improvements, the petroleum sub-sector also experienced challenges resulting from the increase in industry players and multifaceted competition. The sub-sector encountered suspected malpractices such as adulteration and/or tax evasion. These malpractices continue to pose risks of poor fuel quality. In order to combat both adulteration and dumping, the ERB in collaboration with the Ministry of Enery prepared the Statutory Instrument No. 69 of 2017 on Fuel marking.

Beyond 2017, the petroleum sub-sector is expected to experience significant developments. Specifically, the implementation of Statutory Instrument No. 69 of 2017 on Fuel Marking which is scheduled to commence during the first quarter of 2018. The fuel marking program will be adopted as a significant tool for combating such malpractices as adulteration and dumping experienced during the year 2017. In addition, the ERB will continue to collaborate with other stakeholders such as Zambia Revenue Authority (ZRA), Road Transport and Safety Agency (RTSA), Zambia Bureau of Standards (ZABS), Zambia Police Service and other government agencies to enhance compliance.

Furthermore, in 2018 and beyond, the petroleum sub-sector is expected to see the implementation of the new policy which will allow private sector participation in the procurement and financing of national fuel requirements. This new policy will be in line with the Government plans to open up the fuel procurement process thereby limiting its role purely to regulation of the petroleum sub-sector and in the process promoting private sector participation.

Similarly, in the electricity sub-sector, Ndola Energy Heavy Fuel Oil (HFO) Plant was upgraded from 50MW to 110MW. Additionally, Musonda Falls hydro power plant was upgraded from 5MW to 10MW. The country made progress in gravitating towards cost reflective electricity tariffs through upward adjustment of tariffs by 75% that was implemented in two phases. The mining tariffs were also adjusted upwards. In order to diversify the electricity generation mix and promote investment in renewable energy, the Government approved the Renewable Energy Feed-in-Tariff (REFiT) Strategy. The REFiT Strategy will be implemented through the Global Energy Transfer Feed-in Tariff (GETFiT) Zambia Programme. The REFiT/ GETFiT programme is expected to promote investments in renewable energy in the electricity sub-sector. Further, the ERB also commissioned the Cost of Service Study to establish the efficient cost of supplying power to various customer categories and determine the cost reflective tariff levels.

We hope and trust that the report will be a good source of data and information to the Government; other regulators; utilities; non-governmental organisations; academia; investors; energy consumers and other stakeholders on the developments that took place in 2017 and that it will be used as a tool for advancement of the Energy Sector. With the programmes and projects that have taken place in 2017, the Energy Sector is positioned to create a firm foundation for the development of the country.

Langiwe Hope Lungu (Ms.)

Executive Director

July 2018

1.0 INTRODUCTION

Macro-economic Outlook

In 2017, there was a general improvement in the performance of the World economy. In particular the global Gross Domestic Product (GDP) grew from 2.4 percent in 2016 to 3 percent. This growth was attributed to the rebound in global investment which was supported by favorable financing costs, rising profits, and improved business sentiment across both advanced economies and Emerging Market and Developing Economies (EMDEs).[1]

According to the World Bank, GDP in the Sub-Saharan Africa region grew from 1.5 percent in 2016 to 2.6 percent in 2017.[2] This growth was supported by a modest rise in commodity prices, strengthening external demand, favorable rain patterns in a number of countries and improved security situations in several countries. South Africa and oil exporters, which contribute two-thirds of regional output, accounted for most of this growth. Meanwhile, growth in non-resource intensive countries remained solid supported by infrastructure investment, resilient services sectors, and the recovery of agricultural production. Despite this growth, some countries experienced a slowdown particularly in cocoa producing countries like Côte d'Ivoire and Ghana whose prices plummeted, reducing exports and fiscal revenues. Further, the drought in East Africa continued into 2017, adversely affecting economic activities.

In 2017 the Zambian economy recorded some signs of recovery. Particularly, the GDP grew from 3.6 percent in 2016 to 4.1 percent in 2017. According to Central Statistical Office (CSO), of the total 4.1 percent growth, agriculture, forestry and fishing industry had the highest contribution accounting for 1.21 percentage points. This was followed by construction; and education industries which accounted for 0.7 and 0.5 percentage points respectively.

On the macroeconomic front, inflation in 2017 fell from 7.5 percent in 2016 to 6.1 percent and remained in single digit levels. Notably the inflation rate averaged 6.6 percent compared to 18.21 percent in 2016. (CSO, 2018). The single digit inflation was supported by stability of the exchange rate, stable food prices and improved market confidence in the country's policy direction.

During the period under review, the exchange rate of the Kwacha to the United States Dollar remained stable and averaged K9.54/US$ for the period January to December 2017. The lowest exchange rate was observed in November 2017 at K10.04/US$ whilst a pick of K8.96/US$ was recordered in July 2017.

In February 2017, the Bank of Zambia (BoZ) Monetary Policy Committee reduced the Policy Rate from 15.5 percent to 14 percent, the Statutory Reserve Ratio from 18 percent to 15.5 percent and the Overnight Lending Facility Rate from 1,000 basis rate to 600 rate above the Policy Rate.[3] The objective of the reduction was to lower interest rate which had constrained access to credit by the productive sector of the economy thereby stifling economic growth.

During 2017, the lending rates by commercial banks averaged 26.93 percent compared to 28.06 percent in 2016. A high of 29.24 percent was experienced in January and a low of 24.57 percent in December 2017.

[1] https://openknowledge.worldbank.org/bitstream/handle/10986/28932/Global-Economic-Prospects-Jan-2018
[2] http://www.worldbank.org/en/region/afr/brief/global-economic-prospects-sub-saharan-africa
[3] BoZ Monetary Policy Committee announcement (February, 2017)

Performance of the Energy Sector

The performance of the energy sector is mainly influenced by the performance in the oil, gas, coal, electricity and renewables sub-sectors. These are the sectors that drive the primary demand for energy products and services. Fundamentally, factors such as population, economic growth, price and energy efficiency improvements are integral in influencing energy demand.

Boosted by a strong solar Photovoltaic (PV) market, renewables accounted for almost two-thirds of net new power capacity around the world in 2016, with almost 165 gigawatts (GW) coming online. This was another record year, largely as a result of booming solar PV deployment in China and around the world, driven by sharp cost reductions and policy support.

In 2017, new solar PV capacity around the world grew by 50 percent, reaching over 74 GW, with China accounting for almost half of this expansion. For the first time, solar PV additions rose faster than any other fuel, surpassing the net growth in coal.

According to the International Energy Agency (IEA), renewable energy as a serious global force is increasingly taking market share away from coal and natural gases. Further, IEA states that global energy demand rose by 2.1 percent in 2017, more than twice the previous year's rate, boosted by strong global economic growth, with oil, gas and coal meeting most of the increase in demand for energy, and renewables seeing impressive gains. Over 70 percent of global energy demand growth was met by oil, natural gas and coal, while renewables accounted for almost all of the rest[4].

In Asia and Sub Saharan Africa, for the first time, off-grid solar PV applications are forecast to triple to over 3,000 MW in 2022 – from industrial applications, solar home systems (SHSs), and mini-grids driven by government electrification programmes, and private sector investments.

Performance of Petroleum Sub-Sector

In the petroleum sub-sector the market prices for crude oil increased in 2017 averaging an estimated US$52.5/bbl compared to US$43/bbl in 2016. Specifically prices fractuated between US$45.2/bbl to US$68.8/bbl The increase in the price was attributed to reduced production alongside the growing demand. Specifically the Organisation of Petroleum Exporting Countries (OPEC), with the exception of Nigeria and Libya agreed to limit oil production by agreeing to production of 1.2 million barrels per day[5]. This situation was exacerbated by geopolitical tensions in the Middle East. The increase in fuel prices exerted inflationary pressures in most economies. In Zambia, this situation led to two (2) price adjustments in the second half of the year.

Performance of Electricity Sub-Sector

In the electricity sub-sector, in order to implement a cost reflective tariff, the Energy Regulation Board (ERB) approved a 75 percent electricity tariff increment from ZESCO which was implemented in two (2) phases starting with 50 percent effective 1st May, 2017 and an additional 25 percent effective 1st September 2017. The adjustment was necessitated by the continued inability by Government to subsidize ZESCO which experienced a significant increase in accumulated power import costs, among other things, during the period 2015 – 2016 when there was a water crisis that could not support hydro power generation.[6]

[4] www.iea.org/publications/renewables2017
[5] https://thediplomat.com/2017/12/the-global-oil-war-rages-on-with-opec-cut-deal-extension/
[6] 2017 budget speech

Further, the Government initiated several programmes that aimed at increasing the energy mix in the Electricity Supply Industry (ESI) in Zambia such as scaling solar programme by Industrial Development Corporation (IDC), off-grid energy solutions, approval of Renewable Energy Feed-In-Tariff Strategy, import duty waiver on selected solar systems and introduction of coal fired thermal power plants. The Government also commenced the review of legislation, the implementation of the Distribution Grid Code, the Electricity (Grid Code) Regulations and movement toward Open Access Regime.

In 2017, the total national installed electricity capacity increased from 2,826.91 MW in 2016 to 2,896.91 MW reflecting an increase of 2.48 percent. In 2017, 15,195 GWh were sent out against 11,696GWh in 2016, an increase of 29.92 percent. The Seventh National Development Plan (7NDP) has outlined broad strategies and reforms to enhance the supply of electricity which will expand installed capacity, and generation to meet increased peak demand.

In a bid to move to cost reflective tariffs, in 2017, the ERB embarked on a Cost of Service Study (CoSS) with funding from the African Development Bank (AfDB). The main objective of the CoSS is to establish the cost of generating, transmitting, distributing and supplying power to various customer categories and at various points in the industry. Once the study is completed, all tariffs will be determined based on the results of the CoSS.

The report is arranged in five sections as follows: section one is an introduction followed by section two which discusses the key developments and challenges in the petroleum sub-sector. Section three focuses on the key developments and challenges in the electricity sub-sector. Section four discusses licencing issues in the energy sector and section five discusses other issues in the sector such as consumer affairs.

2.0 PETROLEUM SUB-SECTOR

This section discusses the supply of national fuel requirements, operations of state owned fuel enterprises, national consumption of fuel, market share of Oil Marketing Companies (OMCs), pricing of petroleum products challenges and outlook for the petroleum sub-sector.

Petroleum products bulk storage

2.1 Importation of fuel

Zambia's national petroleum requirements are met through the importation of petroleum feedstock and finished petroleum products. The imported feedstock is in the form of spiked[7] crude oil which is, transported through the 1,710 km TAZAMA pipeline and refined at the Government owned Indeni Petroleum Refinery (INDENI) in Ndola on the Copperbelt Province of Zambia. The pipeline is jointly owned by the Republic of Zambia owning 67 percent and Tanzania having a stake of 33 percent. Refined petroleum products, on the other hand, are imported into the country mainly by road, and to a lesser extent, by rail. These are distributed to various Government owned depots, meanwhile, Oil Marketing Companies also import finished petroleum products to supplement Government imports.

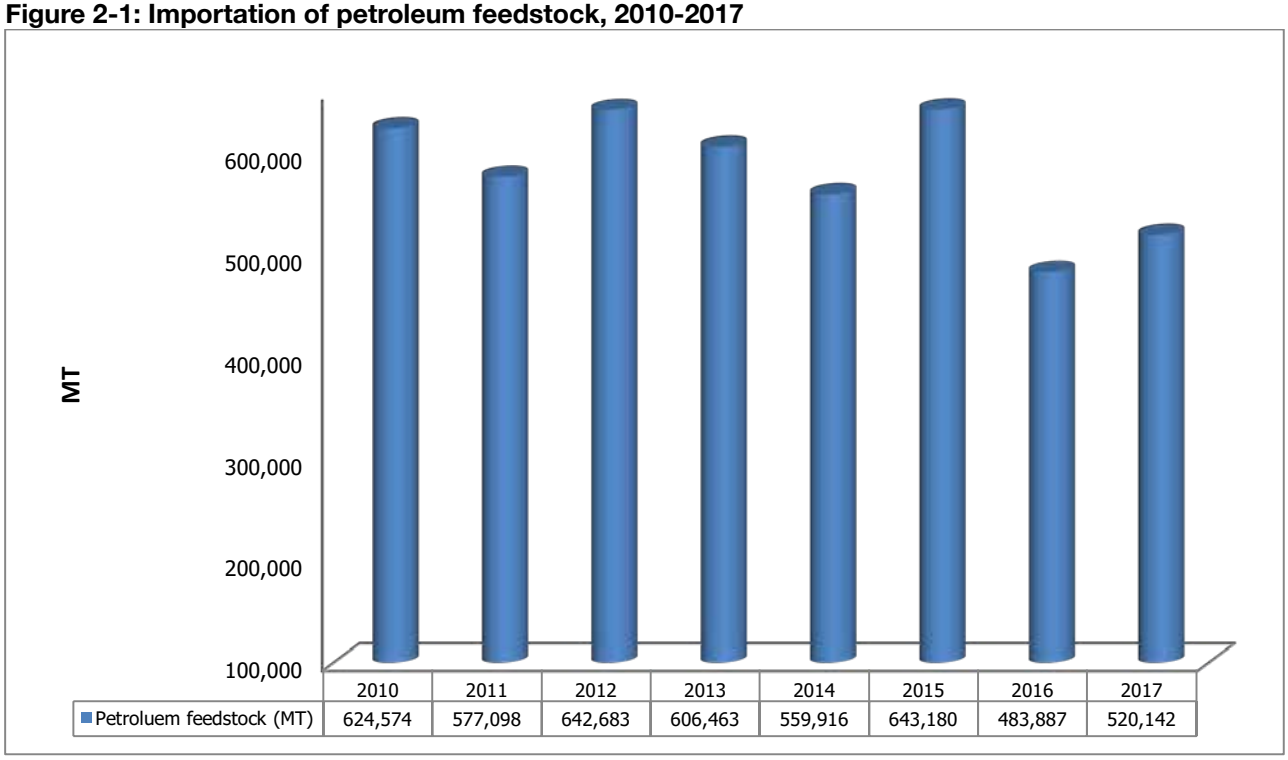
Petroleum products processed from the petroleum feedstock accounts for about 50 percent of the national consumption requirements, while the remaining 50 percent is sourced through imported finished petroleum products. In 2017, INDENI refinery contributed 30.4 percent to the national fuel requirement for petrol and gasoil (including low sulphur gasoil) compared to 37.7 percent in 2016. The rest of the national demand for unleaded petrol and gasoil was met by the importation of finished products by Government and OMCs. OMCs uplift the refined products from Ndola fuel Terminal and distribute them for sale to service stations and commercial customers. Appendix 1 shows the national fuel supply chain.

[7] Spiked or Commingled feed stock is a combination of pure crude oil and other finished petroleum products

2.1.1 Importation of petroleum feedstock

Government imports of petroleum feedstock typically consist of 41 percent crude oil (Oman or Murban); 13 percent condensate/naphtha and 46 percent diesel. The petroleum feedstock is refined at INDENI into finished products namely; unleaded petrol, diesel, kerosene, Liquefied Petroleum Gas (LPG), Heavy Fuel Oil (HFO) and Jet A-1, to meet specific national fuel requirements. Meanwhile, importation of commingled or spiked petroleum feedstock is desirable because INDENI is not designed to process pure crude oil. On average, 7 petroleum feedstock cargos are imported each year. However, in 2017, Government imported a total of 5 feedstock cargoes. Figure 2-1 depicts the trends in the importation of petroleum feedstock from 2010 to 2017.

Figure 2-1: Importation of petroleum feedstock, 2010-2017



Source: TAZAMA

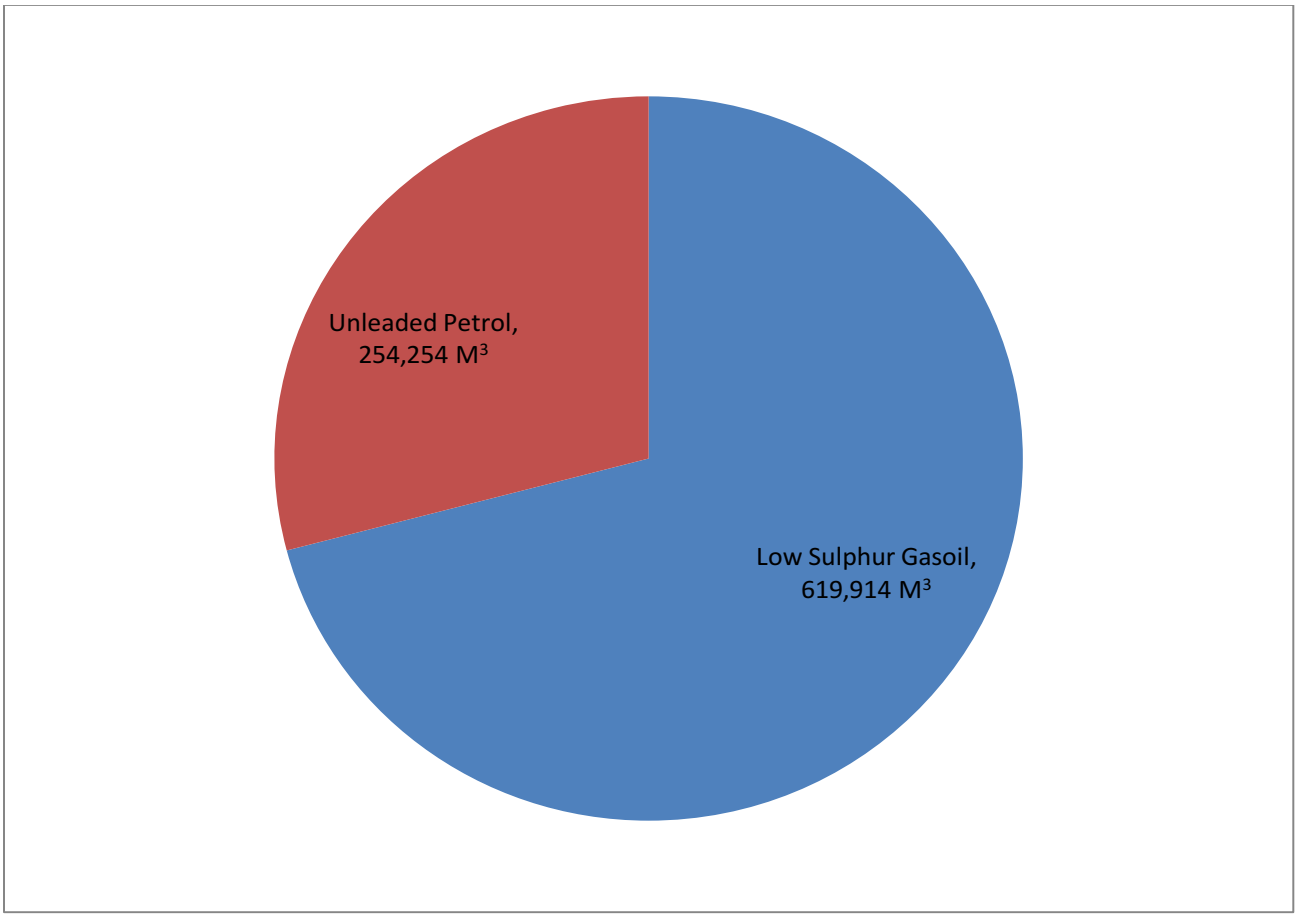
As depicted in Figure 2-1, during the period 2010 to 2017, there has been a general decline in government imports. During this period the government imported an average quantity of 582,243 MT per year. The quantity of petroleum feedstock imported ranged from 483,887 MT recorded in 2016 to 643,180 MT recorded in 2015. The peak imports were attained in 2015 whilst the least were realized in 2016. Between 2016 and 2017, imports increased by 7.49 percent from 483,887 MT to 520,142 MT. Notably, the deep in 2016 was on account of contaminated cargo of petroleum feedstock which was consequently rejected by Government.

2.1.2 Importation of finished petroleum products

In 2017, Government and OMCs imported a total of 254,254 M^3 of unleaded petrol and 619,914 M^3 of low sulphur gasoil (low sulphur diesel or LSG). Of the total imports of unleaded petrol, Government accounted for 98.9 percent (251,380 M^3), while the balance was imported by OMCs.

Similarly, of the total imports of LSG, 387,637 M^3 was imported by the Government while 232,277 M^3 was imported by the OMCs. During the same year, OMCs imported 28,795 M^3 of Jet A-1 and 1,060 MT of LPG. Figure 2-2 depicts the total imports by the Government and OMCs.

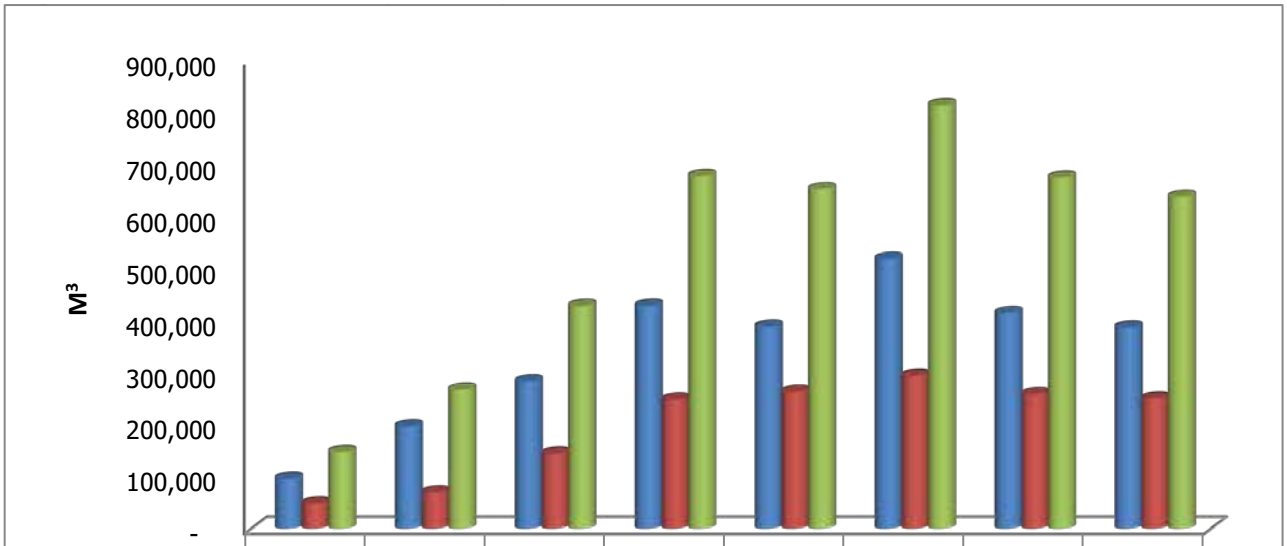
Figure 2-2: Total imports of petroleum products (petrol and diesel) by Government and OMCs in 2017



2.1.2.1 Imports by the Government

To supplement finished petroleum products that are produced by INDENI, the Government has contracted suppliers who import finished products and ferry it by road to various TAZAMA depots. The Government imports of petrol and diesel is depicted in Figure 2-3.

Figure 2-3: Government imports of petrol and diesel, 2010 – 2017



	2010	2011	2012	2013	2014	2015	2016	2017
Diesel	96,791	197,442	283,759	429,378	389,183	519,948	415,796	387,637
Petrol	49,417	71,005	145,374	249,208	264,777	294,876	259,905	251,380
Grand Total	148,218	268,447	429,134	678,586	653,960	814,823	675,701	639,016

Generally, there was an increasing trend in Government imports between 2010 and 2017. During this period, imports averaged 198,243 M^3 and 339,992 M^3 for petrol and diesel, respectively. Beyond 2013, imports by Government almost doubled depicting the diminishing role of INDENI. However, in 2017 Government imports declined by 5.43 percent to 639,016 M^3 from 675,701 M^3 in 2016 mainly due to lack of storage space (ullage) at TAZAMA Depot.

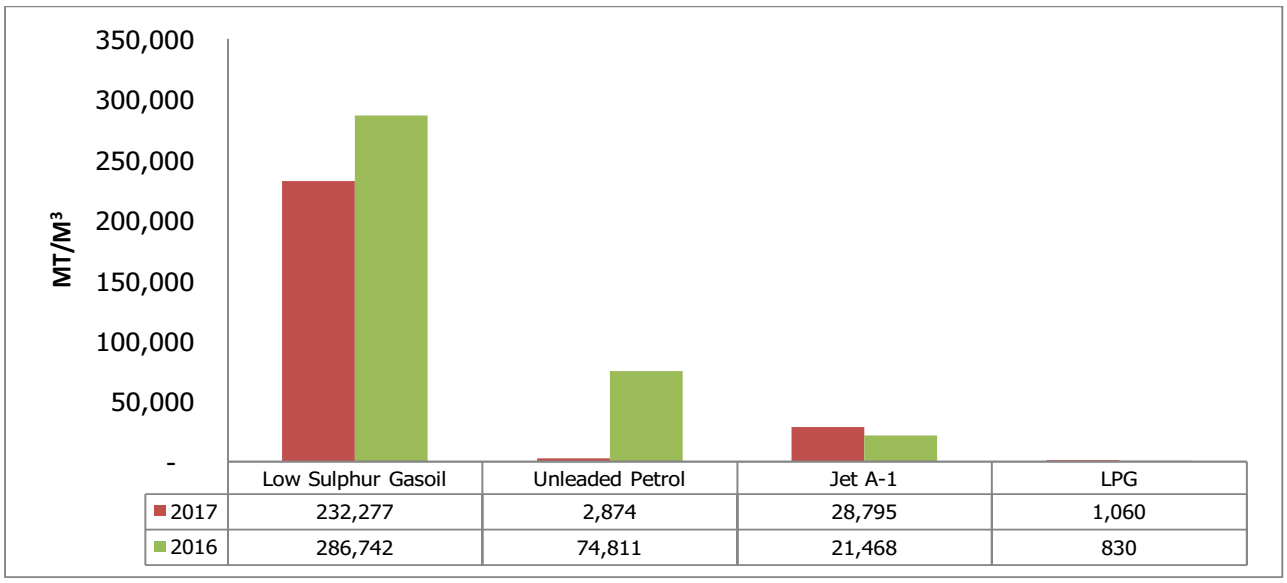
2.1.2.2 Imports by Oil Marketing Companies

Generally, there was a reduction in imports between 2016 and 2017 except for Jet A-1 and LPG. Specifically, imports of petrol reduced by 96.16 percent from (74,811 M^3) in 2016 to (2,873 M^3) in 2017.

Similarly, LSG reduced by 18.99 percent from (286,742 M^3) in 2016 to (232,277 m^3) in 2017. The reduction in imports was attributed to the discontinuation of the importation ban waiver by the ERB. Prior to this, the ERB banned fuel (petrol and LSG) importation by OMCs to allow for a smooth transition to the private sector led importation of petroleum products which was still underway in 2017. Notwithstanding the ban, the ERB provided for issuance of waivers for the OMCs that supply mining companies with LSG and specialized users.

Figure 2-4 shows the annual imported quantities of petroleum products during periods 2016 and 2017.

Figure 2-4: Annual imported quantities of petroleum products during periods 2016 and 2017.



	Low Sulphur Gasoil	Unleaded Petrol	Jet A-1	LPG
2017	232,277	2,874	28,795	1,060
2016	286,742	74,811	21,468	830

*Note that quantities for all products are in M^3 except for LPG which is in MT

LPG and Jet A-1 recorded an increase in imports from 830 MT to 1,060 MT and from 21,468 M^3 to 28,795 M^3, respectively.

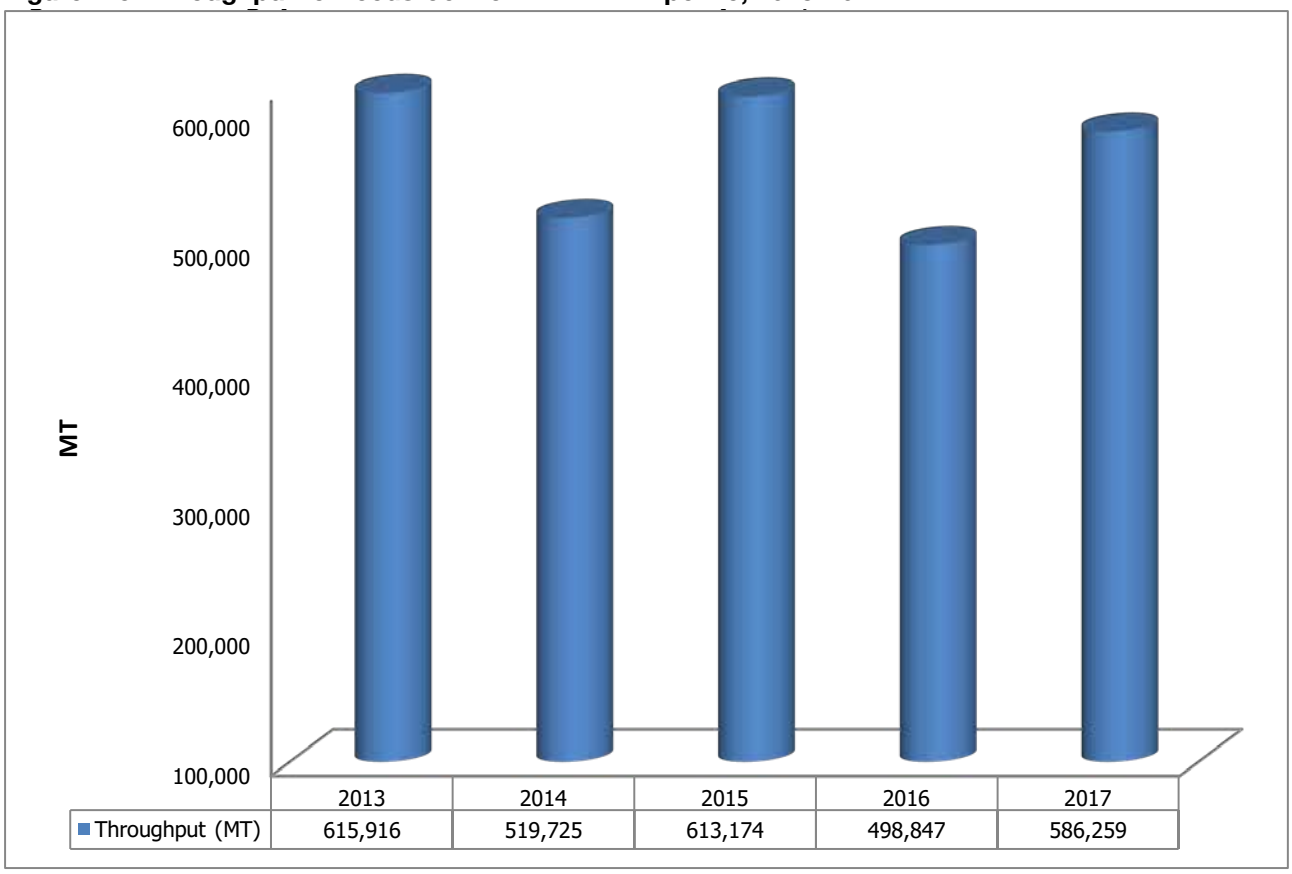
2.2 Operations at TAZAMA Pipelines Limited

This sub-section gives a discussion of operations at TAZAMA in 2017. TAZAMA has a plated throughput capacity of 1,100,000 MT per annum.

