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# SECTOR REFORM AND UTILITY COMMERCIALIZATION (SRUC)

## Background Report on Zambia's Power Sector: Utility Performance & Loss Reduction

June 2015

This publication was produced for review by the United States Agency for International Development. It was prepared by Deloitte Consulting LLP.

# **SECTOR REFORM AND UTILITY COMMERCIALIZATION (SRUC) PROJECT**

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SECTOR REFORM AND UTILITY COMMERCIALIZATION  
(SRUC) PROJECT  
CONTRACT NUMBER: AID-OAA-TO-14-00006  
DELOITTE CONSULTING LLP

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## INTRODUCTION

USAID's **Sector Reform and Utility Commercialization Program (SRUC)** aims to enhance the financial viability and long term sustainability of developing countries' electricity systems, thereby enabling their expansion and establishing the necessary preconditions for clean energy investments.

USAID wishes to use the SRUC Task Order to provide support to the power sectors of Zambia, Mozambique and/or Namibia. In August 2015, USAID and SRUC advisors will carry out a scoping mission to each of the three countries to gain a more complete understanding of the current state of their respective electricity sectors. This scoping trip will provide information that can be used to design an effective SRUC technical assistance program that will reduce system losses and/or facilitate IPP program design and implementation.

This *Background Report* has been written to provide USAID and the SRUC team with easily accessible information prior to their departure on the scoping trip. The document provides insights into the Zambia power sector, focusing on recent and current efforts to improve utility performance and reduce losses. The Report is structured as follows:

- (a) Background information on the operations of the power sector, including any relevant information on technical and commercial losses, loss reduction analyses and strategies, previous approaches to slum and rural electrification and current thinking on best practices and areas of improvement in loss reduction activities.
- (b) To the extent desk research has allowed, detailed information on key performance indicators such as estimates for electricity access rates, technical and non-technical losses, collection rates and subsidies.
- (c) A review of other international donors' work in loss reduction in order to explore potential areas of collaboration, and reduce potential overlap.

Before this, we provide a little information on Zambia's economic profile. Throughout, the reader should note that the authors have not been able to confirm that all data and information included is accurate.

## OPERATIONS OF THE POWER SECTOR

### Economy & Population

Zambia is a Southern Africa Development Community (SADC) member state with a population of nearly 14 million people (5% of total SADC population), an average growth rate of 2.9% and a current urbanization rate of 3.2%. The population is 36% rural, with about 67% of the rural population living in extreme poverty. Economic growth in Zambia has been strong over the last decade, ranging between 6% and 10% between 2003 and 2013, driven by robust activities in the mining, agriculture, manufacturing, construction, transport and communications sectors. This represents a significantly stronger performance than the average growth posted by SADC countries. Estimated gross domestic product (GDP) in 2011 was US\$22.6 billion, translating to a per capita GDP of US\$1,600.<sup>1</sup> The main contributor of GDP is the service sector, which accounts for 70%, followed by the agriculture sector with 20% and the mining and manufacturing sector with 10% (African Economic Outlook (AEO), 2013).

The energy sector as a whole is dominated by biomass, making up over 80% of supply and 70% of demand.<sup>2</sup> While noting the country has several cross border power interconnects for

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<sup>1</sup> IRENA Renewables Readiness Assessment 2013.

[http://www.irena.org/documentdownloads/publications/rra\\_zambia.pdf](http://www.irena.org/documentdownloads/publications/rra_zambia.pdf)

<sup>2</sup> [http://www.irena.org/documentdownloads/publications/rra\\_zambia.pdf](http://www.irena.org/documentdownloads/publications/rra_zambia.pdf)

power wheeling in the region, petroleum is the only energy source imported into Zambia. The country has substantial unexploited reserves of hydropower, coal, and biomass.<sup>3</sup> Zambia has an estimated total hydro power capacity of around 6,000 MW, yet only 1,948 MW have been installed in the country to date. These power plants represent 94% of the total installed capacity, and 99% of the total electricity generated in the country.