2.2.1 TAZAMA throughput

With a throughput capacity of 1,100,000 MT per annum, TAZAMA has over the last five (5) years operated below its designed capacity due to degradation of the pipeline. The pipeline has operated at an average throughput of 568,751 MT per annum. Between 2016 and 2017 in particular, the throughput increased by 19.7 percent from 489,847 MT to 586,259 MT. This was attributed to an increase in the number of imported petroleum feedstock cargoes. Figure 2-5 shows the throughput processed during the period 2013 and 2017.

Figure 2-5: Throughput for feedstock for TAZAMA Pipeline, 2013-2017



Source: TAZAMA

2.2.2 Rehabilitation works at TAZAMA

During the period under review TAZAMA undertook routine rehabilitation works that include pipeline condition monitoring; repair of corroded sections; replacement of pumping units; and rehabilitation of the petroleum feedstock tanks. The purpose of the rehabilitation was to improve pipelines throughput and protection of the environment against leaks. The major rehabilitation works undertaken during 2017 are shown in Table 2-1.

Table 2-1: TAZAMA pipeline rehabilitation works, 2017

No.	Rehabilitation Works	Status/Comment
1.	Replacement of 168m of corroded 8 inch pipelines between Km 926 and Km 935 on section 8/6 (Tunduma – Nakonde Area).	This replacement of pipeline sections costed ZMW 0.3 Million (US$30,000).
2	Replacement of 5.34 km of corroded 8 inch pipelines on 82 sections on 8/2 (Mikumi National Park) in Tanzania.	This replacement of pipeline sections costed Tsh 2.7 Billion (approximately US$1.2million).
3	Replacement of No. 4 Main Pumping Units and auxillary equipment (Chinsali Pumping Station).	Replacement of all old pumping units at all 7 pumping stations to improve pump discharge to 200m^3/hour and enhance reliability of pumping stations. This replacement of pumping station costed US$ 5.5 Million.

2.3 Operations at INDENI Petroleum Refinery Limited

INDENI Petrolium Refinary Limited (INDENI) processes petroleum feedstock to meet part of the petroleum product requirements of the national market. INDENI consists of the following refinery units:

- Large reforming unit;
- Hydro treater for desulphurization of Kerosene and lighter fractions; and
- Vacuum Distillation Unit (VDU) for specific technical conditions.

The plated throughput capacity of INDENI is 1,100,000 MT per annum. However, due to degradation, the maximum throughput capacity has reduced to an average of 850,000MT per annum.

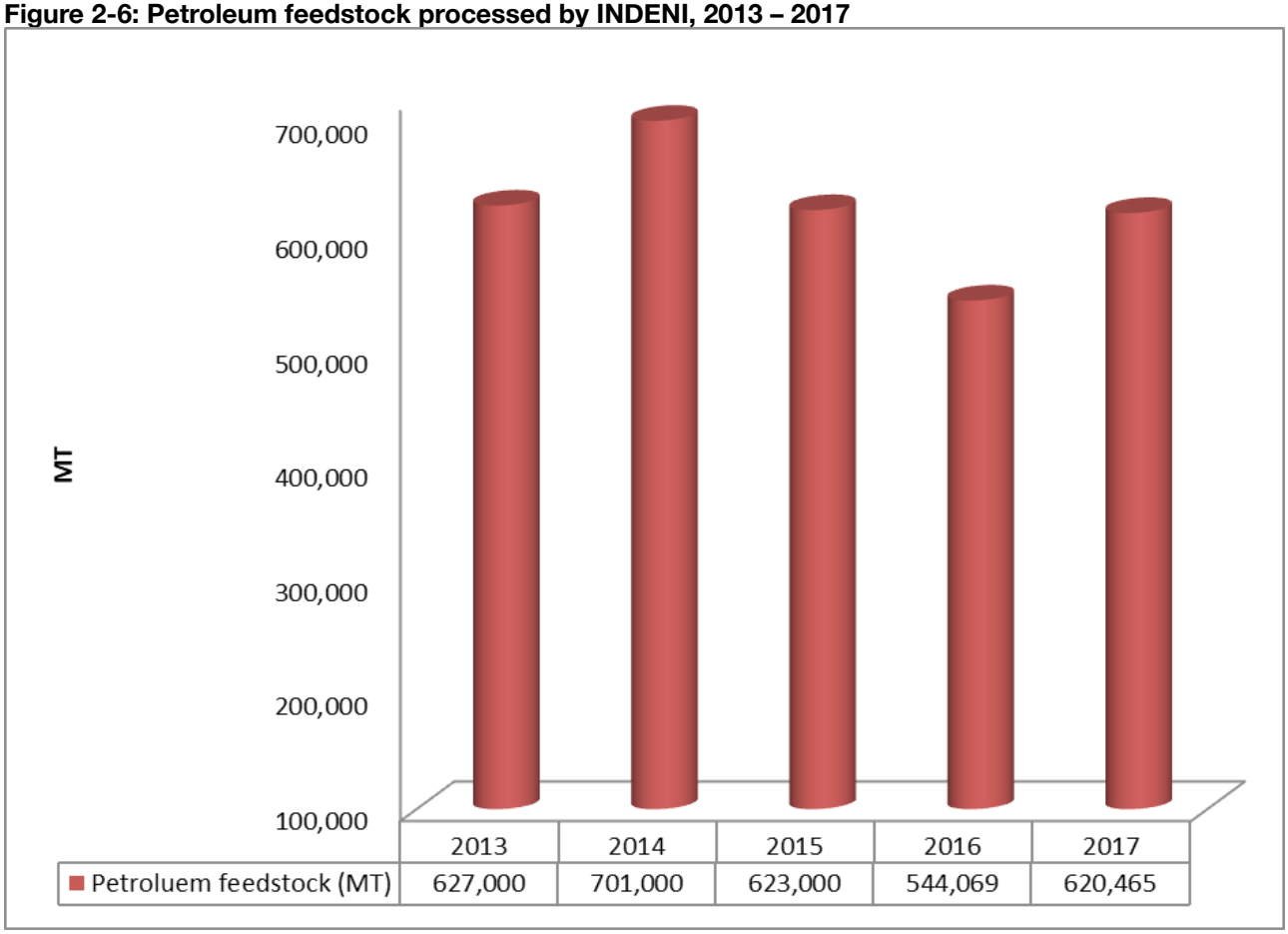
Petroleum Refinery

2.3.1 INDENI throughput

From 2013 to 2017, the throughput for INDENI averaged 623,107 MT. During this period, the highest throughput recorded was 701,000 MT in 2014 while the lowest was 544,069 MT in 2016. During 2017, the throughput was 620,465 MT compared to 544,069 MT in 2016. This represented an increase of 14.0 percent. During the period under review, the refinery was operational for 300 days, having shut down for 65 days, of which 40 days were planned and 25 days were unplanned. This is in comparison to 245 days of operation and 121 days of shutdown in 2016.

The main reasons for the unplanned shutdowns include lack of petroleum feedstock, ullage constraints on premium, slop line leakages and other maintenance works at the refinery. Whilst the refinery was on shutdown in 2017, the Government imported finished petroleum products in order to guarantee security of supply. Figure 2-6 shows petroleum feedstock processed by INDENI, for the period 2013 to 2017.

Figure 2-6: Petroleum feedstock processed by INDENI, 2013 – 2017



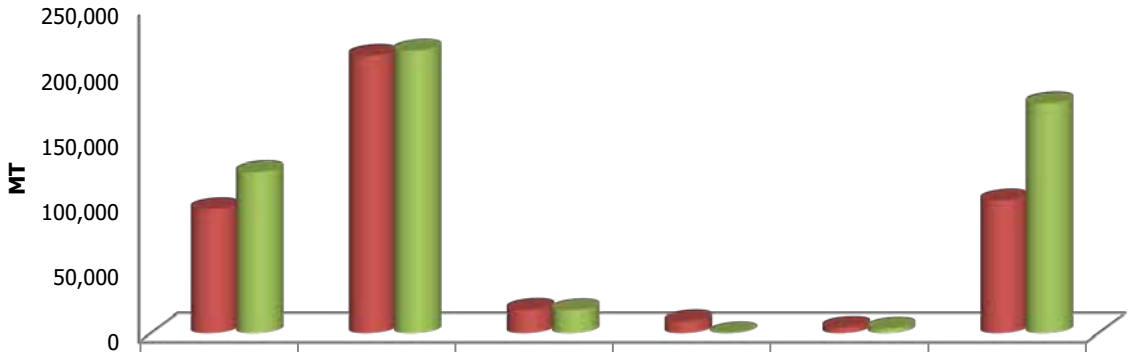
Source: INDENI.

Part of the processed products by INDENI in 2017 included bitumen. The plant managed to produce bitumen with required penetration point grade of 80/100dmm which is required by the local market. This was after modification works on the column C401 internals; and availability of the suitable heavy crude that allows for processing of bitumen. As a result of this, the bitumen loading facility was recommissioned on 18th November 2017 and 359.7 MT of bitumen with penetration point grade of 60/70 dmm was processed and sold. As at the close of the year, the plant had been on phased commissioning and was being realigned to produce the 80/100 dmm penetration point.

2.3.2 INDENI production

In 2017, INDENI produced 30.4 percent of the total diesel and petrol national requirements compared to 37.7 percent in 2016. The rest of the demand for diesel and petrol was met through imports of finished petroleum products. This is depicted in Figure 2-7.

Figure 2-7: Production of petroleum products by INDENI, 2016 – 2017



	Petrol	Diesel	Kerosene	Jet A1	LPG	HFO
2016	95,285	212,638	18,499	9,464	4,839	102,133
2017	123,591	216,672	18,130	386	4,105	176,231

The production of diesel increased from 212,638 MT in 2016 to 216,672 MT in 2017, representing 1.90 percent increase. Similarly, production of petrol increased by 29.71 percent from 95,285 MT in 2016 to 123,591 MT in 2017, while HFO increased by 72.55 percent; from 102,133 MT in 2016 to 176,231 MT in 2017. The increase in HFO production was on account of increased demand of the product which was supported by increased capacity of the Ndola Energy Company Limited (NECL) HFO power plant.

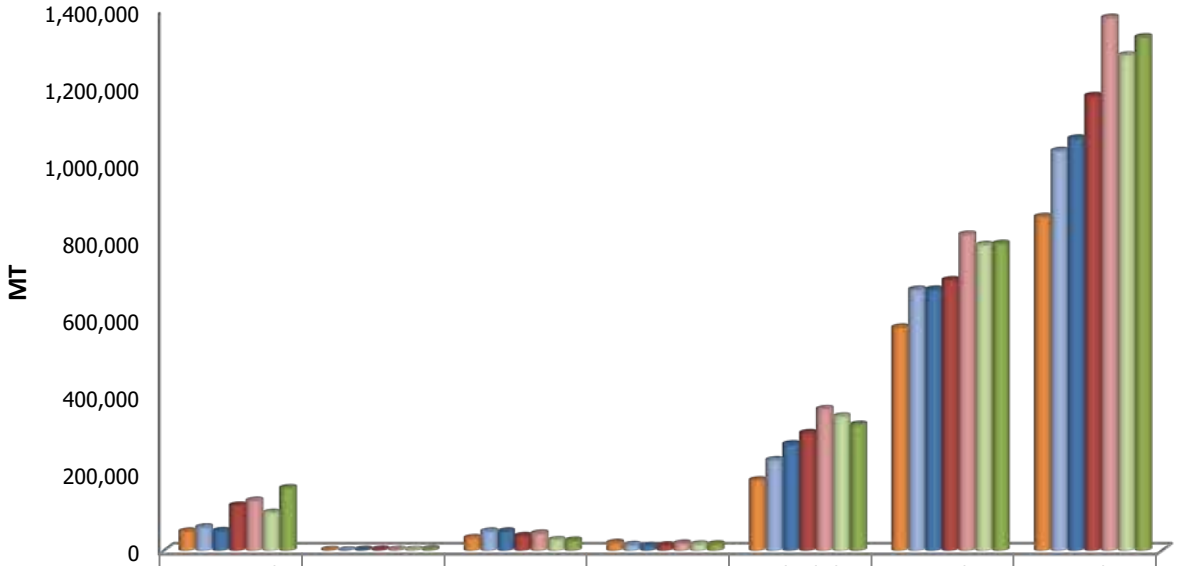
Meanwhile, the production of Jet A-1, LPG and kerosene declined by 95.92 percent, 15.17 percent and 1.99 percent, respectively compared to the same period in 2016. The decline of Jet A-1 production was on account of continued importation by OMCs.

2.4 National consumption of petroleum products

The total consumption of petroleum products in the country during the period under review increased from 1,282,449 MT in 2016 to 1,329,222 MT in 2017, reflecting a 3.65 percent increase. This was attributed to the increase in demand for diesel (including low sulphur gasoil), Heavy Fuel Oil (HFO) and Liquefied Petroleum Gas (LPG).

Figure 2-8 shows the trend in national consumption of petroleum products for the period 2011 to 2017. Generally, during the period 2011 to 2015, there was an upward trend in the consumption of most petroleum products. However, in 2016, consumption of all petroleum products declined, but latter picked up in 2017. The deep in 2016 was on account of reduced

economic activities in the country.



	Heavy Fuel Oils	LPG	Jet-A1	Kerosene	Unleaded Petrol	Diesel	Total Consumption
2011	49,461	2,424	32,593	19,898	182,123	577,836	864,335
2012	60,222	658	49,477	14,669	234,224	675,756	1,035,006
2013	50,793	3,021	49,613	12,315	275,604	676,078	1,067,425
2014	116,821	3,680	38,049	13,776	304,562	700,577	1,177,465
2015	129,149	3,230	44,160	18,300	366,524	818,418	1,379,781
2016	97,881	2,742	27,237	16,045	347,266	791,277	1,282,449
2017	161,766	4,719	26,070	16,242	325,940	794,485	1,329,222

Figure 2-8: Trend in national fuel consumption by type, 2011 – 2017

During the period under review, the consumption of all petroleum products increased except for unleaded petrol and Jet A-1. Specifically, diesel consumption recorded a marginal increase of 0.4 percent from 791,277 MT (941,997 M^3)[8] in 2016 to 794,485 MT (945,816 M^3) in 2017. This growth was in line with the recorded increase in mining output. According to the Ministry of Mines, the performance of the mining sector in 2017 was average. Copper production increased by 2.96 percent from 770,597 tonnes in 2016 to 793,428 tonnes in 2017.

Unleaded petrol was the second most consumed product at 325,940 MT (434,587 M^3)[9] in 2017. However, this was a decline compared to 347,266 MT (463,021 m^3) consumed in 2016 reflecting a 6.14 percent decrease.

The consumption of HFO increased significantly by 65.27 percent during the period under review, from 97,881 MT in 2016 to 161 766 MT in 2017. The increase in demand was attributed to the commissioning of the second phase, 60 MW HFO power plant at NECL. Similarly, there was an increase in the consumption of kerosene from 16,045 MT in 2016 to 16,242 MT (20,430 M^3) in 2017, reflecting 1.23 percent increment.

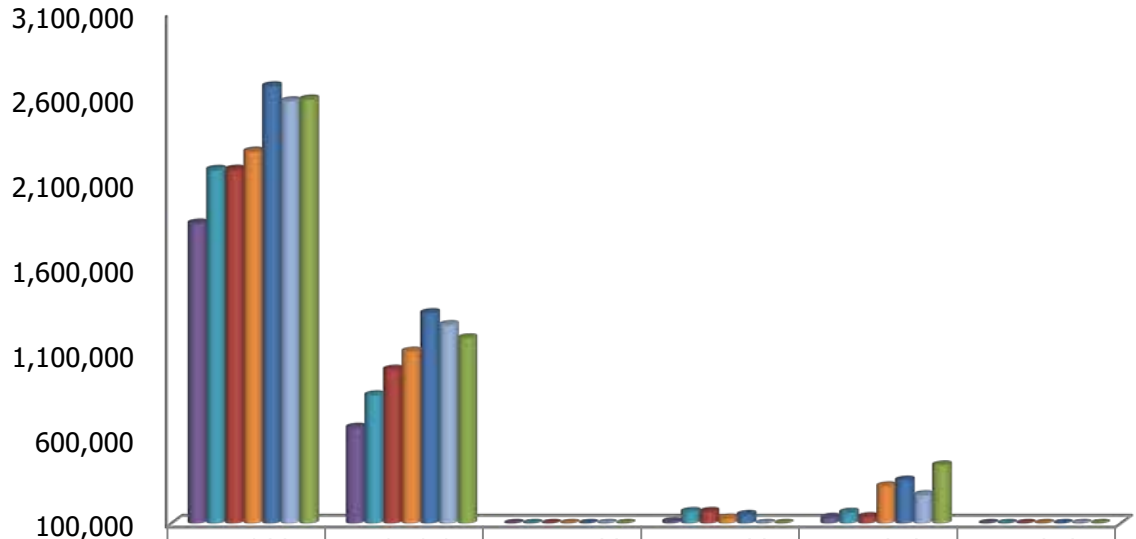
In addition, LPG consumption increased from 2,742 MT in 2016 to 4,719 MT in 2017, representing an increase of 72.10 percent. The increase in LPG may have been triggered by the increase in load shedding that was pronounced in 2015. Meanwhile, the consumption of Jet A-1 declined by 4.28 percent from 27,237 MT in 2016 to 26,070 MT in 2017.

[8] In the case of diesel, 1 MT is equivalent to 1.19 M^3 using a density of 0.84 kilograms/litre
[9] In the case of petrol, 1 Metric Tonne is equivalent to 1.33m3 using a density of 0.75 kilograms/litre

2.5 Daily national average consumption of petroleum products

The daily national average consumption of petroleum products trend is depicted in Figure 2-9. Generally, daily national average consumption for all petroleum products increased between 2016 and 2017, except for unleaded petrol, and Jet A-1. Daily national average consumption for diesel increased from 2,580,813 litres per day in 2016 to 2,591,276 litres per day in 2017. Similarly, daily national average consumption for kerosene, HFO and LPG increased from 54,950 litres per day, 93,863 kgs per day and 7,513 kgs per day to 55,972 litres per day, 443,196 kgs per day and 12,929 kgs per day in 2017, respectively.

Figure 2-9: Daily national average consumption of petroleum products, 2011 – 2017



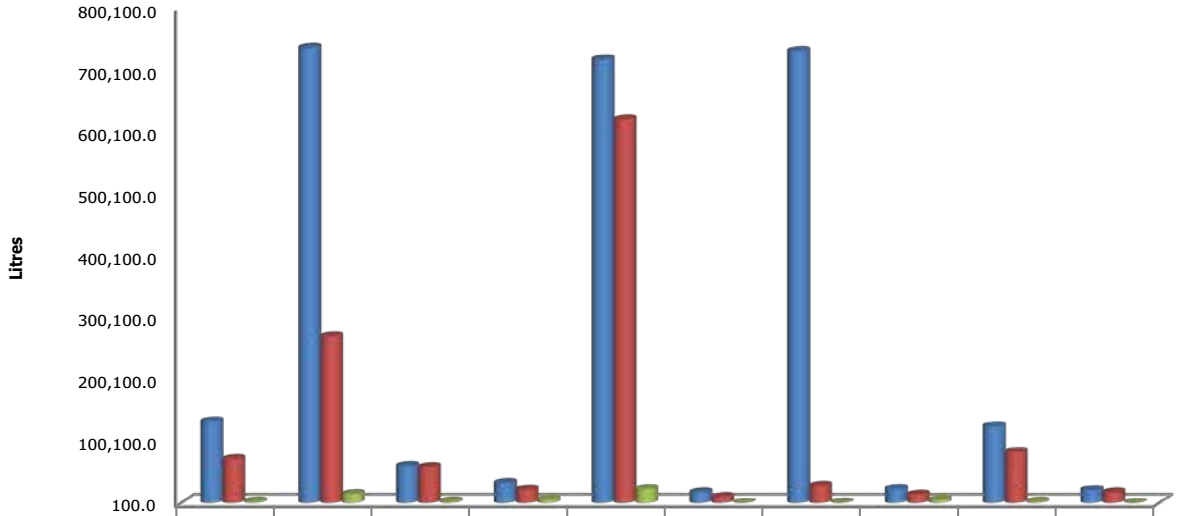
	Diesel (L)	Unleaded Petrol (L)	Kerosene (L)	Jet A-1 (L)	HFO (Kg)	LPG (Kg)
2011	1,862,485	665,290	68,143	111,620	135,510	6,641
2012	2,178,102	855,614	50,237	169,441	164,993	1,802
2013	2,179,138	1,006,772	42,297	169,907	139,160	8,278
2014	2,284,986	1,112,555	47,474	131,126	320,058	10,083
2015	2,669,334	1,338,901	63,065	152,183	353,834	8,849
2016	2,580,813	1,268,551	54,950	93,863	268,168	7,513
2017	2,591,276	1,190,649	55,972	89,841	443,196	12,929

Meanwhile, the daily national average consumption for unleaded petrol reduced from 1,268,551 litres in 2016 to 1,190,649 litres in 2017. Similarly, the average daily consumption for Jet A-1 declined to 89,841 litres in 2017 from 93, 863 litres in 2016.

2.5.1 Average daily national consumption by province

During the period under review, there was variability in the consumption of petroleum products mainly on account of differences in economic and demographic factors. In 2017, high consumption of diesel and petrol was evident in Lusaka, Copperbelt and North-Western Provinces, while low consumption of these petroleum products was observed in Muchinga, Western and Northern Provinces. The average provincial daily consumption for diesel, unleaded petrol, and kerosene is depicted in Figure 2-10.

Figure 2-10: Provincial average daily consumption of diesel, petrol and kerosene, 2017



	Central	Copperbelt	Eastern	Luapula	Lusaka	Muchinga	North Western	Northern	Southern	Western
Diesel	131,518.5	735,593.0	59,408.4	32,207.0	717,104.9	16,870.8	730,571.0	22,930.9	124,130.6	20,940.4
Unleaded Petrol	71,308.6	269,850.5	57,527.5	21,803.2	620,500.0	9,517.7	27,826.8	13,279.3	82,165.9	16,883.9
Kerosene	2,536.5	14,111.6	2,627.6	5,935.1	22,724.1	191.9	588.4	4,961.6	2,277.5	17.6

The average national daily consumption for diesel was 2,591,275 litres in 2017. Of this consumption, the Copperbelt province accounted for the highest proportion at 28.39 percent followed by North-Western province which accounted for 28.19 percent. The provinces with the least consumption for diesel on a daily basis were Western and Muchinga which accounted for 0.81 percent and 0.65 percent, respectively.

The average national daily consumption for unleaded petrol was 1,190,663 litres in 2017. Of this consumption, Lusaka province accounted for the highest proportion at 52.11 percent followed by Copperbelt province which accounted for 22.66 percent. The provinces with the least consumption for unleaded petrol on a daily basis were Muchinga and Northern which accounted for 0.81 percent and 1.12 percent, respectively.

The average national daily consumption for kerosene was 55,972 litres in 2017. Of this consumption, Lusaka province accounted for the highest proportion at 41.03 percent followed by Copperbelt province which accounted for 25.48 percent. The provinces with the least consumption for kerosene on a daily basis were Western and North-Western which accounted for 0.03 percent and 0.01 percent, respectively

The average national daily consumption for HFO was 443,196 kgs in 2017. Of this consumption, the Copperbelt province accounted for the highest proportion at 95.07 percent followed by North Western and Lusaka provinces which accounted for 4.14 percent and 0.79 percent, respectively.

The average national daily consumption for Jet A-1 was 26,069,752 litres in 2017. Of this consumption, Lusaka province accounted for the highest proportion at 69.91 percent followed by Copperbelt province which accounted for 25.61 percent. The provinces with the least consumption for JET A1 on a daily basis were Central and Northern which accounted for 0.66 percent and 0.59 percent, respectively.

The average national daily consumption for LPG was 12,929 kgs in 2017. Of this consumption, Lusaka province accounted for the highest proportion at 62.31 percent followed by Copperbelt province which accounted for 24.31 percent. The provinces with the least consumption for LPG on a daily basis were Luapula and Muchinga which accounted for 0.06 percent and 0.003 percent, respectively.

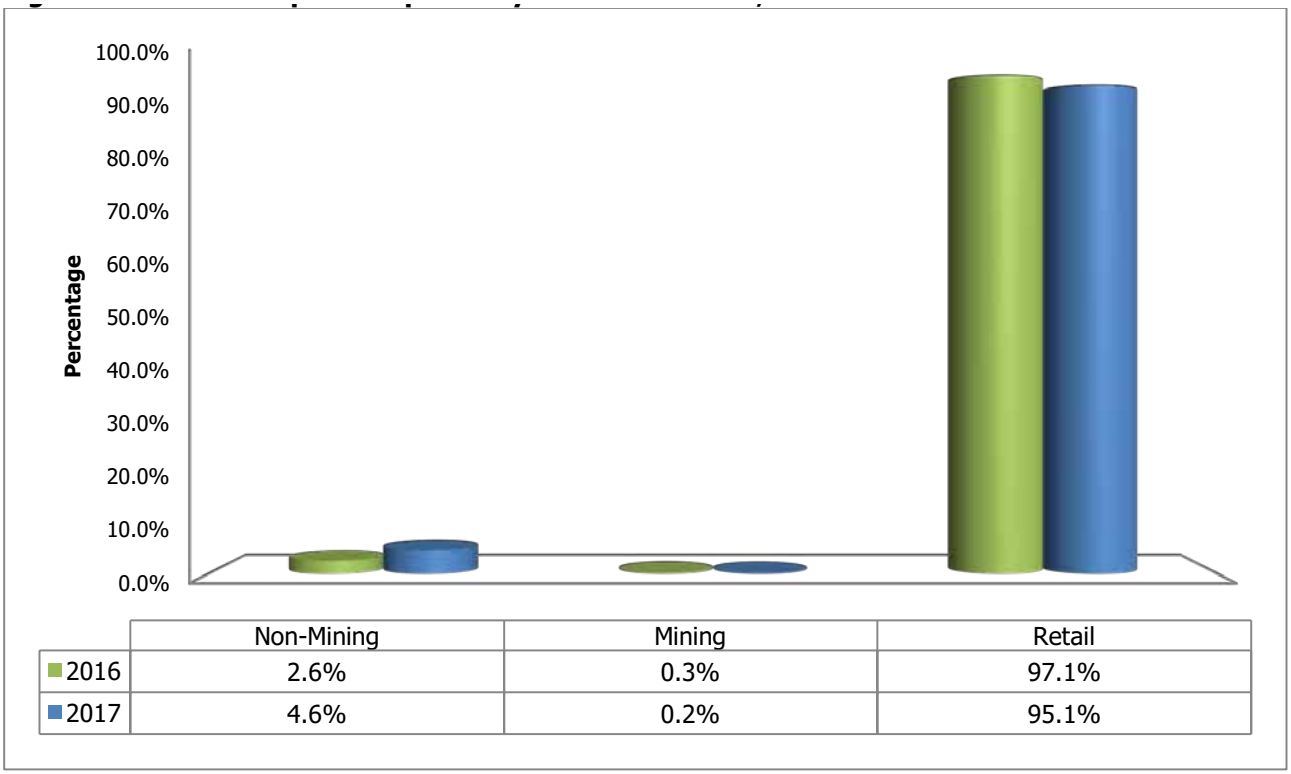
2.5.2 Consumption of petroleum products by economic sector

This section discusses the consumption of petrol and diesel by economic sector in 2017 compared to 2016. The economic sectors are classified as follows: retail, mining and non-mining. Retail refers to petroleum products that are sold at the forecourt 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.

2.5.2.1 Consumption of petrol by economic sector

Consumption of petrol by sector namely mining, retail and other non-mining sectors in 2017 was as depicted in Figure 2-11. In both 2016 and 2017, the retail sector obtained the largest portion of the market share for petrol followed by the non-mining sector. Despite the dominance, the retail sector recorded a decline of 2.0 percentage points to 95.1 percent in 2017 from 97.1 percent market share in 2016. Similarly, the mining sector recorded a decline of 0.1 percentage points; from 0.3 percent in 2016 to 0.2 percent in 2017. Meanwhile, the non-mining sector increased its share by 2.0 percentage points from 2.6 percent in 2016 to 4.6 percent in 2017.

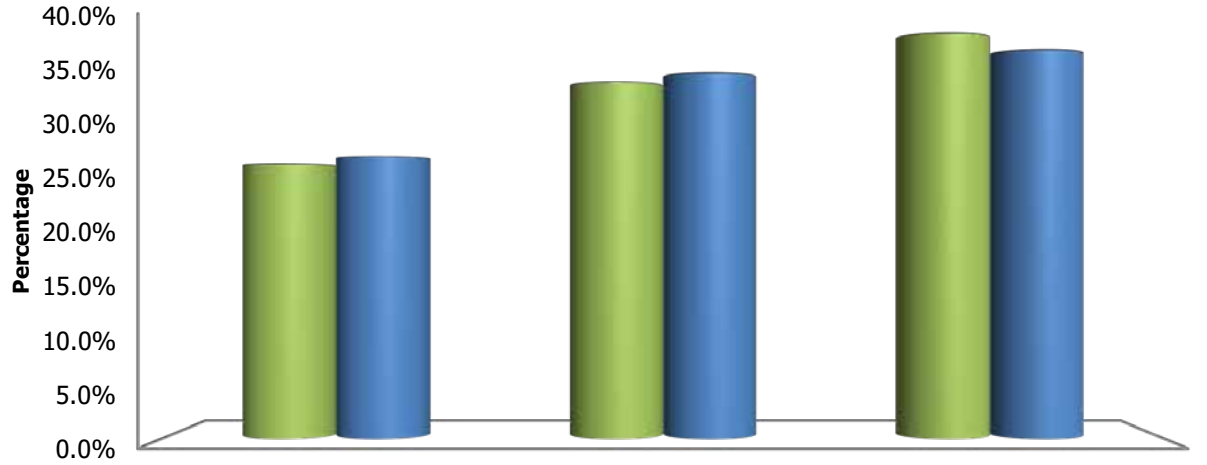
Figure 2-11: Consumption of petrol by economic sector, 2016 – 2017



2.5.2.2 Consumption of diesel by economic sector

In 2017, the consumption of diesel continued to be dominated by the retail sector which consumed 37.5 percent. Despite the dominance, it declined by 1.6 percentage points from 39.1 percent in 2016. Meanwhile, the mining sector increased its share of consumption to 35.3 percent from 34.4 percent in 2016. Similarly, there was a marginal increase of 0.7 percentage points for the non-mining sector's share of national consumption from 26.5 percent in 2016 to 27.2 percent in 2017. Figure 2-12 shows the consumption of diesel by economic sector in 2016 and 2017.

Figure 2-12: Consumption of diesel by economic sector, 2016 – 2017



	Non-Mining	Mining	Retail
2016	26.5%	34.4%	39.1%
2017	27.2%	35.3%	37.5%

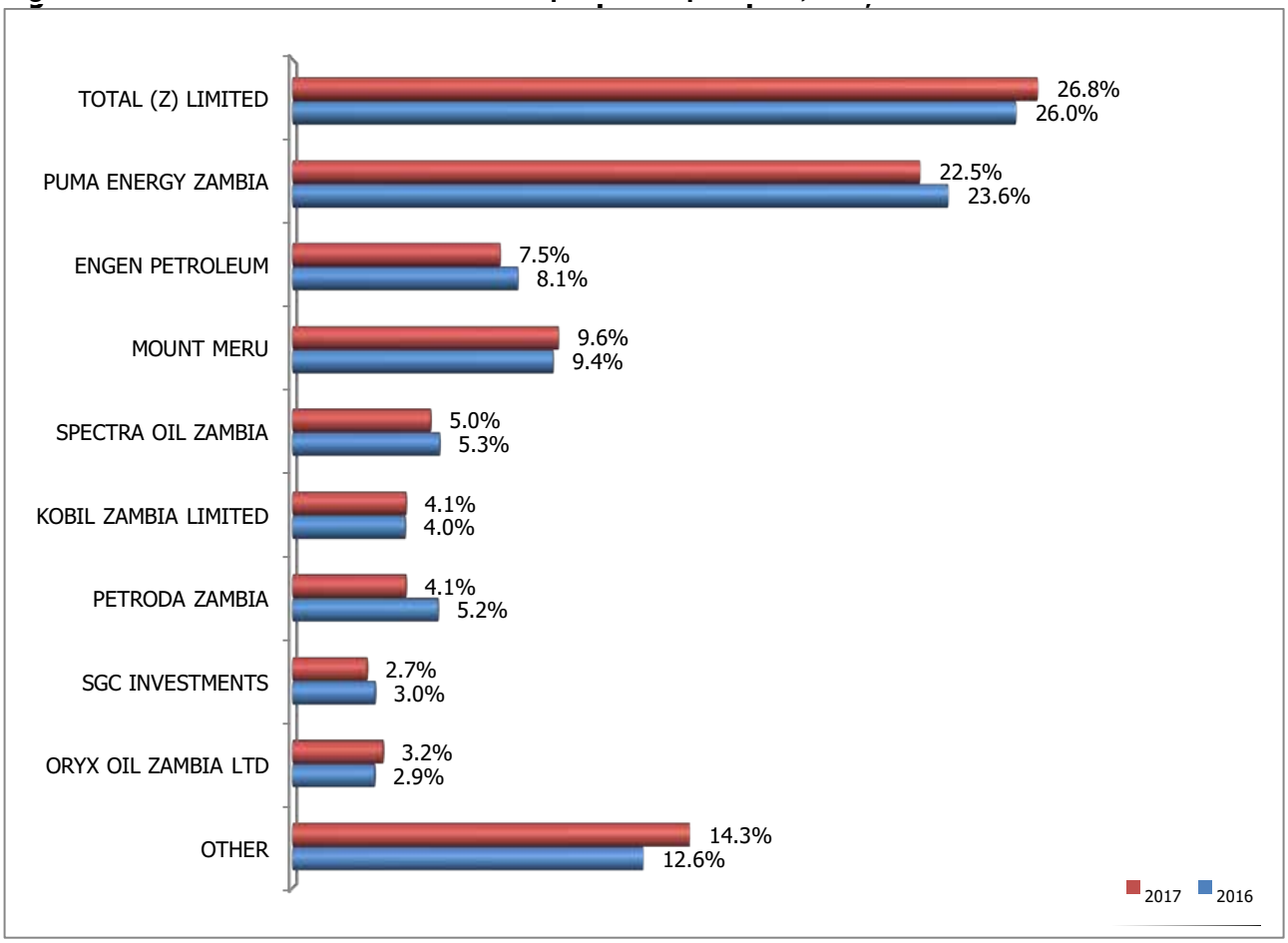
2.6 Market share of Oil Marketing Companies

This section discusses the combined market share for OMCs in 2017 for white products *(diesel, petrol, kerosene)*, lubricants and Jet A-1. The size of an OMC is determined by its market share. Market share is defined as a percentage of an OMCs' total sales to the total industry market sales in a specified period of time. As at 31st December 2017, the number of licenced OMCs by the ERB stood at 55.

2.6.1 Market share of white products

In 2017, as the case was in the previous year, the market share of OMCs for white products, comprising petrol, kerosene and diesel (inclusive of low sulphur gasoil) was dominated by Total Zambia Limited at 26.8 percent followed by Puma Energy Zambia Plc (Puma Energy) at 22.5 percent. Figure 2-13 shows the market share for white products in 2016 and 2017.

Figure 2-13: OMCs' Market share for white petroleum products, 2016-2017



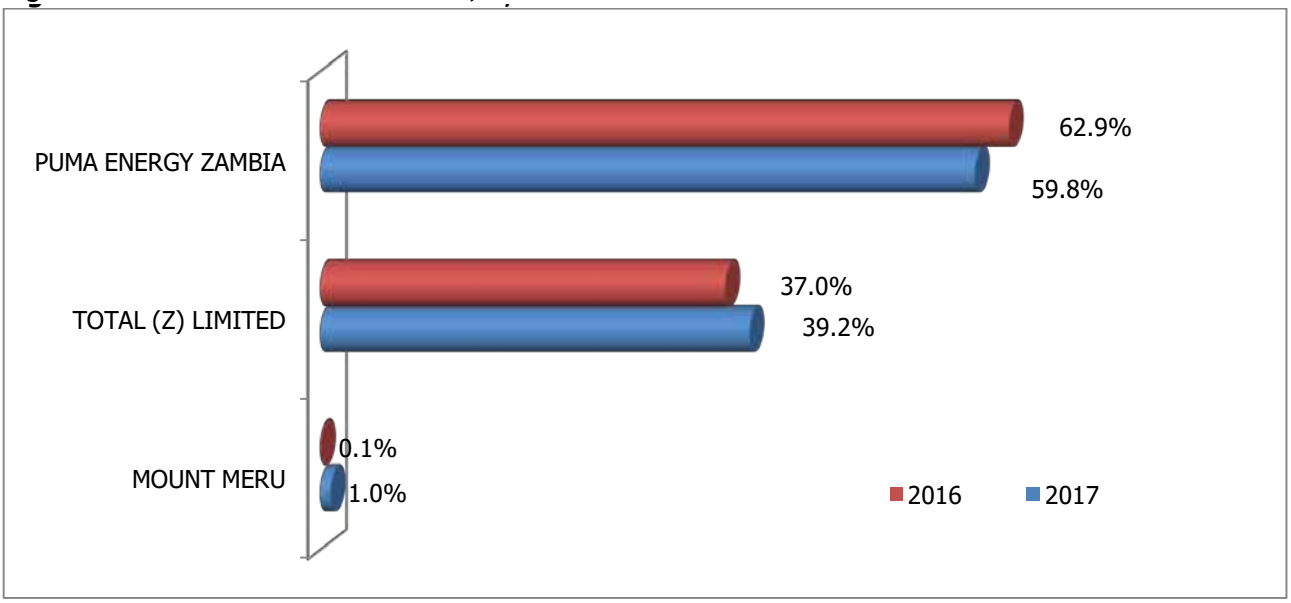
In 2017, there was a shift in the market share for OMCs as depicted in Figure 2-13. Particularly, Total Zambia Limited, Mount Meru Petroleum Limited, Kobil Zambia Limited and Oryx Oil Zambia Limited increased their market share for white petroleum products amounting to 0.8; 0.2; 0.1; and 0.3 percentage points, respectively. Similarly, the combined market share for small OMCs classified as other, recorded an increase from 12.6 percent in 2016 to 14.3 percent in 2017.

Meanwhile, Puma Energy, Engen Petroleum Zambia Limited, SGC Investments Limited, Spectra Oil Corporation Limited and Petroda Zambia Limited recorded a decline in their market share by 1.1; 0.6; 0.3; 0.3; and 1.1 percentage points, respectively between 2016 and 2017.

2.6.2 Market share for Jet A-1

In 2017, there were three (3) OMCs trading in Jet A-1 namely: Puma Energy; Total Zambia Limited; and Mount Meru. The market for Jet A-1 continued to be dominated by Puma Energy accounting for 59.8 percent market share despite suffering a 3.1 percentage point loss compared to 62.9 percent share that it held in 2016. Total Zambia Limited was second in the hierarchy at 39.2 percent, recording an increase of 2.2 percentage points from 37.0 percent in 2016. Similarly, Mount Meru recorded an increase in its market share from 0.1 percent in 2016 to 1.0 percent in 2017. Figure 2-14 shows the OMCs' market share for Jet A-1 in 2016 and 2017.

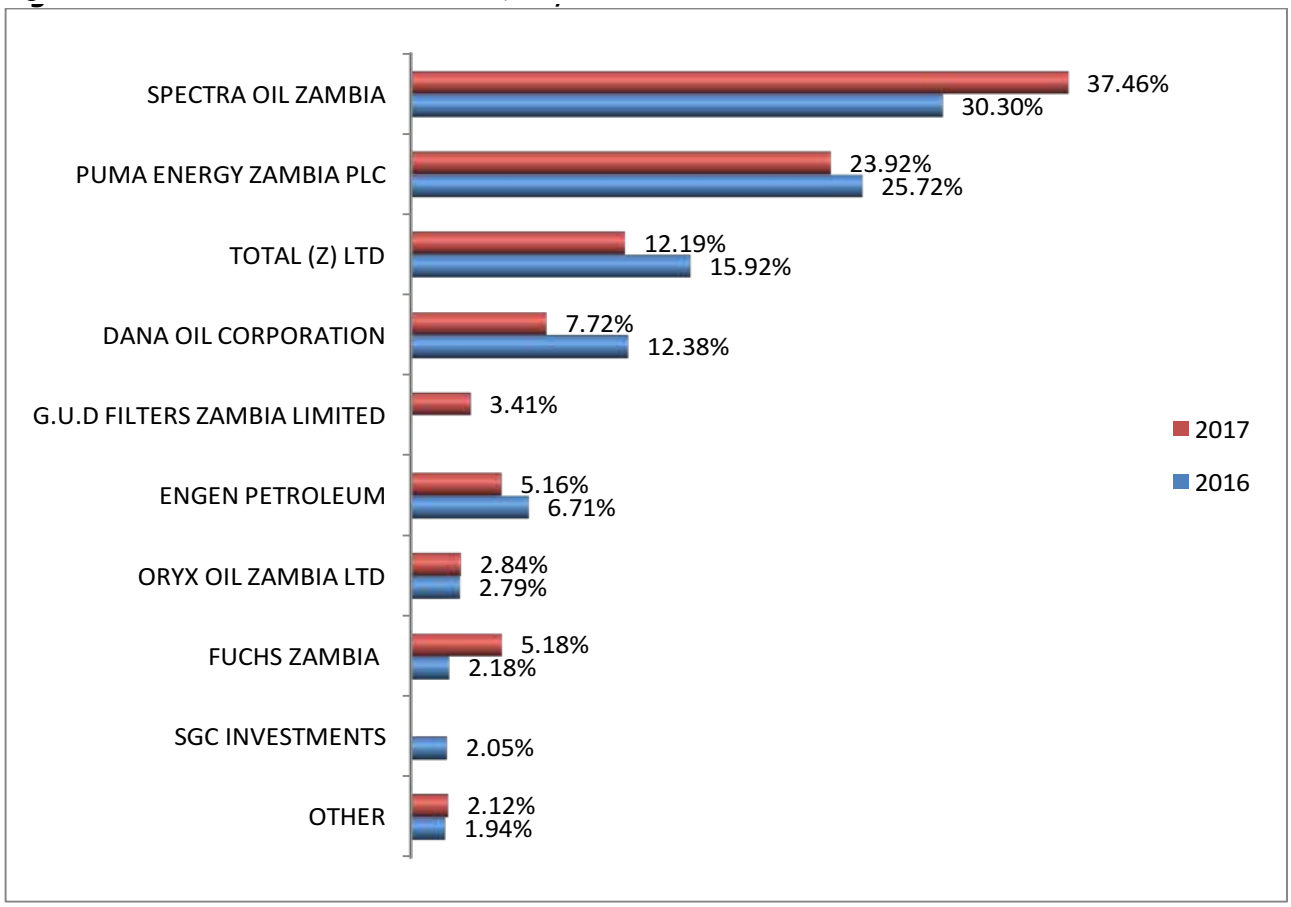
Figure 2-14: Market share for Jet A-1, 2016-2017



2.6.3 OMCs' Market share for lubricants

In 2017, there were a total of 16 companies licensed with the ERB to deal in lubricants. Figure 2-15 depicts the market share for lubricants in 2017 with comparative figures for 2016.

Figure 2-15: Market share for lubricants, 2016-2017



Note: The Lubricants market share for 2016 have been adjusted post reconciliation.

Spectra Oil Zambia maintained its lead in the market for lubricants with its market share increasing by 7.13 percentage points from 30.30 percent in 2016 to 37.43 percent in 2017. This was followed by Puma Energy at 23.90 percent which recorded a decrease of 1.82 percentage

points from 25.72 percent in 2016. Meanwhile, Total Zambia Limited was next in the hierarchy at 12.18 percent from 15.92 percent in 2016. This was followed by Dana Oil Corporation at 7.72 percent. Othe notable lubricants dealers had market share of 5.18 percent, 5.16 percent, 3.41 percent, and 2.84 percent for Engen Petroleum Zambia, G.U.D Filters, Fuchs Zambia and Oryx oil, respectively. The rest of the other dealers had a combined market share of 2.12 percent in the period under review.

2.7 Pricing of petroleum products

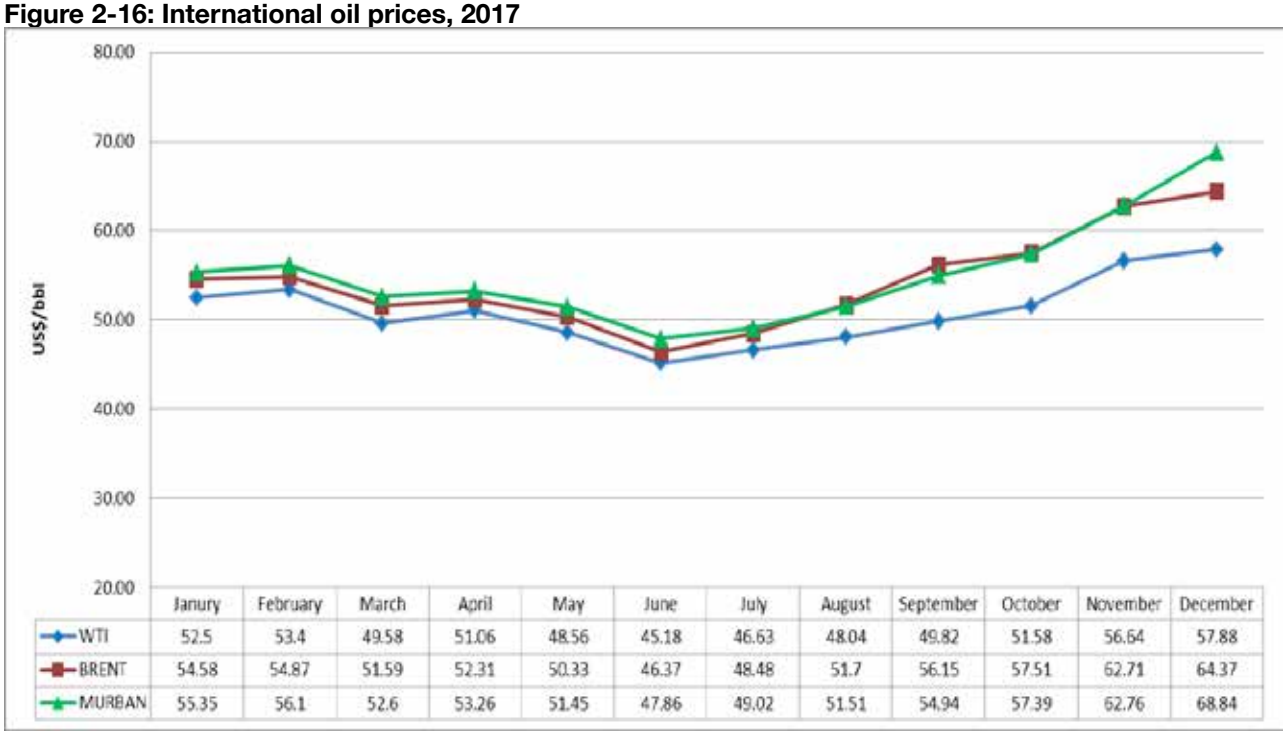
2.7.1 Determinants of petroleum prices

The pricing of petroleum products in Zambia is largely influenced by international oil prices and the exchange rate of the Kwacha to the United States Dollar. Accordingly, any major movements in the two (2) factors could trigger a price adjustment. Price adjustments would similarly be effected if changes were made to the cost lines in the build-up such as levies and duties; margins for transporters; OMCs or Dealers; and changes in pumping or processing fees.

2.7.2 Trends in International Oil Prices

In 2017, international oil prices fluctuated between US$45.2/bbl and US$68.8/bbl as depicted in figure 2-16. Between January and July 2017, there was a gradual reduction in price of petroleum products on the international oil market largely influenced by excess supply of oil and fairly high oil inventories.

Figure 2-16: International oil prices, 2017



	Janury	February	March	April	May	June	July	August	September	October	November	December
WTI	52.5	53.4	49.58	51.06	48.56	45.18	46.63	48.04	49.82	51.58	56.64	57.88
BRENT	54.58	54.87	51.59	52.31	50.33	46.37	48.48	51.7	56.15	57.51	62.71	64.37
MURBAN	55.35	56.1	52.6	53.26	51.45	47.86	49.02	51.51	54.94	57.39	62.76	68.84

In the second half of 2017, international crude oil prices increased as a result of supply cuts by major exporters, led by the Organisation of Petroleum Exporting Countries (OPEC) and Russia. Additionally, strong economic and demand growth; and healthy financial markets improving market fundamentals significantly coupled with falling United States crude inventories contributed to price increase.[10]

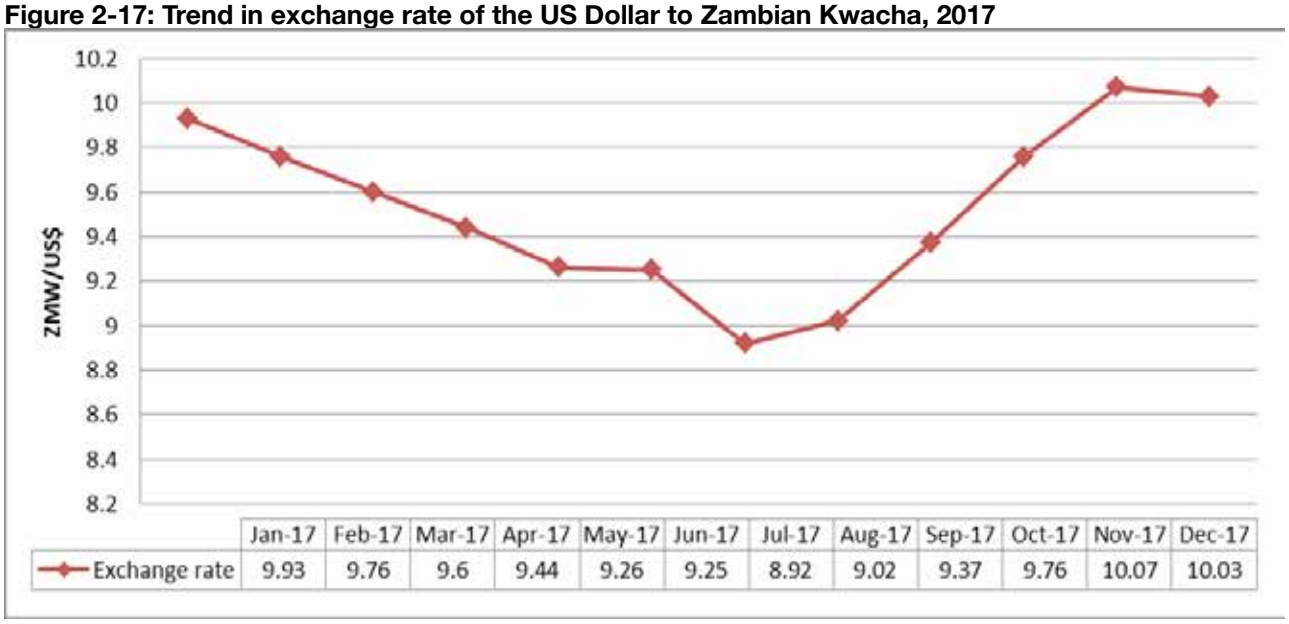
Generally, international oil prices averaged about US$52.5/bbl during the period under review. The oil prices declined to US$46.47/bbl by mid-year and closed the year at US$68.84/bbl, indicating a general increase of 47.2 percent during the second half of 2017.

2.7.3 Trend in the exchange rate

As depicted in figure 2-17, there was sustained appreciation of the Kwacha during the period January to June 2017. In January 2017, the kwacha traded at ZMW 9.93/US$ and by mid-year, declined to ZMW 9.25/US$ representing an appreciation of 6.85 percent. The strengthening of the local currency in the first half of the year was mainly attributed to increased international copper prices and inflows from offshore inventories for government bond.

[10] OPEC January Report, 2018

Figure 2-17: Trend in exchange rate of the US Dollar to Zambian Kwacha, 2017

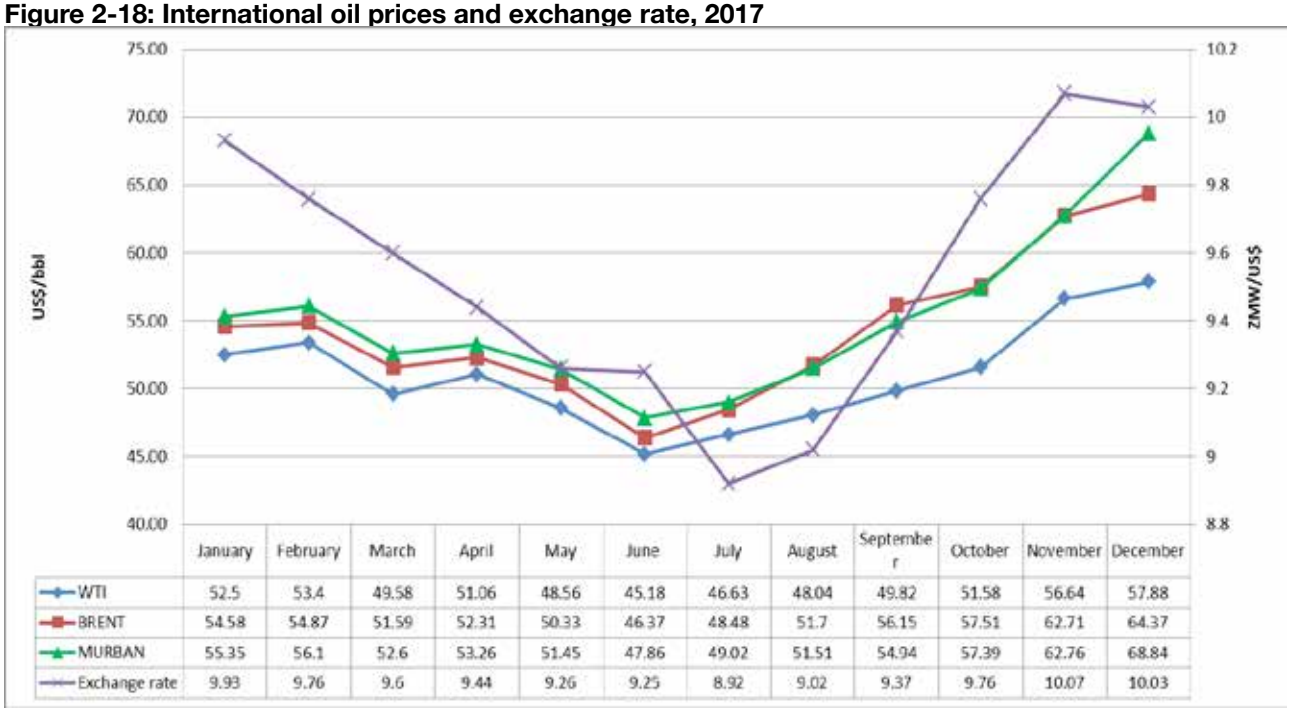


In the third quarter of 2017, the Kwacha to US Dollar exchange rate stabilized and traded at an average rate of ZMW9.10/US$. However, in the fourth quarter, the local currency significantly weakened against the United States Dollar to record a high of the year at ZMW10.07/US$. In the second half of the year however, the weakening of the local currency against major currencies was mainly on account of a sharp decline in exports in September 2017, declining market sentiments following delays in the signing of an expected IMF program, and continued challenges linked to the fiscal and debt position.[11]

2.7.4 Trend in international oil prices and exchange rate

Figure 2-18 below illustrates international oil prices and exchange rate characteristic trend patterns during the period under review. Generally benefits from the strengthening of the Kwacha in the first half of the year were outweighed by relatively stable and increases in oil prices.

Figure 2-18: International oil prices and exchange rate, 2017



[11] Bank of Zambia MPC Statement, February, 2018

2.8 Local and regional fuel prices

In 2017 the ERB continued to review fuel prices using the Cost-Plus-Model (CPM). The CPM operates on the principle that the final price should cover all the costs incurred in the petroleum supply chain. The model is premised on ascertaining by how much the prevailing wholesale and pump prices should change so that the full cost of the imported petroleum feedstock and finished petroleum products is recovered.

Apendix 1shows the petroleum value chain in Zambia while the components of the CPM are discussed in Apendix 2. 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 of diesel is calculated as follows:

i. Expected Revenue from imported LSG (A) = Total quantity of Imported LSG multiplied by The landed unit cost CIF Ndola.

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

iii. Weighted Average Wholesale Price (C) = (A+B)/(INDENI yields of diesel plus LSG Import Quantity).

The weighted average wholesale price of petrol is calculated as indicated as follows:

i. Expected Revenue from imported Petrol (D) = Total quantity of Imported Petrol multiplied by The landed unit cost CIF Ndola.

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

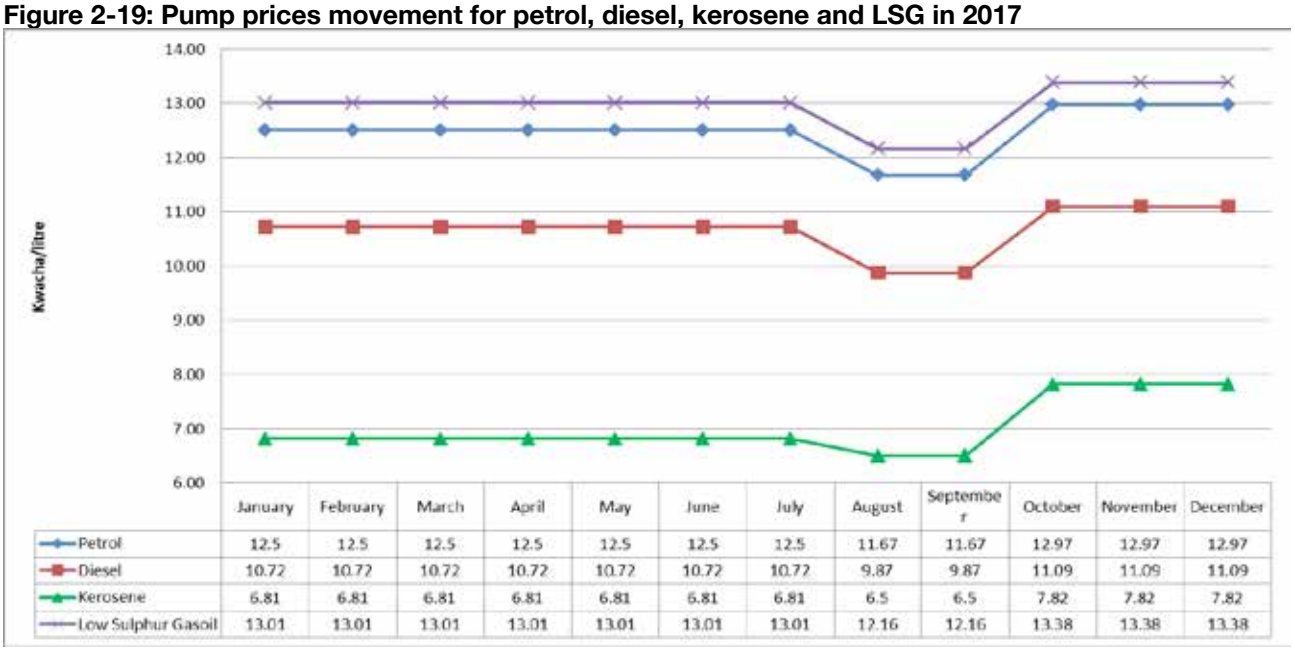
iii. Weighted Average Wholesale Price (F) = (D+E)/(INDENI yields of petrol plus Quantity of Petrol Imported).