Like most of Africa, Zambia is currently battling an electricity supply deficit and suffers very low electrification rates. Although higher than several of its SADC member peers, such as Malawi, Madagascar and DRC, only 22%<sup>4</sup> of Zambia's population has access to electricity in 2014, being 45% in urban and 10% in rural areas. Zambia hopes to reach 90% and 51% access by 2030 in urban and rural areas, respectively.<sup>5</sup>

## **Electricity Sector Structure & Key Participants**

The Zambian Ministry of Mines, Energy and Water Development (MEWD) is the ministry responsible for setting energy sector policy and providing guidance through one of its six departments, the Department of Energy. Within the Department of Energy there are three dedicated units of particular interest to this background report. This includes the Zambian Gender and Energy Network which is involved in the advancement of gender concerns in energy policy.<sup>6</sup> Also within the Department of Energy is the Office for the Promotion of Private Power Investors (OPPI), which works directly with private investors and seeks to provide support for the projects within the ministry.<sup>7</sup> Finally, the Energy Sector Advisory Group contains representatives from government ministries and authorities, development agencies, and commercial enterprises. The group works to encourage cooperation on energy policy, and provide expert opinion on energy matters to government officials involved in policy design<sup>8</sup>. The Rural Energy Authority (REA) also plays a role in developing policies and projects which expand access to electricity throughout the country.

The Energy Regulation Board (ERB) was created under the Energy Regulation Act of 1995, and is responsible for regulating all forms of energy, including electricity. The ERB regulates returns on investment for operators/utilities, the licensing of operators, the setting of tariffs and the monitoring of competition in the market. The ERB reports directly to the MEWD.

The Zambian electricity supply industry is composed primarily of three major players: ZESCO, the state owned vertically integrated generator, transmitter, and distributor, which dominates the power sector and accounts for the majority of activity; Copperbelt Energy Corporation Plc (CEC), a privately owned (floated on the Lusaka stock exchange) power transmission and electricity distribution company that purchases electricity from ZESCO and delivers it to the mining industry based on the Copperbelt, CEC is also a member of the Southern Africa Power Pool (SAPP); and the Lunsemfwa Hydro Power Company (LHPC), an IPP which generates approximately 57 MW of power for sale primarily to ZESCO, and is also the sole IPP to hold a license to trade power on SAPP.

Figure 1 below presents a schematic of the Zambian power sector.

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<sup>3</sup> Energy: Sector Profile, Zambia Development Agency

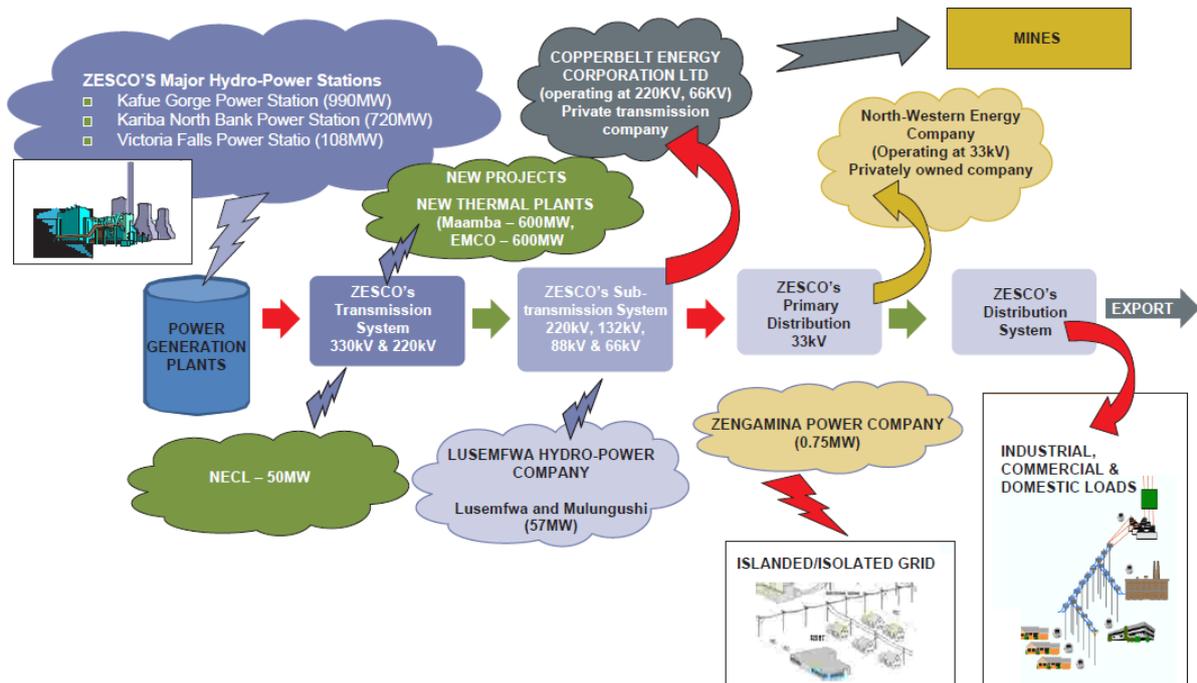
<sup>4</sup> Source: International Energy Agency (IEA), World Energy Outlook 2014

<sup>5</sup> [http://www.irena.org/documentdownloads/publications/rra\\_zambia.pdf](http://www.irena.org/documentdownloads/publications/rra_zambia.pdf)

<sup>6</sup> REEGLE website, <http://www.reegle.info/policy-and-regulatory-overviews/ZM>

<sup>7</sup> Engineering News Website, <http://www.engineeringnews.co.za/print-version/investment-in-zambia-power-generation-critical-for-continued-growth-2013-04-10>

<sup>8</sup> REEGLE website, <http://www.reegle.info/policy-and-regulatory-overviews/ZM>



**Figure 1: Electricity Supply Industry in Zambia<sup>9</sup>**

ZESCO is held publicly and in its entirety by the government of Zambia. The Permanent Secretaries of the Ministry of Finance and National Planning, and the MEWD represent the Government on the Board. ZESCO Limited's electricity is 99% hydro with the remaining one percent being from diesel powered generators, with 50% of the customer base being represented by the mining industry. There is a dearth of data on the company's performance released by ZESCO; some data on generation, transmission, and distribution was released by the ERB in 2009,<sup>10</sup> and the Regional Electricity Regulators Association of Southern Africa (RERA), of which the ERB is a member, released a report in 2015 that includes more recent power sector indicators. Also of interest, the ERB commissioned a Cost of Service Study in 2013 of the entire electricity supply industry to determine the cost of providing power to different categories of consumers,<sup>11</sup> as an update of a study that was completed in 2007.<sup>12</sup>

Copperbelt Energy Corporation (CEC) delivers 50% of all electricity consumed in Zambia. CEC owns and operates significant transmission assets, including an interconnect with the Democratic Republic of the Congo and 1,000 km of other transmission lines. CEC also owns and operates a small gas turbine electricity generator in Zambia, making claim to only 80 MW of generation which CEC uses to supply its own customers.<sup>13</sup>

The Lunsemfwa Hydro Power Company was the first IPP in Zambia, and is split between Agua Imara with a 51% stake and the previous owners Wanda Gorge Investments at 49%. The company operates two hydro power plants, with a combined generation capacity of 56 MW.

Power generation in Zambia is dominated by ZESCO, which controls 93.8% of the generation capacity, the vast majority of that generation begin produced from hydropower.

<sup>9</sup> ERB Report, <http://www.erb.org.zm/reports/EnergySectorReport2012-2013.pdf>

<sup>10</sup> ERB Electricity Sector Brief, <http://www.erb.org.zm/downloads/eregulation/zescotariffs/DescriptionoftheZambiaElectricitySystem.pdf>

<sup>11</sup> ERB Filing, <http://www.erb.org.zm/press/statements/CostOfServiceStudy.pdf>

<sup>12</sup> ERB Filing, <http://www.erb.org.zm/downloads/CostOfServiceStudyReport.pdf>

<sup>13</sup> CEC Annual Report 2014, <http://cecinvestor.com/investor/annual-reports/>

Power Station	Installed Capacity (MW)	Type of Generation	Owner / Operator
Kafue Gorge	990	Hydro	ZESCO
Kariba North Bank	1080	Hydro	ZESCO
Victoria Falls	108	Hydro	ZESCO
Combined Small Hydro	25	Hydro	ZESCO
Isolated Generation	8	Diesel	ZESCO
Lusemfwa and Mulungushi	56	Hydro	Agua Imara, Wanda Gorge
Gas Turbine	80	Diesel	CEC

Source: Energy: Sector Profile, Zambia Development Agency

The two largest generation assets in Zambia are the Kariba North Bank and the Kafue Gorge power station.