In 2017, the Government imported a total of five (05) petroleum feedstock cargoes. Meanwhile, out of the five (05) cargoes received, two (02) resulted in fuel price adjustments. One (01) was an upward adjustment while the other was a downward adjustment.

2.8.1 National fuel pump prices

In 2017, the ERB made two (2) price adjustments as follows: a downward price adjustment in August and an upward price adjustment in October. In August, retail prices for petrol, diesel, kerosene and LSG were reduced by an average of 6.4 percent while in the October adjustment, retail pump prices for these products were raised by an average rate of 13.5 percent. This is depicted in Figure 2-19.

Figure 2-19: Pump prices movement for petrol, diesel, kerosene and LSG in 2017

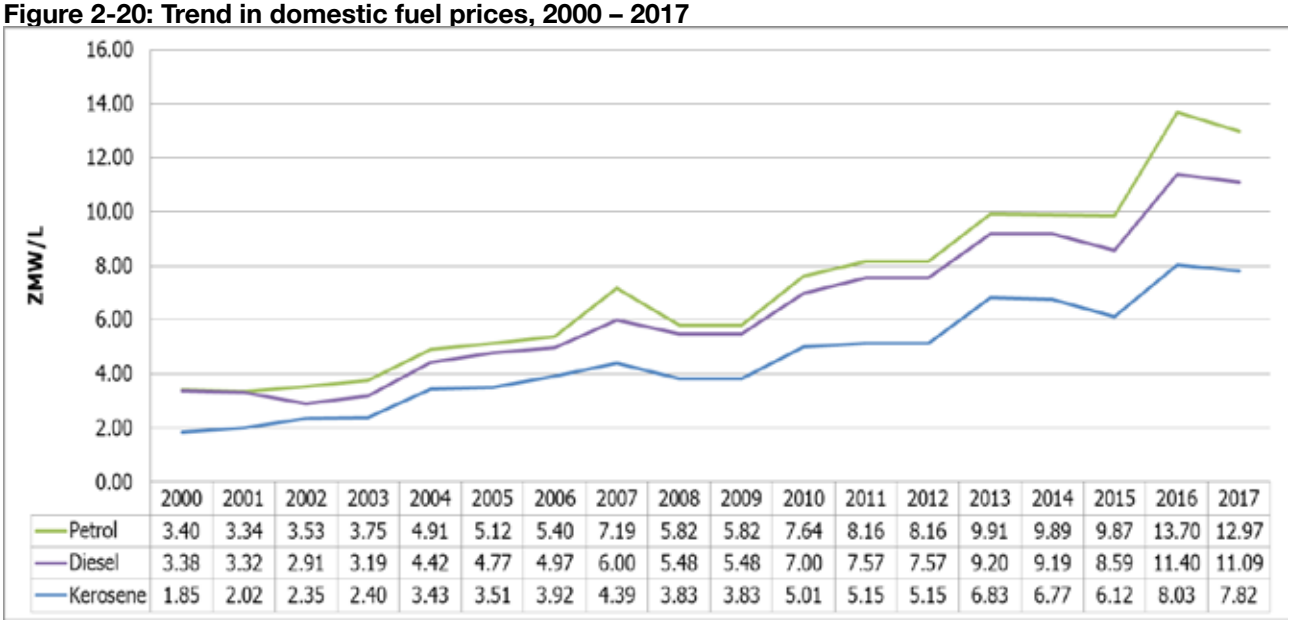


	January	February	March	April	May	June	July	August	September	October	November	December
Petrol	12.5	12.5	12.5	12.5	12.5	12.5	12.5	11.67	11.67	12.97	12.97	12.97
Diesel	10.72	10.72	10.72	10.72	10.72	10.72	10.72	9.87	9.87	11.09	11.09	11.09
Kerosene	6.81	6.81	6.81	6.81	6.81	6.81	6.81	6.5	6.5	7.82	7.82	7.82
Low Sulphur Gasoil	13.01	13.01	13.01	13.01	13.01	13.01	13.01	12.16	12.16	13.38	13.38	13.38

2.8.2 Trend in domestic fuel prices

The pump prices for the three (3) products petrol, diesel and kerosene were generally on the rise during the period 2000 to 2017. The price of petrol has consistently been higher than the price of diesel and kerosene throughout the period under review. During the stated period, the price of petrol had risen from ZMW3.40 per litre in 2000 to ZMW12.97 in 2017. Similarly, the price of diesel had risen from ZMW3.38 per litre to ZMW11.09 per litre, while that of kerosene had risen from ZMW1.85 to ZMW7.82 per litre. The observed steep rise in 2013, was on account of the Government removal of fuel subsidies in order to attain cost reflective fuel prices. Figure 2-20 shows the trend in the domestic pump prices of petrol, diesel and kerosene.

Figure 2-20: Trend in domestic fuel prices, 2000 – 2017

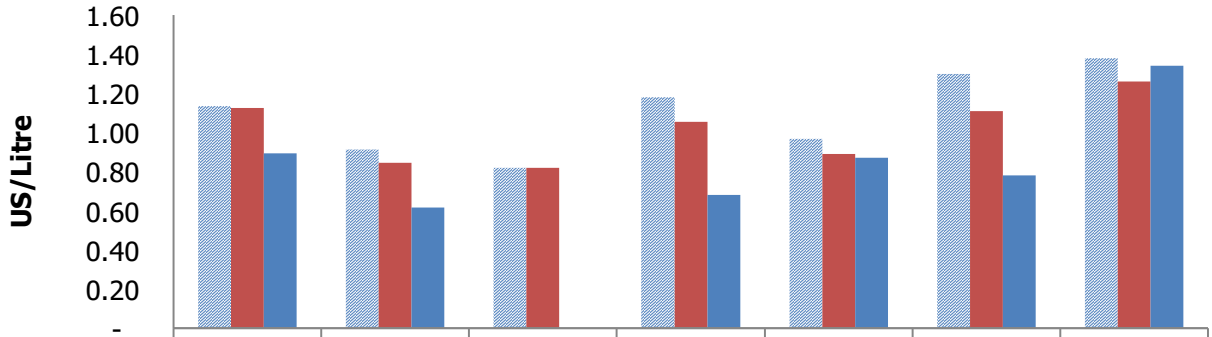


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Petrol	3.40	3.34	3.53	3.75	4.91	5.12	5.40	7.19	5.82	5.82	7.64	8.16	8.16	9.91	9.89	9.87	13.70	12.97
Diesel	3.38	3.32	2.91	3.19	4.42	4.77	4.97	6.00	5.48	5.48	7.00	7.57	7.57	9.20	9.19	8.59	11.40	11.09
Kerosene	1.85	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

2.8.3 Fuel Pump Prices in selected African countries

Pump prices vary in different countries on account of the following, among them, the different cost build-ups; pricing methodologies; government policy; macroeconomic environment; and proximity to the coast. Figure 2-21 shows the regional pump price comparison of petrol, diesel and kerosene as at 31st December 2017 in selected African countries.

Figure 2-21: Regional fuel pump prices as at 31st December 2017



	Malawi	Kenya	Namibia	South Africa	Tanzania	Zambia	Zimbabwe
Petrol	1.14	0.91	0.82	1.18	0.97	1.30	1.38
Diesel	1.12	0.84	0.82	1.05	0.89	1.11	1.26
Kerosene	0.89	0.62		0.68	0.87	0.78	1.34

Source: National Energy Regulator/Department of Energy websites

A comparative analysis of regional pump prices for selected African countries namely Malawi, Kenya, Namibia, South Africa, Tanzania, Zimbabwe and Zambia detemined that the price of petrol was highest in Zimbabwe followed by Zambia, South Africa and Malawi. Similarly diesel prices were highest in Zimbabwe followed by Zambia, Malawi and South Africa. Meanwhile, Namibia recorded the lowest price for both petrol and diesel in the region at US$ 0.82/litre in December, 2017. Kerosene prices fell below US$ 1.00/litre in all the seven countries under review. The highest price for Kerosene as at 31st December, 2017 was US$ 1.34/litre recorded by Zimbambwe.

2.9 Audits on petroleum infrastructure and energy undertakings

In 2017, the ERB carried out compliance audits of licenced petroleum infrastructure. The scope of the audits included: compliance audits of service stations, grading of retail service stations and product quality assessments.

2.9.1 Audit of service stations

During the period under review, the ERB undertook countrywide initial and verification compliance inspections of all operational retail sites. The inspections were conducted to evaluate performance against the set Zambian Standards, licence conditions and Board Orders. A total of three hundred and twenty six (326) sites were inspected and the overall compliance rate at the close of the year was found to be 89.1%. This represented an increase of 1.4% in percentage compliance when compared to 2016 were the average compliance rate was 87.7% at the close of the year. The increase in the compliance rate was attributed to the technical hearings conducted after the initial inspections and subsequent closure of most anomalies found at the retail sites by the licensees.

2.9.2 Grading of service stations

During the year 2017, the ERB conducted grading of service stations in all the provincial centres in the country. A total of 218 service stations were graded using the compliance formula shown below:

Overall Compliance Rate (OCR) = 0.7T + 0.3C

Where T is Technical Compliance Rate; and

C is Consumer Compliance Rate.

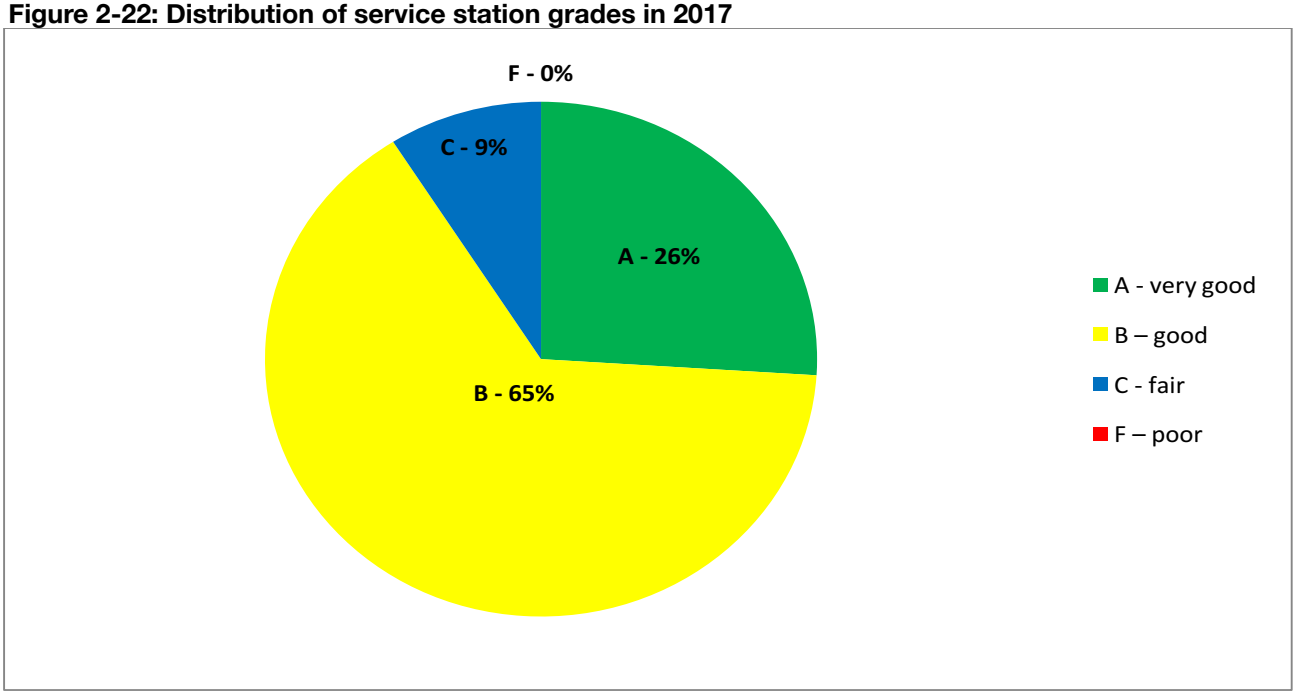
The results of the inspections are shown in Table 2-2 while the distribution of the grades is shown in Figure 2-22.

Twenty six (26) percent of the service stations inspected were graded **A** (very good) in 2017 compared to 11 percent in 2016 when the revised grading criteria was introduced.

Table 2- 2: Grading of retail service stations, 2017

No.	Grade	Number	Percentage	Comment
	A - very good	57	26	Scored above 95%
	B – good	142	65	Scored between 80% and 94%
	C - fair	19	9	Scored between 60% and 79%
	F – poor	0	0	Scored below 60%
Total		**218**	**100**	

Figure 2-22: Distribution of service station grades in 2017



2.9.3 Petroleum product quality monitoring

During the year under review, a total of 106 samples were collected from 14 fuel depots throughout the country and were analysed. The laboratory analysis showed an average overall product quality compliance of 84.5 percent representing a decline of 9.2 percent compared to 93.7 percent in 2016. The decline in overall product quality compliance was attributed to non-adherence to the sampling protocol with respect to sampling practices, sample handling and preservation.

2.9.4 Financial Reviews of INDENI and TAZAMA

In October, 2017, the ERB conducted financial reviews for the two State Owned Enterprises (SOES) namely INDENI and TAZAMA for the period 2015 and 2016. During the year ended December, 2016, TAZAMA and INDENI recorded revenues of K229.90 million and K264.50 million respectively; compared to revenues of K233.57 million and K326.54 million recorded

during the period ended 31st December 2015. Despite experiencing declines in revenue streams between the two years, both companies closed the year 2016 with a positive net worth of K965.90 million and K579.70 million. Further, TAZAMA and INDENI each reported the total assets of K1, 046.01 million and K643.04 million respectively as at 31st December 2016. These total asset position represent the investments in long term and short term assets by the two SOEs for efficient service delivery.

By the close of the financial year 2016, TAZAMA and INDENI recorded positive liquidity ratios of 1.71 and 2.14, respectively. Further, the two SOEs maintained net current asset positions of K56.84 million and K71.95 million demonstrating positive working capital management attributes. Notably, TAZAMA and INDENI recorded net asset positions for the year financial ended 2016.

2.9.5 Strategic Reserve Fund

The price build-up in Zambia includes a line for the Strategic Reserve Fund (SRF). The fund was introduced in 2005 and is used for the following: to finance the development of petroleum infrastructure such as fuel depots; road works around fuel storage depots; rehabilitation of fuel tanks at storage depots; and rehabilitation of infrastructure such as the bitumen plant at INDENI. The programme is managed by the ERB on behalf of the Government.

In 2017, the SRF fee remained at ZMW0.15/litre for petrol, diesel, kerosene and jet A-1, and ZMW0.15/kg for HFO and LPG. The ERB collects this fee through OMCs and has put in place a monitoring mechanism to ensure that OMCs remit the correct amount into the Fund.

2.9.6 Government owned storage depots for white petroleum products

In 2017, the Government completed phase one of the construction of petroleum storage depots across the country. These facilities are located in: Ndola, Lusaka, Mongu, Mpika and Solwezi. The total combined storage capacities at these facilities in 2017 were: 54,600 m^3 for petrol, 99,948 m^3 for diesel, 4,400 m^3 for kerosene and 8,400 m^3 for Jet A-1.Apart from the Ndola fuel terminal, the total cost of constructing the depots was US$ 104 million. The bulk of financing was from the SRF.

Mpika Fuel Depot Source: TAZAMA Pipelines Limited

Within 2017, the Government embarked on the second phase of constructing fuel depots across the country and the following sites have been selected: Mansa; Chipata; Kabwe; and Choma. Table 2-3 shows the estimated cost, status and the storage capacities of the fuel depots.

Table 2-3: Construction of Government owned storage depots for white petroleum products under phase 2

No.	Fuel Storage Depot	Estimated Cost US$' million	Status
1.	Mansa Fuel Depot	33.45	✓ The Government has identified a developer and secured land for the development of the fuel depot ✓ The capacity of the depot will be 6.5 million litres with the following breakdown: • 4 million litres Diesel; • 2 million litres Petrol; and • 0.5 million litres Kerosene. ✓ Contractor has since mobilized and moved to site and is expected to complete the project within 12 months from January 2018.
2.	Chipata Fuel Depot	Yet to be established	✓ The Government has identified a developer and secured land for the development of the fuel depot ✓ The capacity of the depot will be 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.	Kabwe Fuel Depot	Yet to be established	✓ The proposed Kabwe Fuel Depot is currently under planning stage.
4.	Choma Fuel Depot	Yet to be established	✓ The proposed Choma Fuel Depot is under planning stage. ✓ The proposed fuel depot is expected to have a total capacity of 6.5million Litres.

With the construction of these government depots the storage capacity is projected to increase from the current 156,828 M^3 as at 31st December, 2017 to over 177,000 M^3. This is in addition to storage depots owned by OMCs.

2.9.7 Technical standards development

The ERB designs standards with regard to the quality, safety and reliability of supply of energy and fuels in conjunction with the Zambia Bureau of Standards (ZABS). In 2017, the following revised and developed standards were promulgated by the ERB following the ZABS Council Approval in 2016:

2.9.7.1 Promulgation of revised standards

The following revised standards were promulgated by the ERB in 2017.

Zambian Standards (ZS) 385: THE PETROLEUM INDUSTRY – Code of Practice.

ZS 385 Part 1: 2016:	Storage and Distribution of Petroleum Products in Above-Ground Bulk installations;
ZS 385 Part 2 : 2016:	Electrical installations in the distribution and marketing sector;
ZS 385 Part 3: 2016:	The installation of underground storage tanks, pumps/dispensers and pipework at service stations and consumer installations; and
ZS 703:	Rural filling stations: Code of Practice.

2.9.7.2 Promulgation of developed standards

The following revised standards were promulgated by the ERB in 2017.

ZS 385: THE PETROLEUM INDUSTRY – Code of Practice.

ZS 385 Part 4: 2016:	Aboveground Containerized Tank Installation; and
ZS 385 Part 5: 2016:	Operational Requirements at service stations.

2.10 Challenges in the Fuel Sector

In 2017, the petroleum sub-sector experienced the following challenges:

a. Illegal fuel vending

Illegal fuel vending, which includes selling fuel without a licence and/or authorisation from the ERB, continued to be a challenge in 2017. In collaboration with other stakeholders, the ERB continued monitoring ilegal fuel vending activities.

b. Illegal Importation of Fuel

Section 8 of the Energy Regulation Act, Chapter 436 of the Laws of Zambia, prohibits carrying out or engaging in any entrepreneurial activities in the energy sector without a licence or authority of the ERB. During the year under review, the ERB suspended the importation component of the licence to Distribute, Import and Export Petroleum Products. Following the said suspension, there were incidences of illegal importation of fuel perpetuated by some OMCs. Thus, in collaboration with other agencies, the ERB carried out investigations and penalised the erring OMCs, whilst investigations for some were still underway by end of the year.

2.11 Outlook for the sub-sector

Beyond 2017, the petroleum sub-sector is expected to experience significant developments in the following:

a. Fuel Marking Programme

One of the key functions of the ERB is to ensure the provision of quality energy services and products by all licensed entities. The Zambian petroleum market has over the years undergone liberalization which has resulted in an increase of industry players and multifaceted competition. In addition, there has been the emergence of malpractice such as adulteration and/or tax evasion. These malpractices pose a risk to fuel quality and can harm the environment. In order to combat both adulteration and dumping, the ERB in collaboration with the Ministry of Energy prepared a Statutory Instrument No. 69 of 2017 on Fuel Marking which was scheduled

to commence in 2018. The ERB will continue to collaborate with other stakeholders such as Zambia Revenue Authority, Road Transport and Safety Agency, ZABS, Zambia Police Service and others government agencies to enhance compliance.

b. Participation of the private sector in the procurement of fuel

In November 2016, the Government through the Minister of Finance announced a policy direction that would allow private sector participation in the procurement and financing of national fuel requirements effective 1st March 2017. The new policy is intended to improve efficiency in the procurement of fuel. However, by the close of 2017 the Government was still working on modalities to operationalise the policy pronouncement. It is expected that this policy would be effected beyond 2017.

c. Review of the Petroleum Act

During the period under review, the Petroleum Act, Chapter 435 of the Laws of Zambia was still under review in line with the changes in the petroleum sub-sector in order to align it with the key developments in the energy sector.

3.0 ELECTRICITY SUB-SECTOR

This section discusses Zambia's electricity sub-sector. In particular, the section discusses the installed capacity, power generation by ZESCO and IPP's, consumption by different economic sectors and power exports and imports. It further discusses the performance of licencees in the electricity sub-sector and the tariff adjustments for various customer categories. This section also discusses the operational performance of the electricity network. It further discusses renewable energies before it concludes with an outlook for the sector.

3.1 Zambia's installed electricity generation capacity

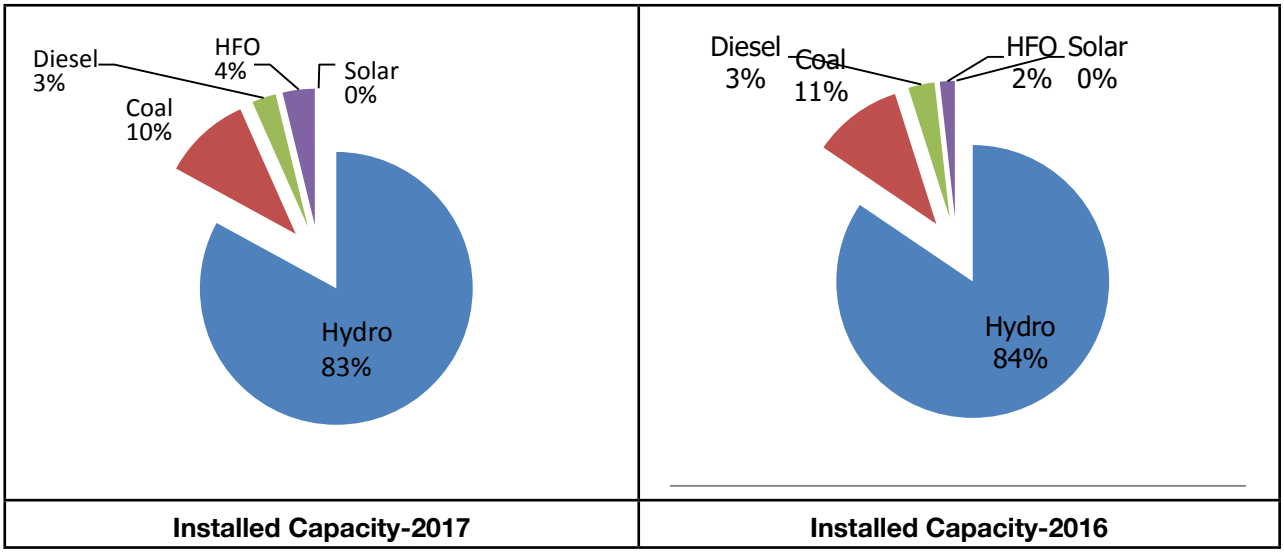
During the period under review, Zambia's electricity generation mix was predominantly hydro which accounted for 83 percent of total installed generation capacity. The rest of the generation mix was composed of coal (10%); HFO (4%); diesel (3%); and solar was less than 0.1 percent. The hydro generation mix comprised of large, small and mini power generation stations[12]. ZESCO owned the bulk of the generation stations while the rest were owned by Independent Power Producers (IPPs). See Appendix 3 for the structure of the ESI in Zambia.

The national installed capacity increased by 2.5 percent to 2,897.21 MW in 2017, from 2,826.91 MW in 2016 (see Appendix 4). The increase was due to the expansion of Ndola Energy HFO power plant by an additional 60 MW and Musonda Falls power station upgrade to 10 MW.

Figure 3-1 compares the contribution of each generation technology in 2016 and 2017. Notably, there has not been much change in the proportions except for HFO which grew by 100 percent.

[12] Large power generation stations are those with installed capacity of 20MW and above Small power generation stations are those with installed capacity of 1MW and above but less than 20MW Mini power generation stations are those with installed capacity of less than 1MW

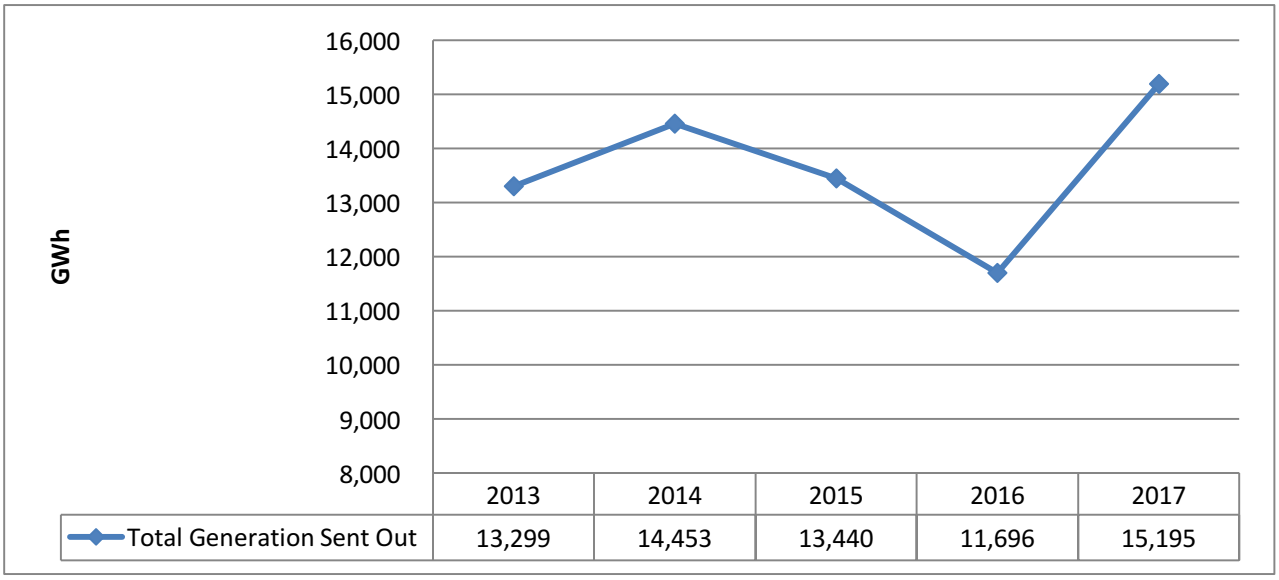
Figure 3-1: National installed electricity generation capacity by technology, 2016 and 2017



3.2 National electricity generation

In 2017, national electricity generation sent out increased by 30 percent, to 15,195 GWh from 11,696 GWh recorded in 2016. The increase was mainly attributed to the improved rainfall experienced during the 2016/2017 season; and additional generation from the HFO plant and the upgrade of Musonda Falls hydro power station. Figure 3-2 shows the trend in national electricity generation from 2013 to 2017.

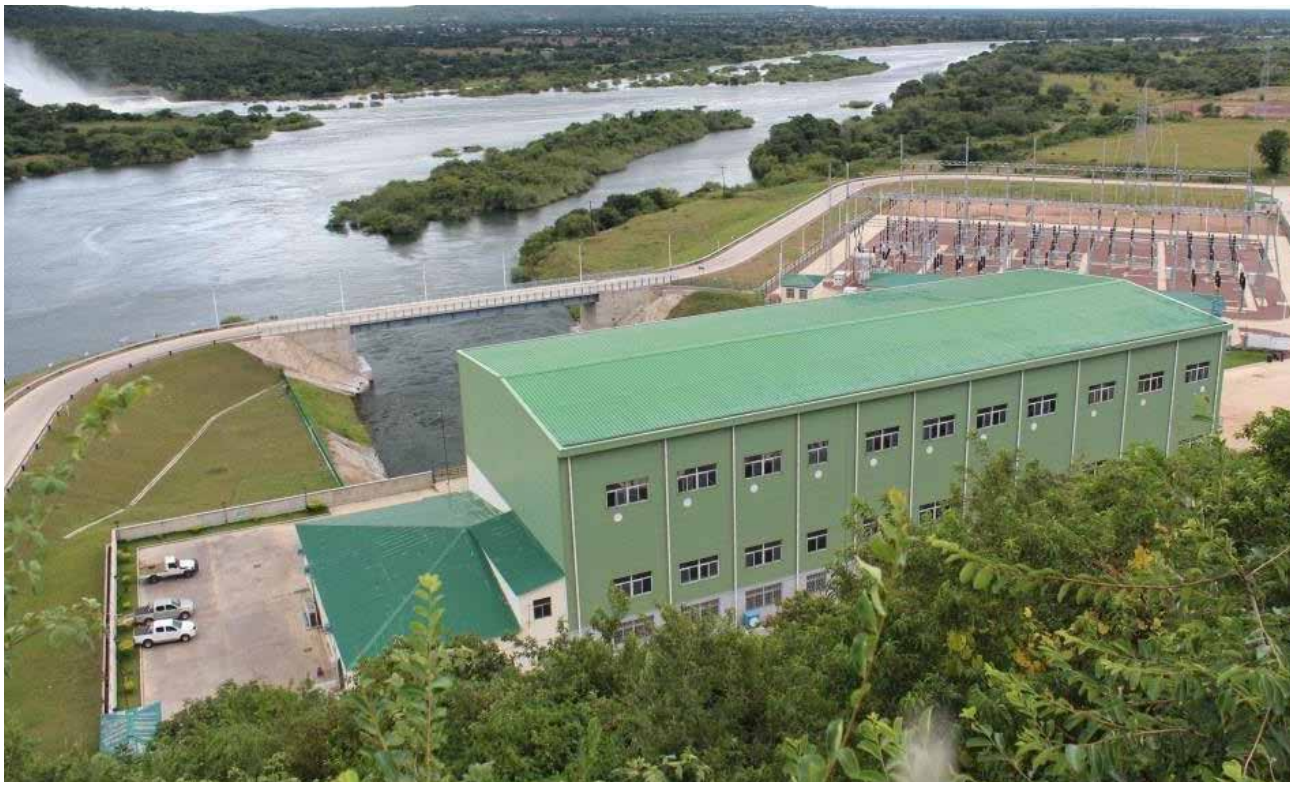
Figure 3-2: Trend in national electricity generation, 2013 – 2017



	2013	2014	2015	2016	2017
Total Generation Sent Out	13,299	14,453	13,440	11,696	15,195

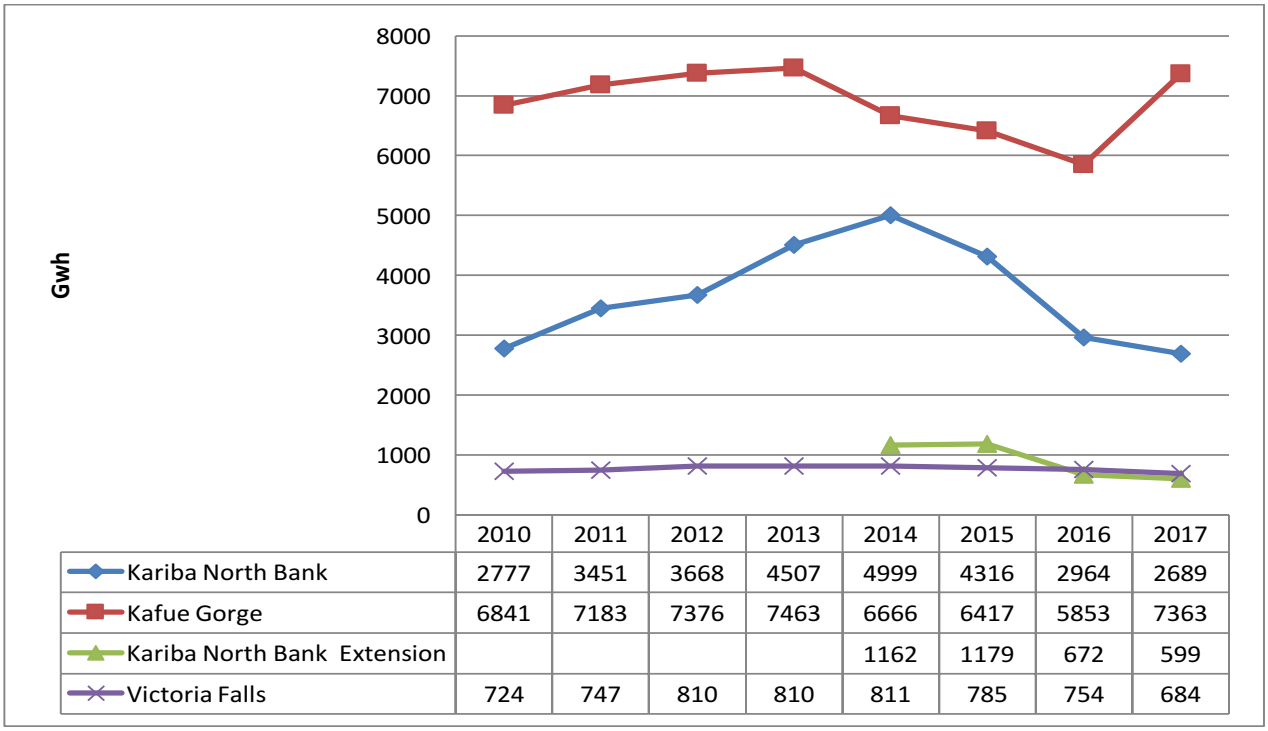
Electricity generation has generally been growing during the period 2013 to 2017. Electricity sent out rose from a low of 13,299 GWh in 2013 to 15,195 GWh in 2017, an increase of 14.3 percent. However, during this period there was a deep in generation between 2014 and 2016 mainly as a result of the drought situation experienced in the Southern African Region which led to significant reduction in the water levels of the major water reservoirs. This adversely affected power generation especially in countries like Zambia which is highly dependent on hydro power.

3.3 Electricity generation from large hydro power plants owned by ZESCO



In 2017, ZESCO owned four (4) large hydro power plants; Kafue Gorge (990MW), Kariba North Bank (720MW), Kariba North Bank Extension (360MW), and Victoria Falls (108MW). Figure 3-3 shows the trend in electricity generation from ZESCO's large hydro power plants for the years 2010 to 2017.

Figure 3-3: Trend in electricity generation, large hydropower plants owned by ZESCO, 2010 2016



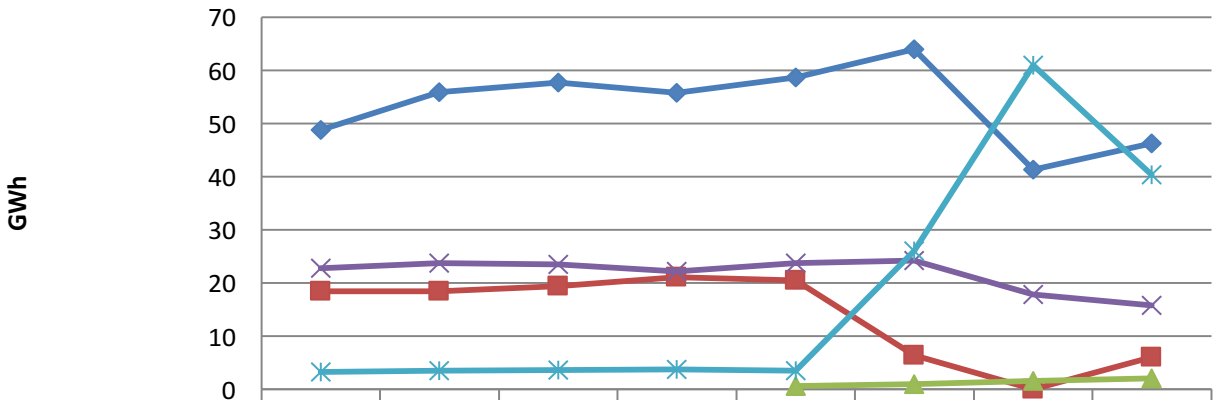
	2010	2011	2012	2013	2014	2015	2016	2017
Kariba North Bank	2777	3451	3668	4507	4999	4316	2964	2689
Kafue Gorge	6841	7183	7376	7463	6666	6417	5853	7363
Kariba North Bank Extension					1162	1179	672	599
Victoria Falls	724	747	810	810	811	785	754	684

In the year under review, the electricity generated from ZESCO's large hydro power plants increased significantly by 10.6 percent from 10,244 GWh in 2016 to 11,334 GWh in 2017.

3.4 Electricity generation from small and mini-hydropower plants owned by ZESCO

In 2017, total electricity generation from small and mini hydro plants owned by ZESCO declined. Figure 3-4 shows electricity generation sent out from small and mini hydro power plants owned by ZESCO for the period 2010 to 2017.

Figure 3-4: Electricity generation from small and mini hydro power plants owned by ZESCO, 2010 – 2017



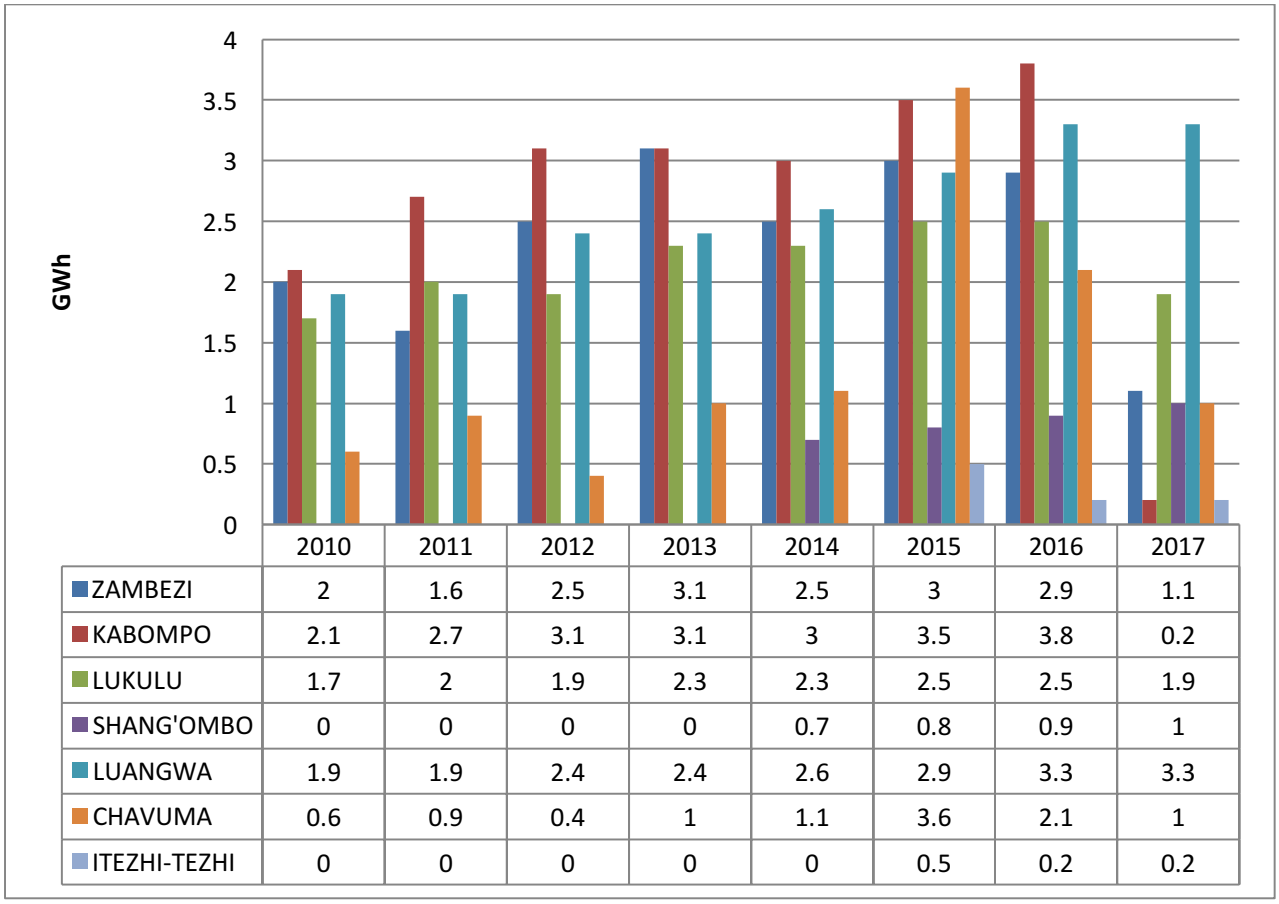
	2010	2011	2012	2013	2014	2015	2016	2017
Lusiwasi	48.8	55.9	57.7	55.7	58.7	63.9	41.3	46.2
Musonda falls	18.5	18.4	19.4	21.1	20.5	6.4	0	6.1
Shiwang'andu					0.7	1	1.6	2.05
Chishimba falls	22.8	23.8	23.5	22.2	23.7	24.2	17.8	15.8
Lunzua	3.3	3.5	3.7	3.8	3.5	26	60.9	40.4

Despite there being an overall decline in electricity generation from small and mini hydro power plants in 2017, Lusiwasi and Shiwang'andu recorded increases of 11.9 percent and 28.1percent respectively. Total generation sent out from ZESCO's small and mini power plants declined by 8.89 percent to 110.6GWh in 2017 from 121.5 GWh in 2016. The observed decline in generation sent out from Lunzua power station and Chishimba Falls was on account of technical problems. In the case of Musonda Falls, the station underwent uprating and produced 6.1 GWh during the test runs.

3.5 Electricity generation from diesel power plants owned by ZESCO

In 2017, total generation from ZESCO's diesel power plants decreased by 56.5 percent from 20.2 GWh in 2016 to 8.79 GWh in 2017. This is depicted in Figure 3-5.

Figure 3-5: Trend in electricity generation from diesel power plants owned by ZESCO, 2010 - 2017



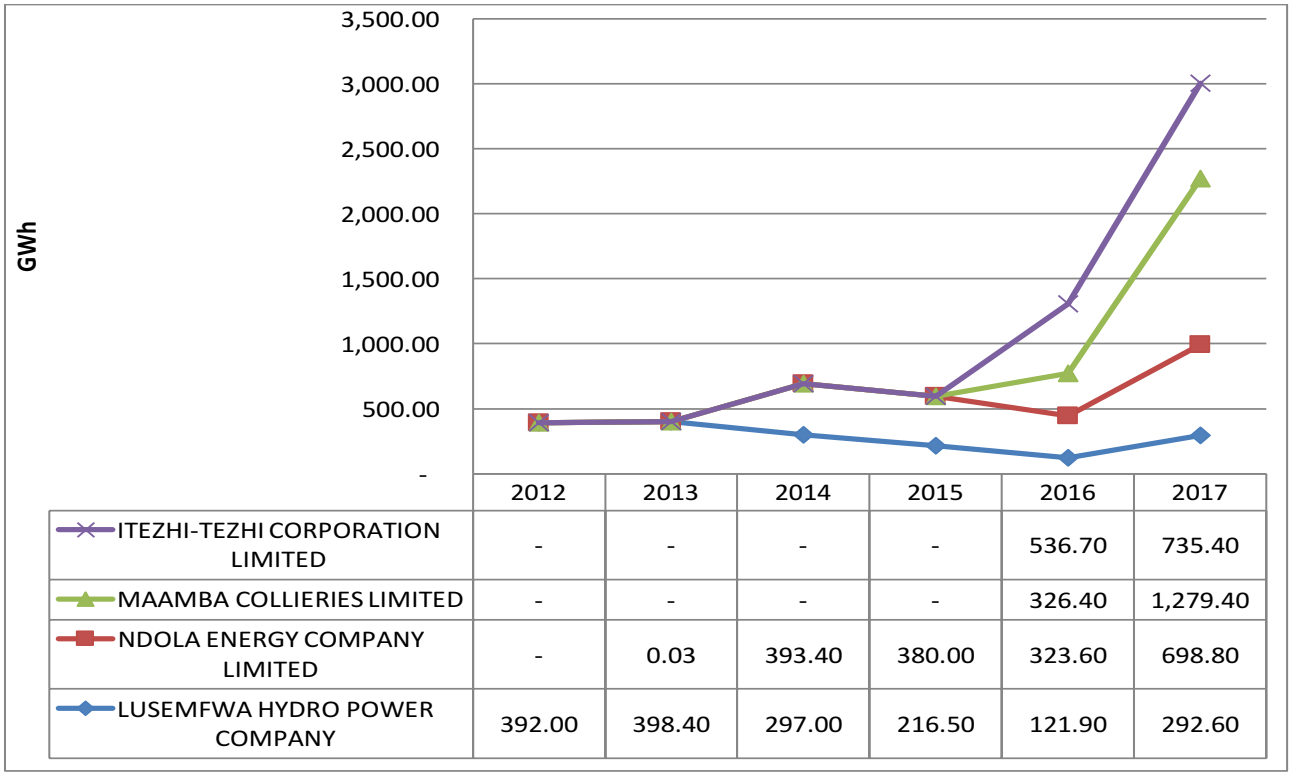
	2010	2011	2012	2013	2014	2015	2016	2017
ZAMBEZI	2	1.6	2.5	3.1	2.5	3	2.9	1.1
KABOMPO	2.1	2.7	3.1	3.1	3	3.5	3.8	0.2
LUKULU	1.7	2	1.9	2.3	2.3	2.5	2.5	1.9
SHANG'OMBO	0	0	0	0	0.7	0.8	0.9	1
LUANGWA	1.9	1.9	2.4	2.4	2.6	2.9	3.3	3.3
CHAVUMA	0.6	0.9	0.4	1	1.1	3.6	2.1	1
ITEZHI-TEZHI	0	0	0	0	0	0.5	0.2	0.2

The decrease in generation was mainly attributed to the decommissioning of some diesel plants in North-Western Province. During this period, all districts in North-Western Province were connected to the national electricity grid. As shown in figure 3-5 among the diesel plants, Luangwa, Lukulu and Zambezi recorded the highest generation as follows: 3.3 GWh, 1.9 GWh and 1.1 GWh respectively.

3.6 Electricity generation from Independent Power Producers (IPP)

In 2017, the ESI had five (5) IPP's namely: Lunsemfwa Hydro Power Company (LHPC), NECL, Maamba Collieries Limited (MCL), Itezhi-Tezhi Power Corporation (ITPC) and Zengamina Power Limited (ZPL). Figure 3-6 shows the trend in electricity generation sent out by the IPP's for the period 2012 to 2017.

Figure 3-6: Trend in electricity generation sent out by IPPs, 2012 – 2017

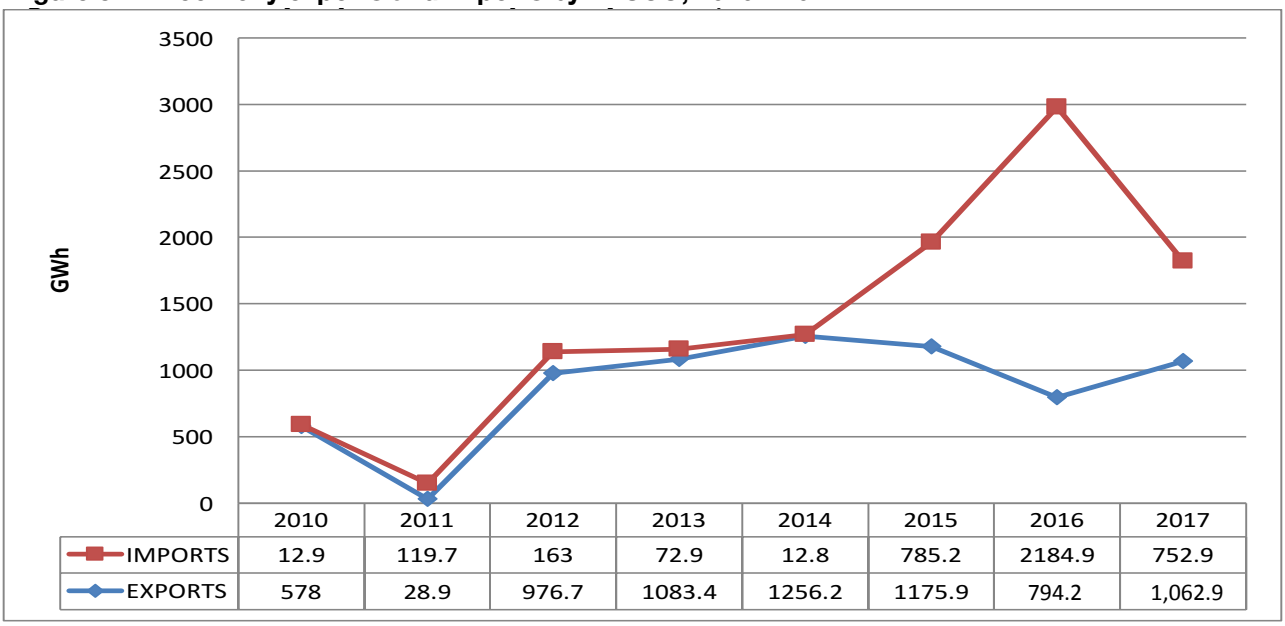


Electricity generation from the power plants by the IPP's increased by 129.4 percent to 3,006.3 GWh in 2017 from 1,310.7 GWh in 2016. Maamba significantly increased generation by 292 percent to 1,279.4 GWh in 2017 from 326.4GWh in 2016. LHPC recorded significant increase in power generation of 140 percent to 292.6 GWh in 2017 from 121.9 GWh recorded in 2016. NECL also recorded an increase in generation of 116.95 percent between 2016 and 2017; from 323.60 GWh in 2016 to 698.80 GWh in 2017.

3.7 Electricity exports and imports by ZESCO

In 2017, ZESCO exported and imported electricity through the Southern African Power Pool (SAPP) and bilateral markets. Figure 3-7 shows electricity exports and imports by ZESCO for the period 2010 to 2017.

Figure 3-7: Electricity exports and imports by ZESCO, 2010 - 2017



ZESCO is a member of the SAPP and does engage in power trading in order to balance the supply and demand on its network. Further, it is also committed to various trade protocols, such as Power Purchase/Supply Agreements, that obligates the utility to export and import as the case may be. Figure 3-7 shows that ZESCO recorded a significant increase in electricity exports of 33.8 percent from 794.1 GWh in 2016 to 1,062.9 GWh in 2017. However, ZESCO's electricity imports declined by 51.4 percent, from 2,184.9 GWh in 2016 to 1,062.9 GWh in 2017. The increase in generation led to the decline in electricity imports.

3.8 National electricity consumption by economic sector

In 2017 the Zambian economy recorded some signs of recovery. The leading sectors were mining, construction, agriculture and services. In tandem with the growth in the domestic economy, the national electricity consumption increased from 10,857.54 GWh in 2016 to 12,191.86 GWh reflecting 12.3 percent growth. The mining customers continued to consume the bulk of power followed by the domestic customers. Table 3-1 depicts the national electricity consumption by economic sector in 2016 and 2017.

Table 3-1: National electricity consumption by economic sector, 2016 – 2017

Sectors	2017	2016	2017	2016
	GWh		Proportion (%)	
Mining	6,202.0	5,918.0	50.9	54.5
Domestic	4,146.9	3,382.9	34.0	31.2
Finance and Property	640.0	498.6	5.2	4.6
Manufacturing	503.4	469.8	4.1	4.3
Agriculture	261.5	227.9	2.1	2.1
Others	87.3	80.1	0.7	0.7
Trade	110.2	97.4	0.9	0.9
Energy and Water	80.9	87.7	0.7	0.8
Quarrying	118.2	59.6	1.0	0.5
Transport	32.0	28.4	0.3	0.3
Construction	9.6	7.1	0.1	0.1
Total	**12,192.0**	**10,857.5**	**100**	**100**

In 2017, the mining sector accounted for 6,202.0 GWh of total consumption representing 50.9 percent. However, despite this dominance, its share declined by 3.6 percentage points compared to 54.5 percent in 2016. Meanwhile, there was an increase in the consumption proportion of domestic customers from 31.2 percent to 34.0 percent. This is line with the increase in domestic customer base from 825,551 as at 31st December 2016 to 894,545 as at 31st December 2017.

3.9 Operational performance of utilities

3.9.1 ZESCO Limited

The ERB monitors the overall performance of ZESCO using the Key Performance Indicators (KPIs) framework. During the period under review, the Board and ZESCO agreed on a new three-year 4th Key Performance Indicators (KPIs) Framework that covers the period January 2017 to December 2019. The agreed framework comprises nine (9) thematic areas. Table 3-2 shows specific KPIs and the assigned weighted scores.

Table 3-2: ZESCO's KPI Framework 2017-2019

No.	Key Performance Indicators	Weighted Score (%)
1	Metering Customers	10
2	Cash Management	20
3	Staff Productivity	15
4	Quality of Service Supply	20
5	System Losses	10
6	Power Generation	10
7	Safety	5
8	Customer Complaints	5
9	Equipment Failure	5
Total		**100**
Minimum mandatory Benchmark score		**75**

The objective of the framework is to evaluate ZESCO's performance with regard to efficiency in customer service, financial management, commercial and technical operations. The detailed description of the new KPI framework is provided in appendix 5.

The performance of ZESCO on the KPIs has an impact on tariff award each time an application for tariff adjustment is lodged with the ERB. The Utility is rewarded for good performance on the KPIs and is penalised for poor performance. Table 3-3 shows the tariff award rules that are applied.

Table 3-3: Tariff award rules 2017-2019

No.	Attained score	Board decision rule
1	0-25%	Utility gets 25% of ERB computed tariff adjustment
2	Above 25% - 50%	Utility get 50% of ERB computed tariff adjustment
3	Above 50%- 75%	Utility gets 75% of ERB computed tariff adjustment
4	Above 75%	Utility get 100% of ERB Computed tariff adjustment

During the period under review, the utility attained a consolidated annual KPI score of 63 percent against the minimum benchmark score of 75 percent. ZESCO performed well in the customer metering, staff productivity, system losses, power generation, and customer complaints resolution indicators. However, the utility did not perform well in the quality of service supply, safety, cash management and equipment failure indicators. The KPI framework is audited periodically to validate the accuracy, consistency and completeness of the data.

Table 3-4 shows the breakdown of ZESCO's quarterly performance on each indicator for the period January to December 2017.

Table 3-4: ZESCO's KPI weighted scores

No	Indicator	Weight (%)	Jan-Mar 2017	Apr-Jun 2017	Jul – Sep 2017	Oct-Dec 2017	Annual Average Score (%)
1	Metering Customers	10	10	10	10	10	10
2	Cash Management	20	0	0	14	12	6.5
3	Staff Productivity	15	14	14	6	6	10
4	Quality of Service Supply	20	5	5	15	10	9
5	System Losses	10	10	10	10	5	9
6	Power Generation	10	10	10	10	10	10
7	Safety	5	0	2.5	0	0	0
8	Customer Complaints	5	5	5	5	5	5
9	Equipment Failure	5	2.5	5	5	3	3
Total Score		100	57	62	75	61	63

Technical Performance

In 2017, a total of 313 facilities for ZESCO in all the ten (10) provinces were inspected with compliance level determined to be 77.2 percent (weighted average) compared to 80.10 percent in 2016 for 291 facilities inspected. The scope of the technical audits included: large hydro power plants, transmission and distribution substations, mini hydropower stations and diesel fueled power stations. In 2017, ZESCO failed to meet the ERB's expected compliance standard of 85 percent. This is depicted in Table 3-5.

Table 3-5: Compliance of inspected facilities in 2016 and 2017

N0.	Type of Facility	2016 % Compliance	2017 % Compliance
1	Large Power Stations	94.9	95.5
2	Transmission Substations>33kV	76.9	79.1
3	Distribution Substations≤33kV	71.5	74.9
4	Mini Hydro Power Stations	86.2	82.6
5	Diesel Fuelled Power Stations	70.9	64.1
6	**ZESCO Overall Average**	**80.1**	**77.2**

Following the technical audits, ZESCO was summoned for a technical hearing to explain how they would resolve the observed non-compliances. The main areas of non-compliances leading to the decrease in compliance rate were issues relating to safety, environment, maintenance, and security of supply. Some of these issues were absence of firm capacity, poor implementation of electrical protection, inadequate fire safety, lack of fire blast and oil containment bund walls, absence of colour coding and equipment labelling, poor substation grounds maintenance, lack of adherence to safety procedures and poor housekeeping among other issues. Further, the hearings were followed by enforcement action were need be.

3.9.2 Copperbelt Energy Corporation Plc

CEC is a private company that owns and operates high-voltage transmission and distribution systems that supply electricity to Zambia's mining companies based on the Copperbelt. Apart from supplying electricity to local mines, CEC has been exporting/wheeling electricity to the Democratic Republic of Congo (DRC), since 2007. Table 3-6 shows the performance of CEC from 2015 to 2017.

Table 3-6: CEC's performance from 2015 to 2017

Business Element	2015	2016	2017
Electricity sales to the mines	4,092GWh	3,521GWh	3,512GWh
Power imports from SAPP	116.4GWh	302.80GWh	340.9GWh
Transmission Losses	2.9%	3.6%	3.0%
Standby Generation Capacity	80MW	80MW	80MW
Energy Generation (From Standby Diesel Generators)	7.17GWh	8.16GWh	12.67GWh

In 2017, CEC sold 3,512 GWh of electrical energy to its mining customers, representing a marginal reduction of 0.26 percent from sales made in 2016 of 3,521GWh. Similarly, transmission losses reduced from 3.6 percent recorded in 2016 to 3.0 percent in 2017. However, the company's standby installed generation capacity remained the same at 80MW.

Technical Performance

In 2017, the ERB undertook a technical compliance audit of CEC Plc facilities which included the transmission network and Gas Turbine Alternator (GTA) stations infrastructure in Chingola, Chililabombwe, Mufulira and Luanshya. The GTAs are strategically located to power critical loads and connected to CAT III breakers for the Mines. These critical loads are mine winders, fans, leaching plants, underground pumps, smelter and the hospitals.

The transmission network was 98.9 percent compliant compared to 96 percent in 2016. For the GTAs the average compliance percentage was 97.9 percent. The following were the identified non-compliances: fire hydrant facilities not available in Luanshya for the 2 X 100, 000 litres diesel tanks, first aid procedure not available and lack of safety procedure at Maclaren GTA site.

CEC solar project

CEC in partnership with the Copperbelt University (CBU) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) invested in the Zambia's first grid-scale solar project. The US$1.5 million 1MW solar plant in Kitwe ("Riverside Solar Project") will yield 1,900MWh per annum over 25 years. Work on the Riverside solar plant commenced in October 2017 and was on track to be completed in February 2018.

Challenges

During 2017, the company recorded some incidents of vandalism and theft on its electrical infrastructure. CEC has since embarked on more robust security measures aimed at reducing crime including awareness campaigns, security liaisons with inter-mine security establishments, the Zambia Police and Judicial System personnel.

3.9.3 Ndola Energy Company Limited

Ndola Energy Company Limited (NECL) is an IPP that generates and supplies power to ZESCO under a long term Power Purchase Agreement (PPA). The company operates an HFO power plant which was uprated from 50MW to 110 MW in 2017. In 2017 total electricity sales to ZESCO amounted to 698.8GWh compared to 380GWh in 2016.

NECL's major challenges included grid voltage and frequency fluctuations outside the operating range of the power plant leading to plant trips which has the potential to negatively affect the efficiency of the plant and its life span. Further, the company experiences the challenge of sending HFO samples for laboratory tests to outside Zambia because there are no independent fuel laboratories in the vicinity that can do qualified and reliable tests of the fuel.

Technical Performance

In 2017, the ERB undertook the technical compliance audit of NECL HFO power generation facilities in Ndola. The overall compliance level for the inspected facilities was at 96.7 percent compared to 100 percent compliance scored in 2016 and this could be attributed to the following non-compliances among others: lack of fire-fighting facilities around 11/66kV step up transformers, expired contents in first aid boxes and non-reflective fire exit signs in engine room.