The Kariba North Bank dam and consequently the Kariba South Power Station were constructed between 1956 and 1962.<sup>14</sup> As the plant was aging, rehabilitation work on this plant began in 2000. To ensure the final two generation units would be rehabilitated, in 2005, the European Investment Bank (EIB) loaned US\$9.37 million along with a US\$15.4 million loan from Development Bank of Southern Africa. Following those financings, in February 2007 the government of China lent US\$300 million for the same purpose, and work was completed in 2009.<sup>15</sup>

Kafue Gorge power station's first generating unit was commissioned in 1971 and the project was completed in 1973. The power station's initial capacity was 600 MW and has since been increased to 990 MW.<sup>16</sup> Civil and turbine rehabilitation work began in 2001 on Kafue Gorge. In 2002, ZESCO awarded a US\$17 million contract to a number of entities to rehab the stations generators. In March 2009, ZESCO reported rehabilitation and uprating of Kafue Gorge was complete extending the life span of the power station by 20 to 30 years.<sup>17</sup>

Transmission in Zambia is operated by two major entities, ZESCO and CEC. ZESCO is the sole owner of the 330 kV nationwide system spanning 2310 km, while the CEC has a more localized transmission system within the Copperbelt region to serve mining needs. The two systems are operated the control center of each respective entity. There are six cross-border line connections comprised of two connections to Zimbabwe, and one each to the Congo, Botswana, Tanzania, and Namibia. Transmission losses in ZESCO's system are relatively low, with an average around 4.1%.<sup>18</sup>

Little information exists on the distribution network within Zambia as it is wholly controlled by ZESCO, and the company has not released a financial or operational report in some years. The most recent information from 2009, indicates the distribution system is broken into 4 divisions, with 4 regions in each division. Losses over the 2009 year ranged from a high of

<sup>14</sup> ZESCO Website, <http://www.zesco.co.zm/AboutUs.html>

<sup>15</sup> Hydroworld Website, <http://www.hydroworld.com/articles/print/volume-17/issue-5/Articles/refurbishment-renewing-veteran-assets-and-securing-new-megawatts-in-zambia-and-nicaragua.html>

<sup>16</sup> ZESCO Website, <http://www.zesco.co.zm/AboutUs.html>

<sup>17</sup> Hydroworld Website, <http://www.hydroworld.com/articles/print/volume-17/issue-5/Articles/refurbishment-renewing-veteran-assets-and-securing-new-megawatts-in-zambia-and-nicaragua.html>

<sup>18</sup> Energy: Sector Profile, Zambia Development Agency

27%, to a low of 15% with an average around 22%. No explanation was given for the variability in the distribution loss figures.<sup>19</sup>