3.9.4 Kariba North Bank Extension Power Corporation Limited

Kariba North Bank Extension Power Corporation Limited (KNBEPC) Limited is a subsidiary of ZESCO. The company was created as a Special Purpose Vehicle (SPV) for developing the Kariba extension project. The company owns the 360MW Kariba North Bank Extension Power Station. The SPV has an Operations and Maintenance Agreement with ZESCO. The plant is operated as a peaking plant with an average operating time of 3.5 hours a day. ZESCO is the off -taker of power generated from the plant under a long term PPA.

In 2017, energy sent out by the plant reduced by 10.9 percent, to 599 GWh from 672 GWh recorded in 2016. The reduction in electricity generation was on account of the improved rainfall experienced during the 2016/2017 rainy season thereby improving hydro power generation from other stations which left KNBEPC being strictly used as a peaking plant.

Technical Performance

In 2017, KNBEPC facilities were audited scoring 93.3 percent compared to 95.7 percent in 2016. The power station performed above the ERB performance standard. However, the minor decrease could be attributed to the non-compliances to safety requirements.

3.9.5 Itezhi Tezhi Power Corporation

Itezhi Tezhi Power Corporation (ITPC) is an IPP that owns and operates the Itezhi-Tezhi hydropower plant with an installed generation capacity of 120 MW. The company is jointly owned by Tata Africa Holdings (SA) Pty Limited and ZESCO. The company has a long term PPA with ZESCO. In 2017 ITPC generated 752.1 GWh as compared to 536.7 Gwh in 2016 representing a 40 percent increase. The increase has been attributed to increased water levels in the Itezhi Tezhi reservoir and increased months of operation. For 2016, ITPC's operation was commissioned in February compared to 2017 in which the plant was operational throughout the year.

3.9.6 Lunsemfwa Hydro Power Company Limited

Lunsemfwa Hydro Power Company Limited (LHPC) owns and operates two hydro power plants namely; Mulungushi and Lunsemfwa. Mulungushi hydro power plant is located 65 kilometres south-east of Kabwe town and Lunsemfwa hydro power plant 110 kilometres away from Kabwe town. Further, LHPC also owns 180 kilometres of the 66kV transmission lines that runs from the two power plants to ZESCO's substation. Mulungushi Hydro Power Plant has an installed capacity of 32MW while Lunsemfwa Hydro Power Plant has an installed capacity of 24MW. LHPC has signed a firm Power Supply Agreement with ZESCO for a period of 15 years. Table 3-7 summarises the operations of LHPC in 2017.

Table 3-7: Operations of LHPC in 2017

Energy Generation from Mulungushi Plant	170,355.69 MWh
Energy Generation from Lunsemfwa Plant	122,235.10 MWh
Load Factor	76%
Total Sales to ZESCO	279,704.88 MWh
Transmission Losses	3%

Technical Performance

In 2017, the ERB undertook a technical audit of LHPC facilities which included the generation power stations Mulungushi and Lunsemfwa, Converter 66/33/11kV Substation and Kabwe Main 66/88kV Substation infrastructure. The overall average compliance from all the four main facilities inspected was 83.6 percent compared to 88.3 percent in 2016. The non-compliances observed were inadequate maintenance equipment and safety concerns. The compliance rating was below the minimum set target of 85 percent. Table 3-8 shows facilities audited and ERB's rating in 2016 and 2017.

Table 3-8: LHPC's facilities inspected and compliance levels, 2016-2017

Type of Facility	Compliance (%)	
	2016	2017
Converter 66/33/11KV	94.30	80.90
Kabwe Step Down 66/88kV	90.51	83.04
Mulungushi Power Station	90.16	80.77
Lunsemfwa Power Station	78.28	89.74
LHPC Overall Average Compliance	**88.31**	**83.61**
ERB Compliance Target	**85.00**	**85.00**

3.9.7 Zengamina Power Limited

Zengamina Power Limited (ZPL) is a private company that owns and operates an off-grid mini-hydro plant with an installed capacity of 0.75 MW. The power plant was officially commissioned in July 2007. ZPL is based in Kalene, North-Western Province and is owned by the North-West Zambia Development Trust (NWZDT). The Company generates and supplies power to Kalene Mission Hospital, Ikelengi central business district and surrounding areas.

Challenges

In 2017, ZPL continued to face challenges such as the need for cost reflective tariffs despite low income levels in rural Kalene; inadequate capital to expand its distribution network in order to increase its customer base; conflict between providing philanthropic services for the rural poor and the need to adopt commercial business practices.

3.9.8 North Western Energy Corporation Limited

North Western Energy Corporation Limited (NWEC) is a private utility company that owns and operates power distribution and supply infrastructure that provide electricity to the residential mining townships in North Western Province of Zambia. NWEC purchases power from ZESCO as a Maximum Demand (MD) customer and supplies to its clients.

NWEC has a 15-year distribution and supply licence, issued in 2008 to distribute up to 20 MW in North-Western Province. The utility uses this capacity to meet the demand of its customers. The ZESCO supply arrangements at Lumwana Mine are governed by the PPA between ZESCO and NWEC, backed by a connection agreement between the site managements companies, that is, Kalumbila Property Development Company and Kabitaka Hills Development Company, and NWEC.

Technical Performance

In 2017, a technical compliance audit of NWEC's facilities was conducted to ascertain its compliance to the licence conditions, standards, codes and other applicable directives and regulations. NWEC facilities audited included Kabitaka, Lumwana and Kalumbila sites.

The average compliance for all three facilities was 73 percent compared to 86.6 percent in 2016. The key non-compliances were mainly safety concerns.

Challenges

NWEC faced the challenge of the time lag between the period when ZESCO's tariffs were adjusted and when NWEC made the corresponding adjustment. This created financial problems for the company because during that period, the utility was purchasing power at higher tariff compared to its lower tariffs for its customers.

3.10 Operational performance of the electricity network

In 2017, the electricity interconnected power system (IPS) in Zambia experienced a total of 30 major power system interruptions which affected most parts of the country. This is in comparison to five (5) interruptions recorded in 2016. Major supply interruptions, as defined in ZS 387 – 2 B.5.1 are any single events that:

a. Lead to a loss of supply to a 1000 consumers or large end-user consumers;

b. Forced interruption index greater than five (5) system-minutes[13].

Appendix 7 shows the details of the interruptions in 2017. In typical IPS infrastructure there should be provision for a back-up infrastructure or redundancy. This is technically referred to as (N-1). In addition to interruptions, the IPS experienced three (3) N-1 constraints on Kabwe- 330kV Pensulo line; Kafue Town 330/220kV transformer and Leopards Hill 330/132kV transformer.

3.11 Network expansion

The Zambian IPS grew following the connecting of North- Western province to the grid and commissioning of the following projects:

a. Kabompo 132kV Mumbezhi line;

b. Chipata West 33kV Msoro line;

c. Mumbezhi 132/33kV substation;

d. Zambezi 132kV Chavuma line;

e. Kafue Town 330/132kV GIS; and

f. Musonda Falls G6 and 7 (2.25MW).

3.12 Power quality management system

The ERB has issued the Power Quality Directives (PQDs) to the licensees in the ESI in order to ensure power quality and reliability as defined in the Zambia Standard ZS 387: Electricity Supply – Power Quality and Reliability Standard. Since then the ERB has been receiving power quality status reports on a quarterly basis from four (04) licensees namely ZESCO, CEC, LHPC and NECL. As at the end of 2017, the four were the only licensees who had installed power quality meters on their networks.

[13] System Minutes = (Energy not supplied MWh/Power at Peak)

In 2017, the ERB continued to monitor the implementation of the PQDs by licensees on a quarterly basis. As part of the directives, the licensees are expected to install power quality recorders at sufficient locations in their electrical networks to adequately characterise and report PQ performance as prescribed in Zambian Standard ZS 387.

To enforce these directives, the ERB developed the Power Quality Management System (PQMS) which seeks to provide a long term mechanism to continuously monitor the power quality (PQ) performance of the Zambian power system and its improvement over time in accordance with the Zambian Standard ZS 387.

To adequately characterise the PQ performance of the network, a total of 345 recorders are required to be installed on the network. As at 31st December, 2017, a total of 98 recorders were installed compared to a total of 52 recorded in 2016. The 98 recorders represent 28 percent of the network.

The annual average compliance for 2017 to power quality was 71.1 percent compared to 61 percent for 2016. The performance in 2017 fell short of the 75 percent compliance rate planned for 2017. The ERB continued to engage various licensees to ensure compliance and implement measures for the improvement of power quality performance in Zambia.

3.13 Low power factor surcharge

Low power factor surcharge is a demand side management measure aimed at reducing reactive power on the system and in turn mitigating power deficit. This promotes efficient consumption of Energy.

In December 2014, the ERB approved the introduction of a low power factor surcharge for industrial, mining, commercial, agricultural and all customers on individual PPAs. Clause 2.2.1 of the *Electricity (Grid Code) Regulations, Statutory Instrument No. 79 of 2013* stipulates the power factor at the point of supply shall be 0.92 lagging or better.

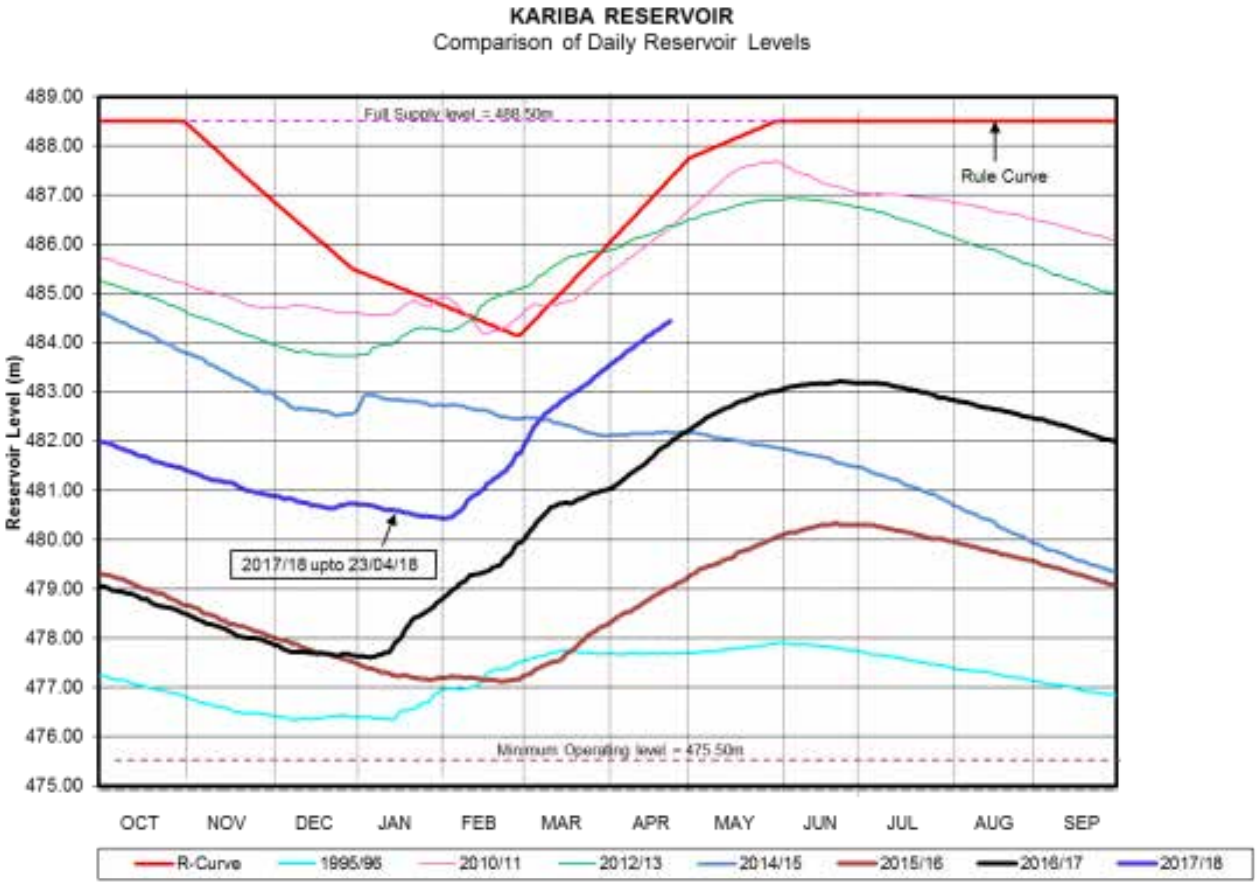
The effective implementation date was initially 1st January 2016 but this was deferred to 1st January 2017 to allow a smooth transition. However, by the end of 2017 there was no implementation because some customers had applied for exemptions to allow them install power factor correction equipment. Based on the foregoing the new effective implementation date is planned for 1st September 2018.

3.14 National power deficit

By the close of 2017, the nation's power deficit had been eliminated. In 2016, there was a deficit of 526 MW. This deficit was however mitigated by the electricity imports from within the region. It is worth noting that during the 2016/2017 rainy season, the main water reservoirs had significant risen in the levels as a result of improved rain pattern and increased water inflows. The Itezhi Tezhi resevoir was filled to full capacity to the extent that excess water was spilled and Kafue Gorge Power Station operated at full capacity. The improvement in ZESCO's hydro power generation and expansion in the IPP's generation capacity ended Zambia's power deficits that was experienced in the preceeding years of 2016 and 2015.

The Kariba Lake was created and designed to operate between levels 475.50m and 488.50m with 0.70m freeboard at all times. Figure 3-8 depicts the water levels for the Lake Kariba reservoir.

Figure 3-8: Water levels at Lake Kariba 1995/96-2017/18 rainy seasons



Source: Zambezi River Authority website

3.15 The Electricity (Grid Code) Regulations – Statutory Instrument 79 of 2013

Section 2.2 of the Governance Chapter of the Electricity (Grid Code) Regulations SI No. 79 of 2013 provides that there shall be a Grid Code Technical Committee (GCTC) constituted every two years by the ERB. In 2017, the GCTC successfully held all the four (4) quarterly meetings besides various expert working group meetings which included Low Power Factor Surcharge sub-committee and Exemptions working group among others.

In the first quarter of 2017, the GCTC secretariat was transferred to System Operator (SO), ZESCO who has since been issued with SO Licence. This is in accordance with the provisions of section 2.4 of the Governance Chapter of the Electricity (Grid Code) Regulations SI No. 79 of 2013 which stipulates that the SO shall serve as the Grid Code secretariat. The ERB served as the interim secretariat since 2014 when the implementation of the Grid Code commenced.

In 2017, the ERB granted exemptions to the IDC Scaling Solar Round 1 project being implemented under the two special purpose vehicles (SPV), Bangweulu and Ngonye Power Companies. Other exemptions granted were to MCL, Konkola Copper Mines (KCM), Mopani Copper Mines (MCM) and (KNBEPC).

Further, the ERB received proposals for amendments to the Grid Code in order to align it to the various technologies such as Renewable Energies.

3.16 Development and Implementation of Key performance Indicators Assessment for non-State Owned Enterprises

The ERB in conjunction with Non-State Owned Enterprises (Non-SOE) Licensees formulated and agreed on a KPI framework to run for a period of three (3) years from January 2017 to December 2019. This framework is aimed at measuring the technical and operational performance of Non-SOE licensees in the ESI in Zambia and assures reliable and quality service delivery to the consumers. The five (5) thematic areas agreed upon in the framework are:

i. Quality of Service Supply – Network availability;

ii. System Losses;

iii. Power Generation;

iv. Infrastructure Compliance; and

v. Safety.

The first set of Non-SOE licensees reporting on a quarterly basis on this framework are CEC Plc, MCL, NECL and LHPC. These licensees are required to submit to the ERB performance data and self-assessed reports against each agreed KPI of the Non- SOE framework. The KPI performance of Non SOEs on technical KPI is shown in Appendix 6.

3.17 Power purchase agreements

During the period under review, the ERB approved four (04) applications for PPA/PSA and one (01) BSA as shown in Table 3-9:

Table 3-9: PPA/PSA and BSA reviews

No.	DETAILS OF PPA/PSA/BSA
1.	ZESCO-Botswana Power Corporation Limited – 10MVA for a period of five (5) years.
2.	ZESCO and CEC: amendment of the Bulk Supply Agreement (BSA);
3.	ZESCO and its mining customers and CEC and its mining customers respectively.
4.	ZESCO and Mpande Limestone limited – 132KV for a period of 10 years
5.	Lunsemfwa hydro power company limited and ZESCO for a period of (fifteen) 15 years.

3.17.1 Electricity tariff reviews

During the year under review, the ERB received two (02) tariff applications from ZESCO and NWEC. The tariff adjustments were reviewed in line with the provisions of the Electricity Act Cap 433 of the Laws of Zambia. While the ZESCO application was subjected to public hearings as per requirements of the law after written public submissions were made to the Board, the NWEC tariff application was not subjected to public hearings as no written submissions were received by the Board.

3.17.1.1 ZESCO tariff review

In March 2017, ZESCO applied to the ERB to adjust electricity tariffs across all customer categories, except for the mining and export customers by an average of 75 percent.

In addition to the 75 percent tariff increment, ZESCO also proposed to change the residential tariff structure. The ERB approve the 75 percent tariff increment and structure as follows:

a. Raise the R1 consumption band upper limit from 100kWh to 200kWh;

b. Raise the R2 consumption band lower limit from 101kWh to above 201kWh;

c. Abolishment of the R3 consumption band; and

d. Retention of the monthly fixed charge at K18.23.

The tariff application was premised on attainment of Cost Reflective Tariffs. The approved tariffs were expected to raise ZESCO's revenue and operating profit. Further, ZESCO needed to raise enough revenue to facilitate for importation of power following the power crisis in 2015/2016 rainy season. The ERB approved the application and the adjustment was implemented in two phases, firstly a 50 percent upward adjustment in May 2017 and a 25 percent upward adjustment in September 2017. Appendix 8 shows the approved tariffs by customer category.

3.17.2 Review of mining tariffs

During the period under review, the ERB received applications by CEC for regulatory approval to amend the Power Supply Agreements (PSA) with its mining customers on the Copperbelt. The amendment was with respect to the new tariff clauses. According to CEC, the bulk supply tariffs adjustments were determined through a consultative process led by the Ministry of Energy and Ministry of Finance.

Further, ZESCO separately engaged in tariff negotiations with their mining customers. The parties agreed to migrate to an average mining tariff of United States Dollar 0.0930 per kilo watt hour (kWh) or US cents 9.3/kWh effective from 1st January 2017.

Based on the foregoing, ZESCO also engaged CEC with the aim of making corresponding amendments to the BSA. This engagement was on-going by the end of 2017.

3.18 Other developments in electricity sub-sector

3.18.1 Electricity Cost of Service study

In April 2017, the ERB launched the Electricity Cost of Service Study (CoSS) with financial support from the African Development Bank (AfDB). The Study was being undertaken by the Economic Consulting Associates Limited of the United Kingdom (ECA) and their local partner Utilink Limited. The objectives of the study were 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 the basis for strategy formulation for the gradual transition from existing financial-cost based tariffs to economic cost reflective tariffs.

The last CoSS was undertaken in 2006. The study was intended to determine the cost ZESCO incurred in generating, transmitting, distributing and supplying power to its various customers and at various supply points in the system.

The 2017 study was wider and will supersede the 2006 study which focused primarily on ZESCO, as the major producer and supplier of about 96 percent of the electricity consumed in the country at the time. However, since then, significant changes have taken place in the Electricity Sector in Zambia. There have been new entrants into the sector, such as Independent Power Producers (IPPs), who have invested in power generation; much higher cost generation sources such as HFO, Solar and Coal have been developed by both ZESCO and IPPs. In addition significant new investments have been made to reinforce

and expand the transmission and distribution infrastructure to improve and expand supply to existing and new areas of the Country, and further there is a growing emphasis on developing the renewable energy resources of the Country. As a result, the cost of electricity production and supply has risen significantly. With these new developments it has, therefore, become imperative that a new electricity cost of service study be undertaken not only to capture developments since the last study was undertaken, but also to be forward looking in consideration of the forecast electricity demand of Zambia over the long-term, and the projected expansion of the power supply infrastructure to meet the forecast future demand in a least-cost manner.

The new study therefore, is industry-wide encompassing all the new power generation sources as well as determining a 20 year load forecast profile and establishing a least-cost system expansion plan to meet the demand.

Further, once the study is completed it will propose a phased migration path that will ensure smooth tariff migration to cost reflective electricity tariffs. By the end of 2017, the study was on-going.

3.18.2 Rural electrification

In 2017, the Rural Electrification Authority (REA) continued to implement rural electrification projects nationwide. REA successfully completed (14) rural electrification projects. Out of the (14) completed projects, (11) were grid extensions while (3) were solar projects. North - Western Province had the most projects with (3) grid extensions and (1) solar project. Table 3-10 shows the number of projects completed by REA in 2017.

Table 3-10: Rural electrification projects completed, 2017

Grid extension projects			
No.	**Name Of Project**	**District**	**Province**
1.	Mulungushi Agro	Kabwe	Central
2.	Mwinuna I	Mpongwe	Copperbelt
3.	Orashio	Mufulira	Copperbelt
4.	Mwinuna II	Mpongwe	Copperbelt
5.	Kaula-Kakwiya	Petauke	Eastern
6.	Mushindamo phase II	Solwezi	North Western
7.	Mushindamo III	Solwezi	North Western
8.	Kankolonkolo	Kasempa	North Western
9.	Kanchomba	Pemba	Southern
10.	Luampa-sub station	Kaoma	Western
11.	Luampa	Kaoma	Western
Solar home systems installations			
12.	Lundazi	Chama	Eastern
13.	Mwinilunga	Mwinilunga	North Western
14.	Chama	Chama	Muchinga

Further, by the end of 2017 (12) additional grid extensions, (2) solar and (1) hydro project were still in progress.

3.18.3 Solar micro-grids

During the period under review, two (02) licence applications (combined generation and supply licence) for solar mini grids were approved and these were:

a. **Standard Micro-grid Initiatives Limited** Which was issued with a Licence to operate a 10.2 kilowatt solar micro-grid located in Mugurameno village of Chieftainess Chiawa of Chirundu District in Lusaka Province. The micro grid has a customer base of about 150 households. The micro-grid has different tariffs according to consumption profile.

b. **Muhanya Solar Limited** Which was issued with a Licence to operate a 30 kilowatt solar mini-grid located in Sinda village located 10 kilometres from Sinda Central District. The project was commissioned in April 2017 and has connected 60 households. The ERB approved tariffs are based on fixed pay-as-you-go system.

3.18.4 Scaling solar project – phase 1

During the period under review, the ERB received and approved applications for Investment Endorsement (I.E) for the development of the two commercial scale solar power plants (i.e Bangweulu Power company Limited owned by Neon S.A.S of France and Ngonye Power Company Limited owned by Enel Green Power S.p.A of Italy) located in the Lusaka South Multi-facility Economic Zone with a combined capacity of 100 MW. The Power Supply Agreements between the two (02) companies and ZESCO were earlier approved in 2016.

Bangweulu Power Company:

During the year under review, financial close was reached for the 54 MW Bangweulu project. Meanwhile, the Engineering, Procurement and Construction (EPC) contractor commenced civil works in December, 2017. The project represents a total investment of 60 million US dollars. According to the IDC, the plant is scheduled to be completed in 2018.

Ngonye Power Company:

For Ngonye power project, the World Bank, in 2017, undertook the preparation of the Partial Risk Guarantee (PRG) package. The project was expected to reach financial close in 2018.

Scaling solar project phase - 2:

During the period under review, the expression of interest ("EOI") for the 200 to 300MW Utility-Scale Solar PV IPP projects was issued in February 2017. Subsequently, the Request for Pre-Qualification (RFP) was also issued. A total of twelve (12) bidders were pre-qualified. According to the IDC, land in four (4) locations has been secured for the second phase of the scaling solar power projects in Chipata, Mumbwa, Chisamba and Ndola.

3.18.5 Distribution Grid Code

The ERB, in consultation with stakeholders developed a Distribution Grid Code ("Distribution Code") for the ESI in Zambia. The purpose of the Distribution Code is to permit the development, maintenance and operation of an efficient, coordinated and economical distribution system and generally to provide a description of the technical connection requirements for large embedded generating systems. The Code also seeks to avoid undue discrimination between Distribution Network Service Providers (DNSPs) and other categories of participants.

In March 2017, the ERB approved the constitution of the Distribution Grid Code Review Panel (DGCRP) and held its inception meeting in October 2017. The DGCRP comprises the following stakeholders in the ESI:

a. Two persons representing the DNSP;

b. One person representing the ERB;

c. One person representing the Transmission SO;

d. One person representing Embedded Generators;

e. One person representing Major Customers;

f. One person representing the REA;

g. One person representing the Engineering Institution of Zambia (EIZ) Council;

h. One person representing Independent Suppliers;

i. Two persons representing the Transmission Network Service Providers; and

j. One person representing the Ministry responsible for Energy

3.19 Southern African Power Pool (SAPP) Perfomance

During the period under review, SAPP added 19,588 MW of new power generation capacity to 61,894 MW that existed in 2016. Meanwhile, the electricity demand increased by 13.3 percent from 52,542 MW in 2016 to 59,539 MW in 2017.

In 2017, SAPP continued working towards establishing and implementing competitive power trading platforms. In this respect, SAPP has successfully implemented the Month-Ahead (MA), Week-Ahead (WA), Day-Ahead (DAM) and Intra-Day Markets (IDM) thereby becoming the first power pool in Africa in establishing and operating such robust markets.

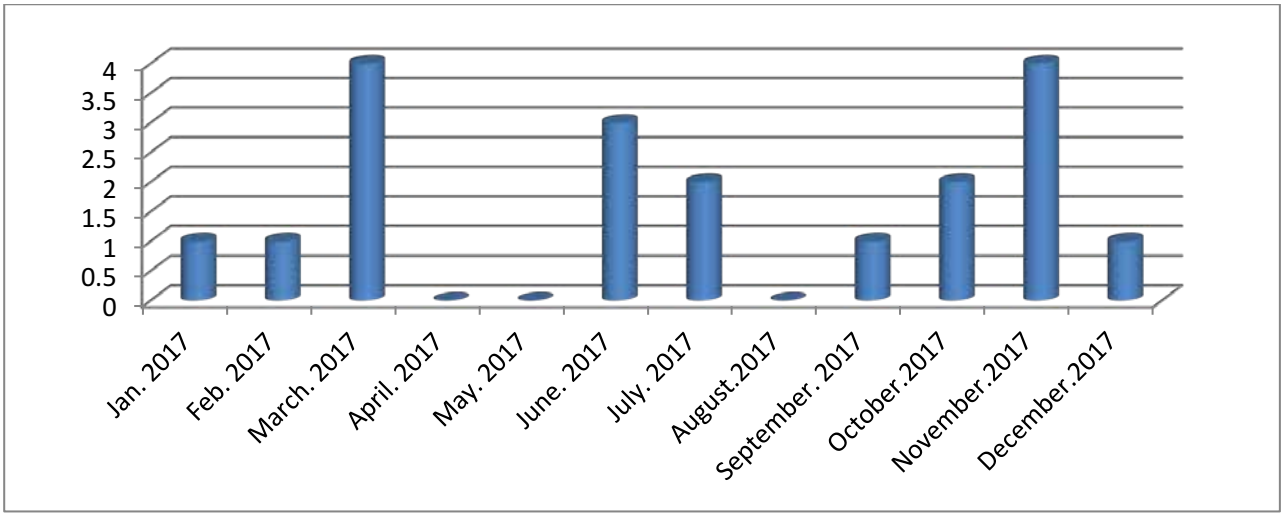
Despite the foregoing developments, SAPP continues to face the challenge of transmission congestion which to some extent has constrained power trading.

3.19.1 SAPP system disturbances

The period under review recorded some system disturbances with March and November topping the list with 4 disturbances each. This was followed by the month of June 2017 which recorded three (3) disturbances. Meanwhile, April, May and August did not record any disturbances. January, February, September and December recorded only one disturbance each. The power oscillations were observed as far as Zambia but the major part of the transmission power network remained stable.

According to the SAPP, in the month of December 2017, one SAPP system disturbance was reported. This was caused by a faulty current transformer in Zambia which caused a 66 kV bus bar fault and lead to subsequent loss of load. Figure 3-9 shows the details.

Figure 3-9: Number of system disturbances on the SAPP network, 2017



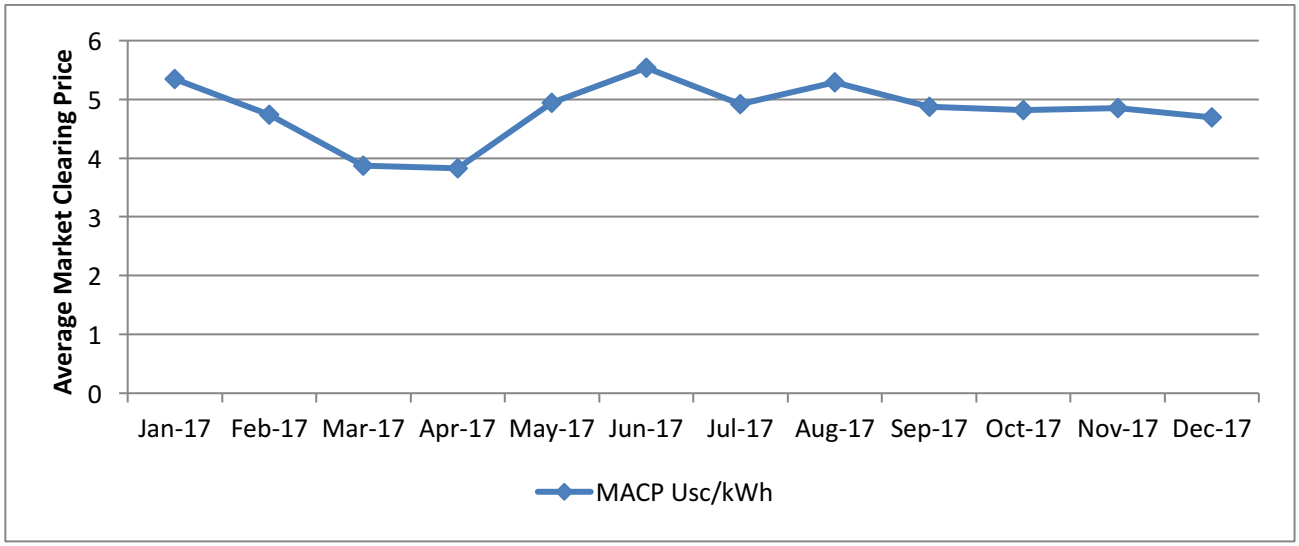
Source: SAPP Monthly Report, 2017.

3.19.2 SAPP power trading

During period under review, the SAPP power trading markets constituted the DAM, IDM, Forward Physical Market Monthly (FPM-M) and Forward Physical Market Weekly (FPMW). The DAM continued to be the dominant market averaging 72.7 percent of total traded power. With the balance shared among the remaining three (03) markets.

In terms of Market Clearing Prices (MCP) under the DAM, monthly average DAM clearing price recorded a downward trend during the first quarter of 2017. The lowest prices were recorded in the months of March and April averaging USc3.8/kWh. The highest prices were recorded during the month of June 2017 when they peaked to USc5.5/kWh. The rest of the year saw slightly lower but stable market prices averaging USc4.8/kWh. Figure 3-10 shows the trend during the year.

Figure 3-10: SAPP market clearing prices, 2017



Source: SAPP Monthly Report 2017

3.20 Outlook for the electricity sub-sector

3.20.1 New Investments in infrastructure

During the period under review, the power sector continued to grow with new investments in generation and other infrastructure projects. Notably, the Batoka Gorge Hydro Electric Power Scheme is expected to be launched in the near future. The project is estimated to cost US$ 6 billion and is expected to produce 2,400 MW to be shared equally between Zambia and Zimbabwe. Further, the Kafue Gorge Lower (KGL) project which is expected to produce 750 MW recorded steady progress.

3.20.2 Open access and transmission pricing framework

Open access to the power grid is an essential element of introducing competition to electricity markets and increasing their efficiency. Open access refers to the possibility for any party selling or buying electricity, for a cost-reflective fee and subject to transparently defined system security constraints, to connect to and make use of transmission systems, regardless of who owns and operates the power grid.

The envisaged Open Access Regulations will complement the Electricity (Grid Code) Regulations, SI No. 79 of 2013, in facilitating non-discriminatory access to the electricity transmission network in Zambia. This will ultimately result in improved efficiency in the operation of electricity network and is expected to encourage more investment in the electricity sub-sector.

With the granting of the System Operator (SO) licence to ZESCO, it is expected that the momentum towards the open-access regime will be maintained to enhance competition in the sector. It is envisaged that the Transmission pricing framework being developed under the on-going Cost of Service Study will complement the open access framework. Thus, with the open access regime ZESCO will no longer be the only off-taker of power as producers will sale to any consumer of their choice while using the already existing facilities.

3.20.3 Legislative reviews and enhancement of regulatory environment

The legislative reviews of the Electricity and the Energy Regulation Acts embarked upon by the ERB are expected to be completed in 2018. These reviews are aimed at enhancing the legislative mandate and improve industry efficiency.

3.20.4 REFiT and GETFiT

On the Renewable Energy front, the Global Energy Transfer Feed in Tariff (GETFiT) program for a 100 MW solar PV is expected to be launched in early 2018. The Renewable Energy Feed in Tariff (REFiT) strategy also envisages allocating up-to 100 MW of capacity to hydro projects. GETFiT intends to launch the hydro tender in mid-2018. Subsequent tenders could call for other technologies including biomass and geothermal. In terms of regulation, the ERB continued to develop the supporting regulatory framework for REFiT.

4.0 LICENCING IN THE ENERGY SECTOR

The ERB issues licences to undertakings engaging in entrepreneurial activities in the energy sector as provided under the Energy Regulation Act, Chapter 436 of the Laws of Zambia as read together with the Energy Regulation (Licensing) Regulations of 1998.

4.1 Licensing of Undertakings

In line with licensing procedures (legal, technical and financial assessment), the ERB conducted licensing inspections for all duly lodged applications.

During the period under review, a total of one hundred and fourteen (114) licence applications were processed, of which eighty-five (85) were initial applications while twenty-nine (29) were renewals. In addition, twenty-five (25) retail sites were approved for inclusion onto existing retail licences. See Table 4-1 below.

Table 4-1: Licence applications processed, 2016-2017

Period	Initial Applications		Var.	Renewals		Var.	Retail Site Inclusions		Var.
	2017	2016		2017	2016		2017	2016	
Quarter 1	9	15	(6)	10	11	(1)	7	15	(8)
Quarter 2	34	19	(15)	12	5	(7)	3	4	(1)
Quarter 3	23	12	(11)	5	6	(1)	6	10	(4)
Quarter 4	19	11	(8)	2	17	(15)	9	7	(2)
	85	**57**	**(28)**	**29**	**39**	**(10)**	**25**	**35**	**(10)**

Initial applications

In 2017, 85 initial applications were processed compared to 57 in 2016 representing an increase of 28. The increase was mainly attributed to the increased number of licences to manufacture, wholesale importation and installation of solar energy systems (Solar Licences) processed. This was necessitated by the change in the criterion in the regulatory regime for solar energy systems, where fifty-one (51) solar licenses were processed as compared to eleven (11) in 2016. In addition, a total of sixteen (16) waivers to import solar energy systems for own-use were granted during the period under review.

Renewal applications

In 2017, 29 renewal applications were processed compared to 39 in 2016 representing a decrease of 10. The types of licences issued are summarised in the Table 4-2.

Table 4-2: Standard licences issued in 2016 and 2017

No	Sector/Type of Licence	Number of Licences Issued		Var.
		2017	2016	
1.	Distribute, Import and Export of Liquefied Petroleum Gas	2	7	(5)
2.	Distribute, Import and Export of Petroleum Products	14	16	(2)
3.	Generation of Electricity	1	2	(1)
4.	Generation of Electricity for Own Use	0	1	(1)
5.	Importation of Lubricants	10	6	(4)
6.	Manufacture, Wholesale Importation and Installation of Solar Energy Systems	51	11	(40)
7.	Retail of Liquefied Petroleum Gas	1	9	(8)
8.	Retail of Petroleum Products	6	11	(5)
9.	Road Transportation of Petroleum Products	28	30	(2)
10.	Bio Ethanol Production	1	0	(1)
11.	Transmission of Electricity	0	1	(1)
12.	System Operator Licence - Zambian Interconnected Power System	0	1	(1)
13.	Supply of Electricity	0	1	(1)
	Total Licences issued	**114**	**96**	**18**

In 2017, 114 licences were processed compared to 96 in 2016 representing an increase of 18. The major contributor to the increase was the licence to manufacture, wholesale importation and installation of solar energy systems.

In addition, a total of forty-one (41) construction licences were issued during the period under review, for retail sites and/or storage depots around the country.

Further, 119 provisional licences and eight (8) inclusion of retail sites were issued during the period under review, as shown in the Table 4-3. A provisional licence is issued as an administrative arrangement, to applicants who have met all the licensing requirements and whose applications are due for gazetting. The variance in the standard licences issued compared to the provisional licences is attributed to some applications having not been finalised as at the end of 2017.

Table 4-3: Provisional licences issued in 2017

No.	Provisional licence/temporary permit type	No. of licences issued
1.	Authority to Operate Retail Site	8
2.	Distribute, Import and Export LPG	1
3.	Distribute, Import and Export Petroleum Products	20
4.	Importation of Lubricants	8
5.	Manufacture, Wholesale Importation and Installation of Solar Energy Systems	58
6.	Retail of LPG	2
7.	Retail of Petroleum Products	7
8.	Road transportation of petroleum products	23
	Total licences issued	127

During the period under review, the top 10 leading licensees in transportation of petroleum

products that complied with both ERB and ZABS requirements to uplift products from TAZAMA were as depicted in the Table 4-4.

Table 4-4: Leading licensees in transportation of petroleum products

No.	Name of licensee	No. of tankers
1.	Juba Transport Ltd	77
2.	Mohab Transport Ltd	40
3.	Keren Motors Ltd	25
4.	Horn Afric Transport Ltd	33
5.	Mount Meru Petroleum Ltd	29
6.	Superstar Forwarders Ltd	19
7.	Petroda Zambia Ltd	14
8.	Osman Transport Ltd	11
9.	Atosh Transport Ltd	15
10.	SGC Investments Ltd	10

During the year under review, the summary of the number of valid licences by type is depicted in the Table 4-5.

Table 4-5: Number of licences by type in 2017

No.	Licence type	Total No.
1.	Retailing of Petroleum Products	42
2.	Distribute, Import and Export Petroleum Products	67
3.	Transportation of Petroleum Products	120
4.	Manufacture, Wholesale Importation and Installation of Solar Energy systems	80
5.	Distribute, Import and Export- LPG	60
6.	Retail of LPG	4
7.	Importation of Lubricants	17
8.	Bioethanol Production	1
9.	Refinery of Petroleum Products	1
10.	Electricity	
	i. Generation/own use	15
	ii. Supply	2
	iii. Distribution	4
	iv. Transmission	3

5.0 OTHER SECTORAL ISSUES

5.1 Consumer and Public Affairs

One of the core functions of the ERB is complaints handling. The ERB is mandated to receive and resolve complaints on among other things, energy price adjustments, service provision by licensed entities as well as other energy related facilities in the sector.

5.2.1 Complaints handling

The ERB in 2017 received complaints through the following: offices located in Lusaka, Chinsali, Livingstone and Kitwe; Competition and Consumer Protection Commission (CCPC); and the toll free line 8484. In 2017, a total of 240 complaints were received and investigated. A total of 169 were resolved in accordance with the complaints handling procedures as outlined under Appendix 9. The complaints resolved represented a resolution rate of 70.4 percent against a set target of 70 percent. Table 5-1 shows the complaints resolutiion rate according to sub-sector .

Table 5-1: Complaints resolution rate per sub-sector

No.	Complaint by source	No. of complaints received	No. resolved	Resolution rate (%)
1.	Electricity	155	103	66.5
2.	Petroleum	85	66	78
TOTAL		**240**	**169**	**70.4**

The complaints received mainly related to the following: delayed service connections; pricing of energy products; and poor quality of products and service provided.

During the period under review, the ERB undertook several measures to mitigate the complaints, among them the following:

a. Engaged service providers to resolve complaints and prevent future occurrences.

b. Sensitisation campaigns to educate the public on pricing of energy products and services. This was done via road shows, print and electronic media. To enhance outreach activities the ERB continued to use its mobile office.

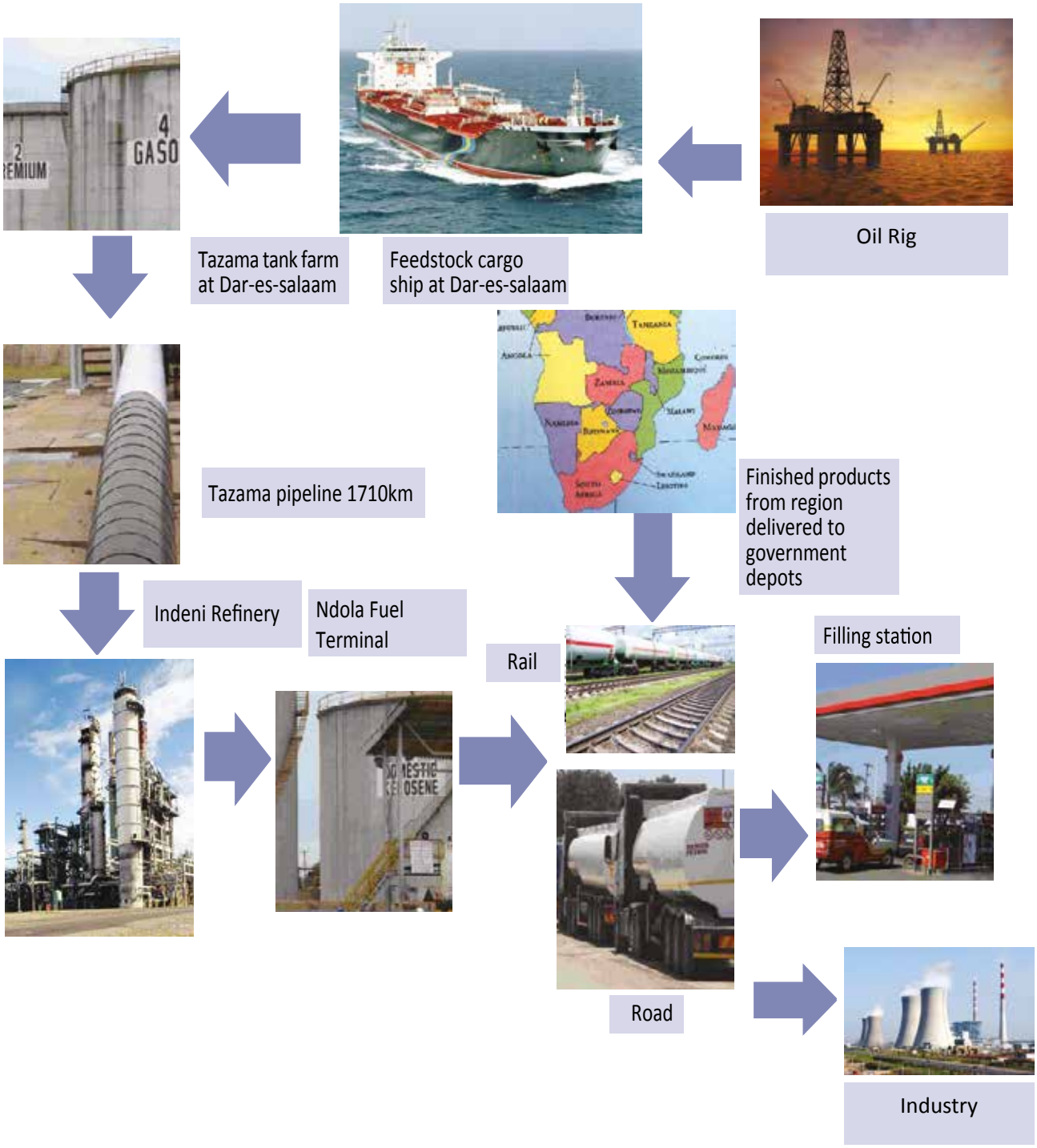
c. Inclusion of service grading for energy undertakings such as retail service stations.

During the period under review, the ERB held 12 hearings out of the 45 major complaints that required extensive investigation representing 26.7 percent. The other 33 were investigated and resolved without any hearings.

5.1.2 Service charter

During the period under review, the ERB service charter was implemented. The charter outlines the service level agreements that aim to enhance operational efficiency of matters that affect stakeholders. Under the charter, all processes have been assigned timelines in which a service must be concluded. The charter is a public document and is accessible by all stakeholders. Appendix 10 presents details of the charter.

Appendix 1: Petroleum Value Chain



Appendix 2: Cost-Plus Pricing Model

The Wholesale Price Build up

The ERB uses the CPM to determine the wholesale price of all the refined products at INDENI and the pump prices for petrol, diesel, low sulphur gasoil and kerosene. In arriving at these prices, the model takes into account 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 NFT where the product is stored and sold. The Table below shows the different cost elements up to the wholesale price.

Cost elements upto the wholesale price

No.	COST ELEMENT	UNIT COST	BASIS
1.	Cost-Insurance-Freight (US$/MT)		Contract/Supplier Invoice
2.	Ocean Losses	0.30%	Best Practice
3.	Wharfage	1.25%	Tanzanian Harbour Authority
4.	Finance Charges	4.00%	Financier
5.	Collateral Manager (US$/MT)	0.39	Stock Monitoring Agreement
6.	Insurance	0.15%	Insurer
7.	TAZAMA Storage Fee (US$/MT)	2.00	TAZAMA
8.	TAZAMA Pumping Fee (US$/MT)	54.00	Approved ERB Pumping Tariff
9.	TAZAMA pipeline consumption and losses	1.48%	Determined by ERB
10.	Agency Fee (US$/MT)	5.00	Agency Agreement
11.	Refinery Fee (US$/MT)	60.38	Approved ERB Processing Fee
12.	Refinery Consumption and Processing Losses	9%	Determined by ERB
13.	Terminal Losses (LPG, Petrol, Diesel/Kerosene/Jet A-1/ HFO, respectively)	1%, 0.5%, 0.3%	Best Practice

The cost elements of the wholesale price build-up are discussed below.

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, Tanzania. The quantities of the constituent components of the petroleum feedstock, which include Crude Oil, Condensate, Naphtha and Gas oil, are multiplied by the unit costs to derive the total monetary cost of the feedstock.

The information is obtained from the supplier's invoice which is based on the contract between GRZ and the oil supplier and ultimately used to compute a profitability statement.

ii. Ocean losses

The 0.3 percent ocean loss is based on international best practice. This is the acceptable loss incurred during loading and offloading of petroleum feedstock and petroleum products from a vessel.

iii. Wharfage

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

iv. Finance charges

A financing charge of 4 percent to cover the cost of financing the cargo, particularly the letter of credit (LC) costs, and the cost of refinancing for liabilities that remain un-discharged after payment has been effected through the LC.

v. Collateral management fees

Collateral management fees are set at US$0.39/MT. The financier employs the services of a collateral manager in order to secure their interests. The financier usually holds the petroleum feedstock and petroleum products as collateral, so the collateral manager has to manage the stocks. The basis for providing the fees is stipulated in the "Stock Monitoring Agreement" signed between the collateral manager, the financier and the Government agent.

vi. Insurance

The insurance cost is set at 0.15 percent of CIF. The insurance covers the cost of insuring the feedstock from the Dar-es-Salaam to Ndola.

vii. TAZAMA storage fee

TAZAMA charges US$2/MT/month 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 charge was agreed upon between TAZAMA and the Government.

viii. TAZAMA pumping fee

TAZAMA charges US$54.00/MT to the importer for transporting petroleum feedstock through the pipeline from the Dar-es-Salaam tank farm to the refinery in Ndola.

ix. TAZAMA pipeline consumption and losses

Consumption and losses for TAZAMA are currently set at 1.48 percent. The losses comprise consumption at 0.83 percent based on the consumption level of 10 litres/MT of petroleum feedstock for the pumping engines at the pumping stations and allowable losses at 0.65 percent.

x. Agency fee

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

xi. Processing fee

INDENI charges a processing fee of US$60.38/MT for refining (processing) petroleum feedstock. This fee is approved by the ERB on the basis of licensees' revenue requirement.

xii. Refinery consumption and losses

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

i. Normal processing losses; and

ii. Consumption, as some quantities are consumed as fuel in the process.

The consumption and losses are set at 9 percent; that is, 8.4 percent relates to consumption with the balance of 0.6 percent relating to losses.

xiii. Terminal losses

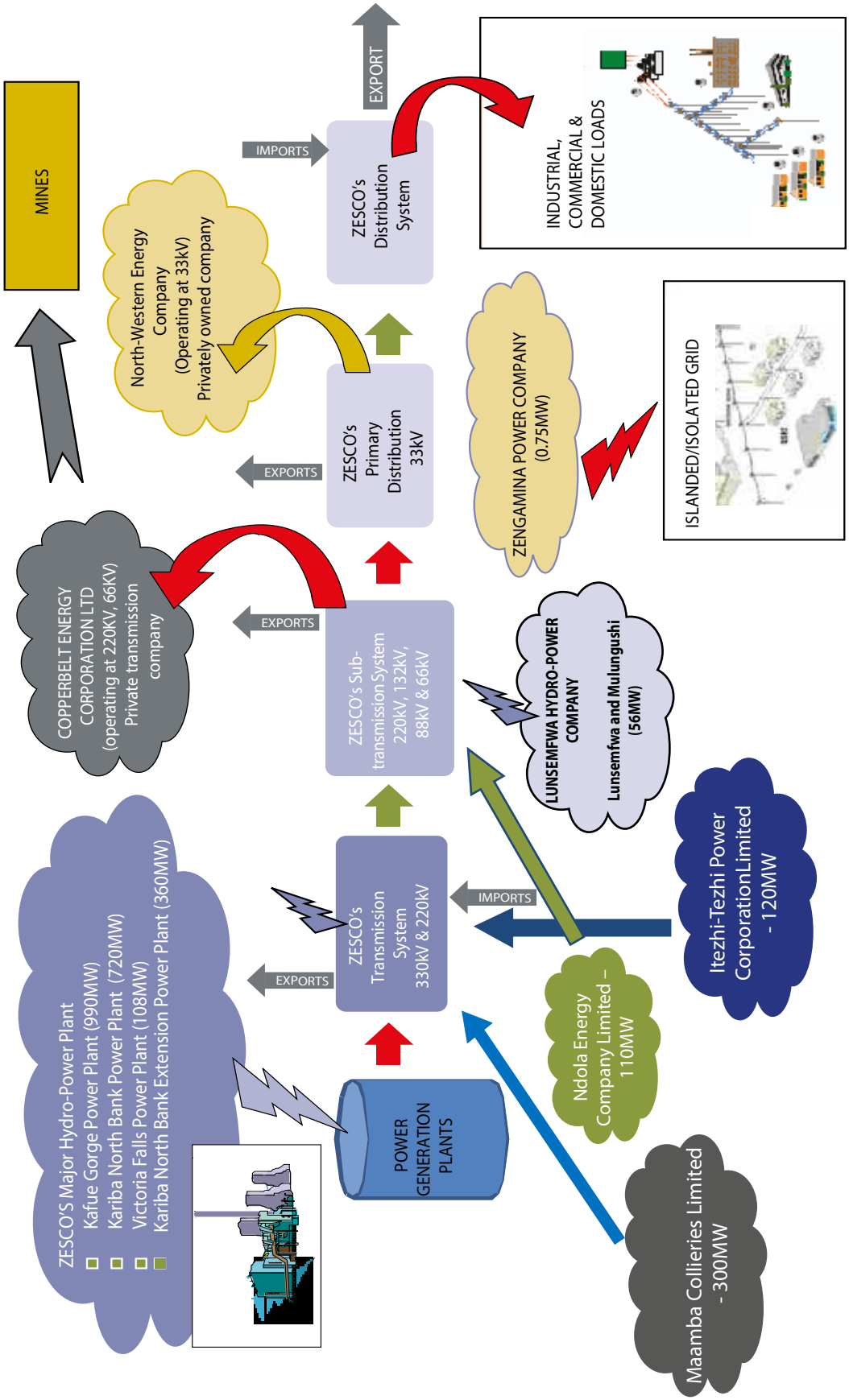
These are terminal losses as prescribed by international norms and best practice. A loss level of 0.5 percent is allowed for petrol whilst a loss of 0.3 percent has been allowed for diesel, kerosene, jet A-1 and HFO covering handling and storage losses. A loss of 1 percent is provided for LPG.

The Retail Pump Price Build-up

The build-up to the retail pump price constitutes the terminal fee; respective statutory excise duty on the different products; the OMC, Dealer and transporters margins (as determined by the ERB); the ERB fees of 0.7 percent of turnover; the Strategic Reserves Fund (SRF) fees (for infrastructure development in the sector and procurement of strategic reserves); and Value Added Tax (VAT) on products. The Table below gives an outline of these costs up to the retail pump price, based on prices as at 31st December, 2017.

No.	DETAILS	UNIT COSTS	WORKINGS
1.	Wholesale price to OMC	K7.65, K7.40, K6.46 and K9.36 per litre each for petrol, diesel, kerosene and LSG, respectively.	**a**
2.	Terminal fee	K0.025/litre	**b**
3.	Marking fee	K0.10/litre	**c**
4.	Excise duty (incl.) road levy	K1.97 for Petrol/litre, K0.62/litre for Diesel and LSG, K0/litre for Kerosene	**d**
5.	Ex-NFT/fuel depot		**E=(a+b+c+d)**
6.	Transport cost	K0.26 for Petrol, K0.26 for Diesel, K0.09 for Kerosene and K0.26 for LSG	**f**
7.	OMC margin	K0.56/litre	**g**
8.	Total (Excluding VAT)		**h=(e+f+g)**
9.	Dealer margin	K0.38/litre	**i**
10.	Price to dealer		**j= (h+i)**
11.	ERB fees	0.7%	**k**
12.	SRF fees	K0.15/litre for Petrol, Diesel and Kerosene	**l**
13.	Price before VAT		**m=(j+k+l)**
14.	VAT	16%	**n**
15.	Uniform Pump Price	K12.97, K11.09, K7.82 and K13.38 per litre each for petrol, diesel, kerosene and LSG, respectively.	**o=(m+n)**

Appendix 3: Structure of Electricity Supply Industry in Zambia



Appendix 4: National Installed Electricity Generation Capacity in 2017

Licencee	Station	Machine Type	Installed Capacity (MW)
ZESCO Limited Generation Plants	Kafue Gorge	Hydro	990
	Kariba North Bank	Hydro	720
	Kariba North Bank Extension	Hydro	360
	Victoria Falls	Hydro	108
	Lunzua	Hydro	14.8
	Lusiwasi	Hydro	12
	Chishimba Falls	Hydro	6
	Musonda Fals	Hydro	10
	Shiwang'andu	Hydro	1
Itezhi-Tezhi Power Corporation	Itezhi-Tezhi	Hydro	120
Zengamina Generation Plant	Ikelengi	Hydro	0.75
Lusemfwa Generation Plants	Mulunguish	Hydro	32
	Lunsemfwa	Hydro	24
	Total Hydro		**2,398.55**
Maamba Collieries Limited	Maamba Power Plant	Coal	300
	Total Coal		**300**
Copperbelt Energy Corporation Plc Generation Plants	Bancroft	Diesel	20
	Luano	Diesel	40
	Luanshya	Diesel	10
	Mufulira	Diesel	10
ZESCO Limited Generation Plants	Kabompo	Diesel	2.00
	Zambezi	Diesel	1.9
	Mufumbwe	Diesel	0.8
	Luangwa	Diesel	2.6
	Lukulu	Diesel	0.5
	Chavuma	Diesel	0.8
	Total Diesel		**88.60**
Ndola Energy Company Limited Generation Plants	Ndola	Heavy Fuel Oil	110
	Total HFO		**110**
Rural Electrification Authority Generation Plants	Samfya	Solar	0.06
	Total Solar		**0.06**
	Grand Total		**2,897.21**

Appendix 5: ZESCO Key Performance Indicators in 2017

No.	KPI and Weight ()	Sub KPI	Target	Actual Performance	Comment
1.	**Metering Customer (10)**	Quotation Time	ZESCO is required to issue quotations for all types of connections within 30 days from the date of application;	Quotations were issued within 11 days on average.	Target achieved
		Connection Time	ZESCO is required to make standard residential connection to supply within 30 days upon payment	Standard connections were done within 16 days on average.	
		Customer Metering Percentage Score **10** **Indicator was fully achieved**			
2.	**Cash Management (20)**	Mining Customers debtor days	ZESCO is required to reduce mining days to not more than 60 days.	ZESCO's mining debtor days stood at 312 days as at 31st December 2017.	Target not achieved
		Export Customer debtor days	ZESCO is required to reduce export debtor days to not more than 60	ZESCO's export debtor days stood at 283 days as at 31st December 2017.	Target not achieved
		Domestic Customer Debtor Days	ZESCO is required to reduce domestic (residential, commercial and maximum demands customers) debtor days to not more than 60 days	ZESCO's domestic debtor days stood at 79 days as at 31st December 2017.	Target not achieved
		GRZ Customer Debtor Days	ZESCO is required to reduce GRZ debtor days to not more than 90 days.	ZESCO's GRZ debtor days stood at 571 days as at 31st December 2017.	Target not achieved
		Cash Management Percentage Score **6.5** Despite not meeting the set targets, however, the utility has made improvements in reducing the debtor days from a high of 907 days to 312 days at end of December 2017. A score was awarded for recognizing effort made in reducing the debtor days			
3.	**Staff Productivity (15)**	Corporate Customer-Employee Ratio	ZESCO is required to maintain a Corporate customer-employee ratio of 100:1 or better.	ZESCO achieved a Corporate Customer-employee annual average ratio of 84:1.	Target not achieved
		Lusaka Division Customer-Employ ratio	ZESCO is required to maintain a Lusaka Division customer-employee ratio of 100:1 or better.	ZESCO achieved a Lusaka Division customer-employee annual average ratio of 136:1.	Target achieved
		Copperbelt Division Customer-Employ ratio	ZESCO is required to maintain a Copperbelt Division customer-employee ratio of 100:1 or better.	ZESCO achieved a Copperbelt Division customer employee annual average ratio of 122:1.	Target achieved

No.	KPI and Weight ()	Sub KPI	Target	Actual Performance	Comment
		Northern Division Customer-Employ ratio	ZESCO is required to maintain a Northern Division customer-employee ratio of 75:1 or better.	ZESCO achieved a Northern Division customer-employee annual average ratio of 84:1.	Target achieved
		Southern Division Customer-Employ ratio	ZESCO is required to maintain a Southern Division customer-employee ratio of 100:1 or better.	ZESCO achieved a Southern Division customer-employee annual average ratio of 101:1.	Target achieved
		Staff Costs	ZESCO is required to Reduce staff costs to 30 or less as a share of total operations and maintenance costs (O&M).	ZESCO's annual staff costs stood at 29 of total annual O&M costs.	Target achieved
		Staff productivity Percentage Score Indicator was not fully achieved.			**10**
4.	**Quality of Service Supply (20)**	**SAIDI**[13]	ZESCO is required to maintain an annual System Average Interruption Duration Index (SAIDI) of 32 hours or less.	ZESCO recorded annual average SAIDI of 47.5 hours per custome	Target not achieve
		SAIFI[14]	ZESCO is required to maintain the System Average Interruption Frequency Index (SAIFI) of 5.25 times or less.	ZESCO recorded annual average SAIFI of 4.4 times.	Target achieved
		CAIDI[15]	ZESCO is required to maintain the Customer Average Interruption Duration Index (CAIDI) at 6 hours or less	ZESCO recorded annual average CAIDI of 10.7 hours.	Target not achieved
		ASAI[16]	ZESCO is required to maintain the Average System Availability Index (ASAI) at 90 or better.	ZESCO recorded quarterly average ASAI of 93.4.	Target achieved
		Quality of Service Percentage Score Indicator was not fully achieved.			**9**
5.	**System Losses (10)**	Transmission Losses	ZESCO is required to maintain transmission losses at 6 or better.	ZESCO recorded annual average transmission losses of 5.5.	Target achieved
		Distribution Losses	ZESCO is required to maintain distribution losses at 12 or better.	ZESCO recorded annual average distribution losses of 11.25.	Target achieved
		System Losses Percentage Score Indicator not fully achieved			**9**

[13] SAIDI refers to the average outage duration for each customer served.
[14] SAIFI refers to the frequencies of interruptions per customer.
[15] CAIDI refers to the average duration of a power supply outage.
[16] ASAI refers to availability of a given power system.

No.	KPI and Weight ()	Sub KPI	Target	Actual Performance	Comment
6.	**Power Generation (10)**	Unit capability factor (UCF)[17] for large hydro plants	ZESCO is required to maintain a generation UCF for large hydro power plants at 80 or better.	ZESCO recorded annual average UCF of 85 for large hydro power plants.	Target achieved
		UCF for small hydro plants	ZESCO is required to maintain a generation UCF for mini hydro power plants at 60 or better.	ZESCO recorded annual average UCF of 86 for small hydro power plants.	Target achieved
		Power generation Score percentage Score Indicator fully achieved			**10**
7.	**Safety (5)**	Fatality	ZESCO is required to ensure that no fatalities are experienced on account of negligence.	ZESCO recorded nine (9) fatalities in 2017.	Target not achieved
		Lost time injury	ZESCO is required to ensure that no Life Threatening Injuries (LTIs) occur on account of negligence.	ZESCO recorded a total of 63 LTIs in 2017.	Target not achieved
		Safety Percentage Score Indicator was not achieved.			**0**
8.	**Customer Complaint Resolution (5)**	Complaint resolution rate	ZESCO is required to maintain a total customer complaint resolution rate of 90 or better for all reported complaints.	ZESCO recorded annual average customer complaint resolution rate of 98.	Target achieved
		Replacement of faulty meters	ZESCO is required to replace faulty meter within 5 days after a complaint is reported.	ZESCO recorded annual average duration of two (2) days for replacement of faulty meter.	Target achieved
		Customer complaints Percentage Score Indicator fully achieved.		**5**	
9.	**Equipment Failure (5)**	Distribution transformer replacement rate	ZESCO is required to maintain distribution transformers as a proportion of total number of distribution transformers in service/month at a rate of 0.1 or less.	ZESCO recorded annual average distribution transformer replacement rate of 0.2.	Target not achieved
		Meters replacement rate	ZESCO is required to replace meters as a proportion of total meters in service at a rate of 0.25 or less.	ZESCO recorded annual average meters replacement rate of 0.0.	Target achieved
		Equipment Failure Percentage Score Indicator was not fully achieved			**3**
Total Annual Percentage Score			**63**		

17 UCF refers to the ratio of actual to potential output of a given power plant.

Appendix 6: Key Performance Indicators for Non-State Owned Enterprises

No	Licencee	Applicable KPI	Target (%)	Performance Score (%)
1	NECL	Unit Capability Factor	50	69.0
		Safety (LTI)	0	0
		Safety (Fatalities)	0	100
2	CEC	System Losses		2.3
		Quality of Service (Transmission)	95	99.0
		Quality of Service (Distribution)	85	99.5
		Safety (LTI)	0	0
		Safety (Fatalities)	0	100
3	MCL	Unit Capability Factor	50	48.4
		Safety (LTI)	0	0
		Safety (Fatalities)	0	100
4	LHPC	Unit Capability Factor	80	64.6
		Safety (LTI)	0	0
		Safety (Fatalities)	0	100

Appendix 7: Major power supply interruptions, 2017

No.	Date	System Minutes	Description
1.	14th February 2017, 17:19hrs	1.55	System disturbance occurred at 17:19hrs when the 330kV Luano – Kansanshi line tripped on distance impedance zone 1 on all phases resulting in load loss of about 208 MW.
2.	19th February 2017, 19:27hrs	2.0	System disturbance occurred at 19:27hrs when the 330kV Nambala – Kalumbila line tripped on distance impedance zone 1 resulting in loss of about 115MW load on the system due shut-down of the Kalumbila substation.
3.	26th February 2017, 04:06hrs	7.35	System disturbance observed on the system at 04:06hrs resulting in loss of load on Under Frequency Protection. Frequency dropped to a minimum of 48.67Hz and the estimated load lost was 176MW. The disturbance was due to the trip of the 400kV Matimba (Eskom) – Phokoje (BPC) Interconnector.
4.	12th March 2017, 00:30hrs	1.62	System disturbance occurred at 00:30hrs when the 330kV Nambala – Kalumbila line tripped on distance impedance zone 1 resulting in loss of about 126MW load on the system due to loss of the Kalumbila substation.
5.	22nd March 2017, 18:18hrs	6.55	System disturbance on the system at 18:18hrs resulting in loss of load on the Copperbelt and the North-Western Province on Over-Voltage Protection. Frequency dropped to a minimum of 48.67Hz resulting in estimated load lost on the system of 356MW. The disturbance was attributed to the trip of the 220kV Luano – Michelo line on differential protection on the CEC networks. The CEC – SNEL interconnector tripped and locked out resulting in high voltages on the Copperbelt and North-Western networks.
6.	19th April 2017, 14:19hrs	8.6	System Disturbance experienced after trip of the CEC 66kV Maposa – Refinery lines 1 and 2 and Maposa – Dola Hill line. The disturbance was as a result of fault on the NECL – Refinery line and the Refinery 66kV busbar. The NECL Phase 1 and 2 plants tripped out (102.5MW).
7.	24th April, 2017, 18:18hrs	5.02	System disturbance occurred when the 88kV Kafue Town – Mazabuka line tripped on distance Impendance and resulted in loss of about 45.4MW load in Mazabuka.
8.	29th April, 2017, 22:44hrs	5.35	System disturbance occurred at 22:44hrs when at Kafue Gorge Unit 2 tripped out on cylinder gate closed indication and resulted in estimated generation loss of 155MW.
9.	03rd May, 2017, 00:51hrs	1.07	System disturbance occurred at 00:51hrs when at Itezhi- Tezhi Unit 2 tripped out to turbine bearing low oil level indication and resulted in loss of about 54MW generation on the system.
10.	07th May, 2017, 06:29hrs	13.78	System disturbance occurred at 06:29hrs when at MCL Unit 1 tripped out due to frequency excursions after separating the southern grid from the main grid at Mazabuka substation.
11.	14th May, 2017, 11:07hrs	30.9	System disturbance occurred at 11:07hrs after trip of the Luano 330kV Kansanshi line due to fault on Lumwana busbar isolator 116 resulting in estimated load loss of 360MW.

12.	09th June, 2017, 16:58hrs	3.3	System disturbance occurred at 16:58hrs after trip of C-Station at Victoria Falls Power Station on a spurious flood gate detection protection resulting in loss of 40MW generation on the system.
13.	02nd August 2017, 16:25hrs	External Disturbance – No load lost on the IPS	External system disturbance was experienced at 16:25hrs due to the trip out of the Michelo 1 and 2 and Luano – 220kV Karavia lines on Directional Over Power. The system disturbance was caused by the trip out of the Kolwezi HVDC Convertor in the SNEL network.
14.	03rd August 2017, 15:28hrs	0.214	System disturbance was experienced at 15:28hrs due to the trip out at Lumwana 330/33kV substation of 33kV mine feeders 1 and 2 on under voltage protection. The 33kV busbar voltage was 33.74kV just before trip out. The two feeders were carrying a total of 32MW.
15.	06th August 2017, 12:54hrs	External Disturbance – No load lost on the IPS	External system disturbance was experienced at 12:54hrs resulting in power swings on the CEC - SNEL interconnector. Power flows on this interconnector increased from 84MW to 259MW exports and changed to 121MW imports and finally settled at 90MW exports at 12:59hrs. The system disturbance was caused by the loss of load in the SNEL network.
16.	22nd August 2017, 18:30hrs	5.16	System disturbance occurred at 18:30hrs. The disturbance was caused by the tripping of 33kV Barlastone Feeders 1 and 2 at Lusaka West substation on over current and earth fault protection. This was as a result of a cut yellow phase jumper at Barlastone substation on 33kV Matero line and an estimated load of about 60MW was lost
17.	28th August 2017, 11:41hrs	1.37	System disturbance occurred at 11:40 hrs when Skyways – 66/33kV CEC transformers T1, T2 and T3 tripped on over current and earth fault. NECL phase 1 units also tripped on over current.
18.	13th September 2017, 13:23hrs	18.85	A system disturbance occurred at 13:23hrs. The disturbance was caused by the tripping of 330kV Kariba North – Leopards Hill line 2 on differential and distance protection with fault location of 20km from Kariba North end. Line isolated for inspections and estimated load of 78MW was shed at evening peak and CEC and NamPower imports and SNEL exports were suspended.
19.	26th October 2017, 02:15hrs	2.34	A system disturbance occurred at 02:15hrs. The disturbance was caused by the tripping of 88kV Leopards Hill – Water works 1 and 2 on overcurrent and earth fault protection indication. The fault was caused by a blown 33kV UTH circuit breaker and an estimated load of 40MW was lost.

20.	27th October 2017, 02:36hrs	Load loss on the customer's side	System disturbance observed at 02:36hrs with loss of load at Kalumbila Mines of about 120MW. The fault was suspected to be on the mine side.
21.	9th November 2017, 10:15hrs	No load lost on the IPS	System disturbance was observed at 10:15hrs. The ZESCO-ZETDC tie line experienced power swings, from 201MW import to 351MW import and then to 10MW export before stabilising at about 106MW import.
22.	11th November 2017, 13:58hrs	1.83	System disturbance occurred; caused by suspected lightning strike on the 33kV mine feeders at Kansanshi substation. ▪ Kansanshi, Lumwana and Kalumbila mines lost about 293.5MW of load while 331.2MW was lost on the IPS. ▪ The ZESCO - ZETDC tie line went from 258.7MW import to 32.5MW export. ▪ The interconnected power system then experienced over voltages, the voltage at Kitwe substation rising from 316KV to 332.8kV. ▪ SO re-dispatched power station active and reactive power production levels and compensating equipment for tie line power flow and voltage control.
23.	12th November 2017, 19:54hrs	5.72	The IPS experienced a system disturbance as a result of the tripping of the Luano - 220kV Karavia line 2. ▪ CEC, Kansanshi, Lumwana and Kalumbila mines lost 476.6.5MW of load. ▪ SO re-dispatched generation and compensating equipment for Tie line power flow and voltage control.
24.	20th November 2017, 19:54hrs	No load lost on the IPS	System disturbance was observed on the IPS as result of the loss in generation in ZESA at Hwange. ▪ Power swings from 73.1MW import to 144.7MW export on ZESCO – ZESA tie lines observed with resulting frequency drop from 49.96Hz to 48.75Hz. ▪ At the time of the disturbance, the ZESCO and ZESA power systems were off parallel with ESKOM.
25.	21st November 2017, 05:11hrs	No load lost on the IPS	System disturbance was observed on the ZESCO – ZESA tie line experiencing power swings from 105.7MW import to 233.6MW export. The frequency dropped from 49.74Hz to 49.63Hz. ▪ This was due to loss on generation in ZESA control area at Hwange Power station. ▪ There was no loss of load on the IPS. ▪ At the time of the disturbance, the ZESCO and ZESA control areas were off parallel with ESKOM.

26.	24th November 2017, 08:10hrs	2.41	System disturbance occurred on the IPS with the ZESCO - ZESA tie line experiencing power swings of above 420 MW. ▪ The frequency rose from 50.00Hz to 50.14Hz. ▪ The IPS experienced an overvoltage condition with voltage at Kitwe substation rising from 319.4kV to 352.7kV. ▪ A total of 435.7MW of load was lost on CEC network. ▪ SO re-dispatched power station reactive power production levels and compensating equipment for system voltage control.
27.	28th November 2017, 16:35hrs	8.24	System disturbance occurred on the IPS with ZESCO - ZESA tie line experiencing power swings from 217.7MW import to 188.4MW export. ▪ The frequency rose from 49.88Hz to 50.14Hz. ▪ The IPS then experienced overvoltage conditions with the voltage at Kitwe substation rising from 319.4kV to 352.7kV. ▪ This was due to loss of 290.7MW of load on the CEC network after the tripping of the Luano - 220kV COSAK line. ▪ ZESCO lost about 115.4MW of load on overvoltage.
28.	03rd December 2017, 16:36hrs	No load lost on the IPS	System disturbance occurred on the IPS with the ZESA tie line experiencing a power swing from 320.6MW import to 74.3MW import. ▪ This resulted in an over voltage condition at Kitwe substation which rose from 320.6kV to 327.8kV and a subsequent tripping of the 220kV Maposa-Frontier line on the CEC network. ▪ SO re-dispatched power station reactive power production levels and compensating equipment for system voltage control.
29	4th December 2017, 15:44hrs	0.34	System disturbance occurred on the IPS caused by the tripping of 220kV Luano - Michelo line on the CEC network. ▪ The IPS lost 237MW of load and experienced an overvoltage condition, with voltages at Kitwe rising from 306kV to 334kV. ▪ The frequency went up from 49.97Hz to 50.21Hz. ▪ SO re-dispatched power station reactive power production levels and compensating equipment for system voltage control.

30.	28th December 2017 15:37hrs	7.89	System disturbance occurred on the IPS caused by a bus bar fault on the CEC network at Avenue 66kV substation. ▪ The IPS lost 655.5MW of load and experienced an overvoltage condition, with voltage at Kitwe rising from 316kV to 346kV. ▪ Frequency increased from 50.11HZ to 50.38HZ. ▪ ZESA tie line experienced a power swing from 195.6MW import to 419.1MW export. ▪ SO re-dispatched power station active and reactive power production levels as well as compensation equipment on the system to normalize the tie line power flows and system voltages.

Appendix 8: Electricity Tariff Adjustment in 2017

CUSTOMER CATEGORY		Current tariffs	New Tariff 15th May 2017	New Tariff 1st Sept 2017
1.METERED RESIDENTIAL(Prepaid) (capacity 15 kVA)				
R1 -Consumption up-to 200kWh in a month	Energy charge/kWh)	0.15	0.15	0.15
R2 - Consumption above 201 kWh in a month	Energy charge/kWh)	0.51	0.77	0.89
	Fixed Monthly Charge	18.23	18.23	18.23
2.COMMERCIAL TARIFFS (capacity 15kVA)				
Commercial	Energy charge/kWh)	0.31	0.47	0.54
	Fixed Monthly Charge	55.09	82.64	96.41
3.SOCIAL SERVICES				
Schools, Hospital, Orphanages, churches, water pumping & street lighting	Energy charge K/kWh	0.28	0.42	0.49
	Fixed Monthly Charge	47.91	71.87	83.84
4.MAXIMUM DEMAND TARIFFS				
MD1- Capacity between 16 - 300 kVA	MD Charge (K/kVA/Month)	13.97	20.96	24.45
	Energy Charge (K/kWh)	0.2	0.30	0.35
	Fixed Monthly Charge (K/Month)	136.82	205.23	239.44
	Off Peak MD Charge (K/KVA/Month)	6.98	10.47	12.22
	Off Peak Energy Charge (K/kWh)	0.15	0.23	0.26
	Peak MD Charge (K/KVA/Month)	17.46	26.19	30.56
	Peak Energy Charge (K/kWh)	0.25	0.38	0.44
MD2- Capacity 301 to 2,000 kVA	MD Charge (K/kVA/Month)	26.13	39.20	45.73
	Energy Charge (K/kWh)	0.17	0.26	0.30
	Fixed Monthly Charge (K/Month)	273.62	410.43	478.84
	Off Peak MD Charge (K/KVA/Month)	13.07	19.61	22.87
	Off Peak Energy Charge (K/kWh)	0.13	0.20	0.23
	Peak MD Charge (K/KVA/Month)	32.67	49.01	57.17
	Peak Energy Charge (K/kWh)	0.21	0.32	0.37
MD3- Capacity 2,001 to 7,500kVA	MD Charge (K/kVA/Month)	41.75	62.63	73.06
	Energy Charge (K/kWh)	0.14	0.21	0.25
	Fixed Monthly Charge (K/Month)	579.74	869.61	1,014.55
	Off Peak MD Charge (K/KVA/Month)	20.87	31.31	36.52
	Off Peak Energy Charge (K/kWh)	0.1	0.15	0.18
	Peak MD Charge (K/KVA/Month)	52.19	78.29	91.33
	Peak Energy Charge (K/kWh)	0.17	0.26	0.30
MD4-Capacity above 7500kVA	MD Charge (K/kVA/Month)	41.98	62.97	73.47
	Energy Charge (K/kWh)	0.12	0.18	0.21
	Fixed Monthly Charge (K/Month)	1,159.50	1,739.25	2,029.13
	Off Peak MD Charge (K/KVA/Month)	20.99	31.49	36.73
	Off Peak Energy Charge (K/kWh)	0.09	0.14	0.16
	Peak MD Charge (K/KVA/Month)	52.48	78.72	91.84
	Peak Energy Charge (K/kWh)	0.14	0.21	0.25
NOTE; The above tariffs are:-				
(a) Exclusive of 3% Government excise duty				
(b) Exclusive of 16% Value Added Tax (VAT)				

Appendix 9: Complaints Handling Procedure

Type of complaint	Time-frames for resolving the complaint
Complaints in the electricity sub-sector	
Connection to Supply	5 – 30 working days, depending on nature of works prescribed under Zambian Standard (ZS) 397
Unplanned Interruptions	Up to 48 hours
Billing	10 working days
Faulty Meters	15 working days
Poor Voltage	30 working days
Disconnection	Within 24 hours after payment of outstanding bill
Wrong Tariffs	30 working days
Compensation Claims	60 working days
Other Complaints	Up to 30 working days
Complaints in the petroleum sub-sector	
Pump prices (Fuel price per litre)	Up to 48 hours
Poor Quality of Fuel	30 working days

Appendix 10: Service Charter

No.	Service Commitment	Standard of Service
	Issue invoice for license application fees	**23** working days
	Issue Provisional License for all license applications	**7** working days
	Issue Standard License for all license applications	By the last day of the quarter
	Issue Construction License	**10** working days
	Advise ZEMA on project brief	**22** working days
	Produce incident and accident investigation report	**8** working days
	Conclude review of electricity tariff applications	**90** working days
	Publish petroleum industry statistics	**Every 30th** day
	Pay suppliers for all supported invoices	**30** working days
	Refund OMCs Uniform Pump Price	**10** working days of Ministry of Energy instruction.
	Publish annual procurement plan on the website	Every January
	Resolve consumer complaints	**22** working days
	Convene hearing for unresolved complaints	By the last day of the quarter
	Communicate ERB position on complaint	**2** working days
	Answer toll free line calls	Within 1 minute of receipt
	Resolve toll free line disruptions	**2** days
	Attend to clients at the reception	**5** minutes
	Complete recruitment process	**60** working days

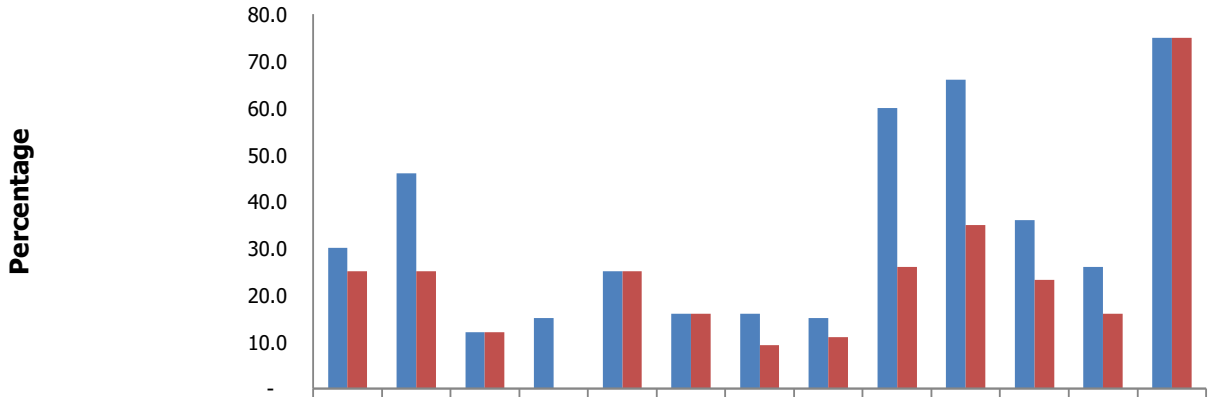
Annex 1: Import of Petroleum Feedstock, 2016-2017

Cargo name	Month	Tonnage (metric tonnes)
MT. Argos	March 2016	90,000.00
MT. Signal Puma	May 2016	92,569.00
MT. Afra Oak	June 2016	93,970.00
MT. Leyla K.	September 2016	102,330.06
MT. Desh Mahima	December 2016	105,018.00
Total		**483,887.06**
MT. Desh Mahima II	March 2017	105,506.22
MT. Desh Garima	May 2017	104,802.36
MT. Desh Mahima III	July 2017	105,094.44
MT. Desh Garima II	September 2017	102,129.44
MT. Desh Garima III	December 2017	102,610.90
Total		**520,143.36**

Annex 2: Retail Service Station Network in 2017

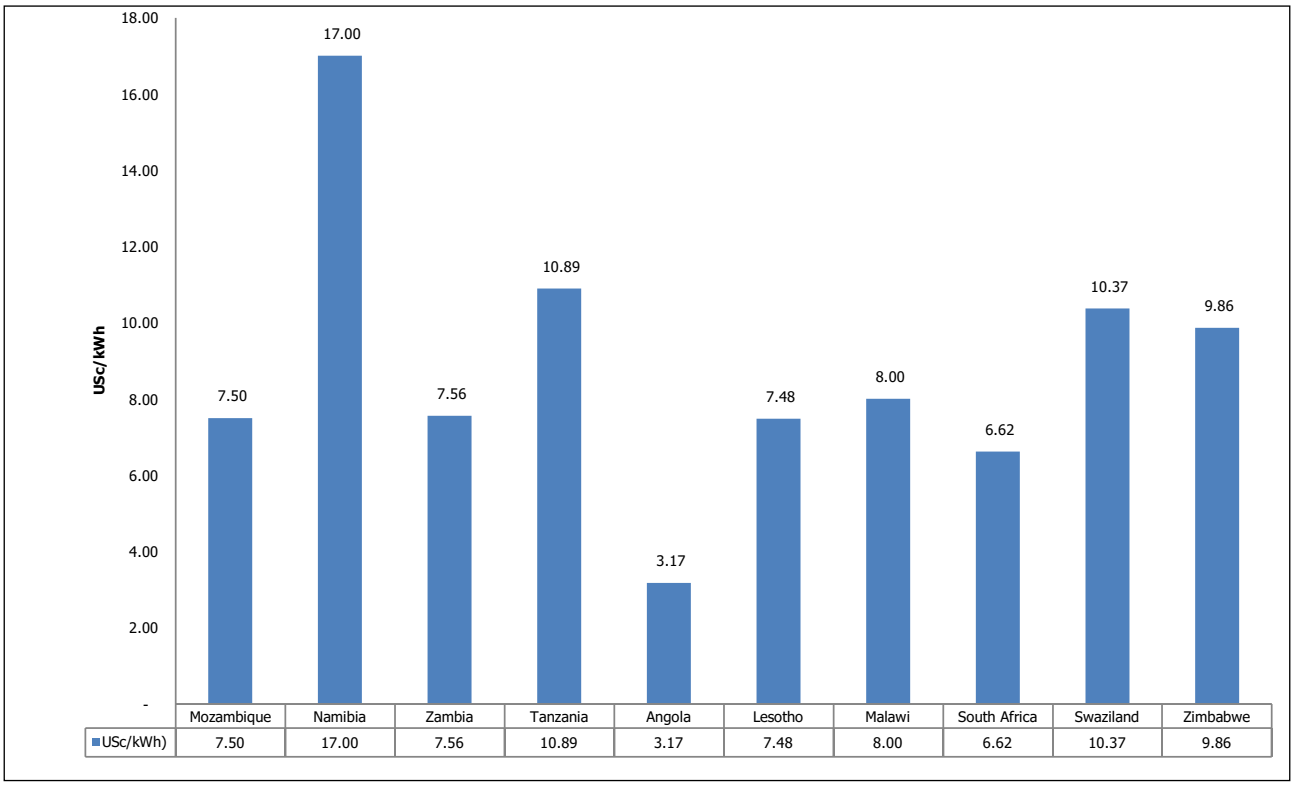
Company	Central	Copperbelt	Eastern	Luapula	Lusaka	Muchinga	orth Weste	Northern	Southern	Western	Total
ALPHA ENTERPRISES	2					1					**3**
ATLAS PETROLEUM COMPANY LIMITED		1		1							**2**
COLLUM LUNM TIAN LIMITED					1						**1**
ECO PETROLEUM LIMITED		3				1					**4**
ENGEN PETROLEUM	1	6	1		19			2	3		**32**
KOBIL (Z) LIMITED	3	6	3		9				5	1	**27**
LAKE PETROLEUM LTD	3	9			3		1				**16**
LBM INVESTMENT LIMITED				1		1		2			**4**
LUAPULA OILS LIMITED				1							**1**
LUSHOMO	1										**1**
MOUNT MERU PETROLEUM (Z) LTD	2	6	2	1	15	1	1		3		**31**
NGUCHA ENERGY CORPORATION LTD				2	3						**5**
OASIS OIL ZAMBIA			4								**4**
ORYX OIL ZAMBIA LTD		5	2	1	2				2		**12**
PETRODA ZAMBIA LTD		5			12		1				**18**
PETROLINK LIMITED							1				**1**
PUMA ENERGY ZAMBIA PLC	3	16	5	1	19	1	2	1	6	3	**57**
RAVASIA PETROLEUM LTD					1						**1**
SABOT ZAMBIA LTD								1			**1**
SAMFUEL LIMITED	2	6			1						**9**
SGC INVESTMENTS		12	2		8	1	1	1	2		**27**
SPECTRA OIL ZAMBIA					3						**3**
STAR OIL COMPANY LTD		1									**1**
SUBAN PETROLEUM (Z) LTD		3			1	1				1	**6**
TOTAL (Z) LTD	7	15	1	1	19	2	2	1	3	1	**52**
TRIBUTE INVESTMENTS LIMITED							1				**1**
U-FUEL ZAMBIA LTD	1										**1**
WADA CHOVU (Z) LTD		2									**2**
ZACKS HARDWARE LTD					1	1					**2**
ZAF CUSA	1										**1**
REFUEL PETROLEUM LIMITED										1	**1**
QUALITY PETROLEUM					1						**1**
OIL BAY	1										**1**
LUKULU FILLING STATION										1	**1**
ENDRONE PETROLEUM							1		1		**2**
CHEEKA							1				**1**
Grand Total	**27**	**96**	**20**	**9**	**118**	**10**	**12**	**8**	**25**	**8**	**333**

Annex 3: Zambia's Average Electricity Tariffs Adjustment, 1998-2017



	Jan-1998	Oct-1998	Apr-1999	Oct-1999	Apr-2000	Oct-2000	Jan-2003	Apr-2005	Dec-2007	Jul-2009	Jul-2010	Jul-2014	May-2017
Average % Applied for	30.0	46.0	12.0	15.0	25.0	16.0	16.0	15.0	60.0	66.0	36.0	26.0	75.0
Average % Approved	25.0	25.0	12.0	-	25.0	16.0	9.3	11.0	26.0	35.0	23.2	16.0	75.0

Annex 4: SADC Average Electricity Tariffs (Us Cents/Kwh) as at December 2017



	Mozambique	Namibia	Zambia	Tanzania	Angola	Lesotho	Malawi	South Africa	Swaziland	Zimbabwe
USc/kWh)	7.50	17.00	7.56	10.89	3.17	7.48	8.00	6.62	10.37	9.86

Annex 5: Licencing procedure

The following are the steps under the current licensing procedures:

1. Once an Applicant submits a licence application, the Legal Department assesses the application to determine whether the activity applied for is one that requires licensing under the Energy Regulation Act, Chapter 436 and the Electricity Act, Chapter 433 of the laws of Zambia;
2. Upon being satisfied that an application has been duly lodged and that the activity applied for is one authorized by the relevant legislation, the application is forwarded to the Directorate of Technical Regulation for a technical assessment and the Directorate of Economic Regulation for a financial assessment;
3. Where an application is not duly lodged or the activity applied for is not regulated by the ERB, the Applicant is informed in writing of any additional information required or that the activity applied for is not subject to regulation;
4. Where an application has been forwarded to the Directorate of Technical Regulation, a technical assessment of the application is carried out by way of inspection of the Applicant's energy facility in order to determine whether or not the Applicant is technically capable of carrying out the activity applied for;
5. In an event that the technical assessment of an application is not successful, the Applicant is notified of the technical anomalies of the energy facility inspected which need to be addressed;
6. It is worth noting that the purpose of a financial assessment of a licence application is to determine the financial capability of the Applicant to carry out the licensed activity and to determine the licence application fee for the activity applied for;
7. The application is, where a financial assessment is successful, subsequently referred to the Executive Director for approval of the assessment/ application fee;
8. After the Executive Director approves the assessment/application fee, the application is submitted to the Director of Finance who causes an invoice to be issued to the Applicant;
9. Once an invoice is issued, the Applicant is notified in writing of the licence application fee to be paid to the Ministry of Finance – Energy Regulation Board Revenue Account within 14 days of the date of receipt of the invoice;
10. Upon payment of the application fee, a search to verify the shareholding structure and status of registration is conducted at the Patents and Companies Registration Agency.
11. Administratively, the Applicant will be issued with a Provisional Licence upon payment of the license assessment fees.
12. Thereafter, a Notice of Intention to Issue a Licence for the Executive Director's approval is prepared and once approved, the Notice is published in the GRZ Gazette for thirty (30) days inviting members of the public to present objections (if any) to the issuance of a licence to the listed Applicants; and
13. In the event that there are no objections to the licence application gazetted, the Board approves the issuance of a standard licence to the Applicant and the Board decision to issue or not to issue a licence is communicated to the Applicant within 14 days of the date of the Board decision.

ENERGY
REGULATION
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