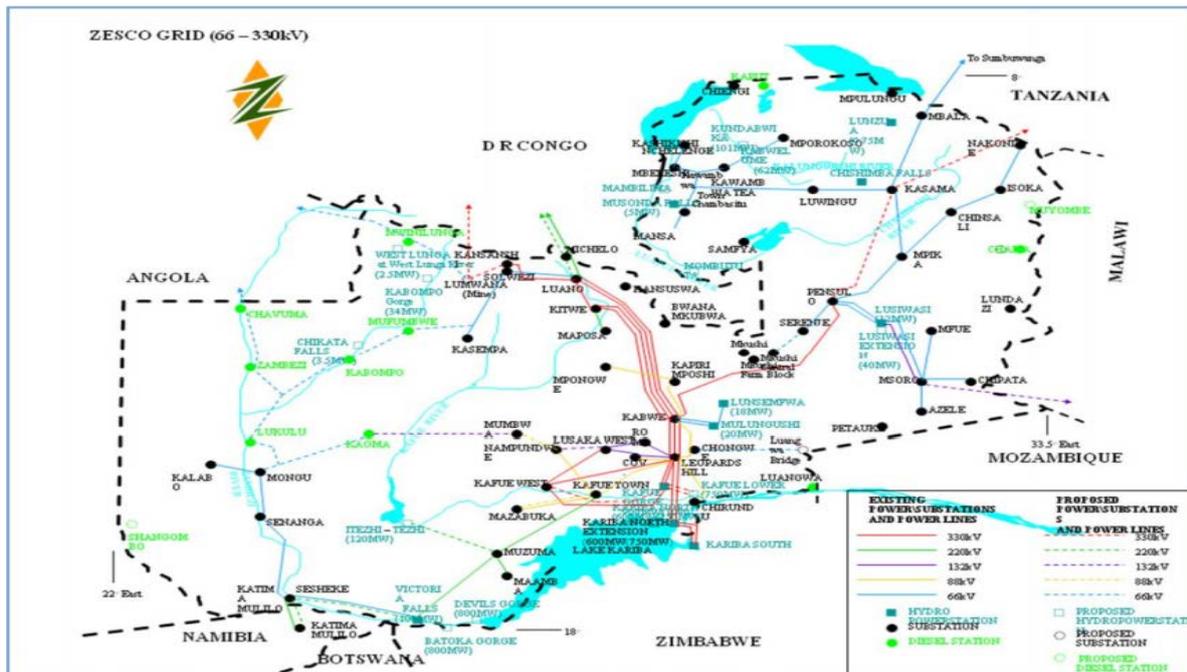


Figure 1. ZESCO Grid Transmission System

Source: Ministry of Energy and Water Development, 2008

## New Energy Sector Projects

ZESCO has three significant power generation projects it hopes to bring online soon, totaling 1,230 MW. The Kariba North Bank Extension is a project financed by the China Exim Bank and the Development Bank of Southern Africa to expand the capacity of the existing Kariba North Bank Power Station to 360 MW.<sup>20</sup> The Itzhi-Tezhi Hydro Power Project is a 120 MW base load power plant and a 280 km transmission line to connect the power station to the national grid.<sup>21</sup> The Kafue Gorge Lower Project is a hydro power station with a projected installed capacity of 750 MW, which would significantly increase Zambia's power presence in the southern African region.

The Rural Electrification Authority (REA) has a number of initiatives aimed at increasing the use of solar energy. The group is currently in the process of developing a 60 kW solar mini-grid to supply a community of approximately 50 households.<sup>22</sup> Under a build-own-operate (BOO) model, the government of Zambia has reviewed various institutions wishing to develop a total of 30 MW solar photovoltaic around the country.<sup>23</sup>

Wind energy potential in Zambia is thought to be relatively low, yet the Department of Energy has plans to develop a wind chart of the nation to identify potentially viable locations.

Zambia has more than 80 hot springs. The springs are generally perceived as being cost prohibitive, and have largely not been tapped for industrial or energy provision. Currently

<sup>19</sup> Energy: Sector Profile, Zambia Development Agency

<sup>20</sup> SinoHydro Website,

<http://eng.sinohydro.com/index.php?m=content&c=index&a=show&catid=42&id=133>

<sup>21</sup> EU Africa Infrastructure Website, <http://www.eu-africa-infrastructure-tf.net/activities/grants/itezhi-tezhi-hydro-power-and-transmission-line-project.htm>

<sup>22</sup> MEWD Website, <http://www.mewd.gov.zm/index.php>

<sup>23</sup> IRENA Report, [http://www.irena.org/documentdownloads/publications/rra\\_zambia.pdf](http://www.irena.org/documentdownloads/publications/rra_zambia.pdf)

only one small geothermal generation plant is partially operational. ZESCO is considering reviving the plant<sup>24</sup>.

### **Electricity Sector Laws**

The Electricity Act of 1995, subsequently amended in 2003, was formulated to regulate the generation, transmission and distribution of electricity in Zambia. The act created the Energy Regulation Board by outlining its tasks and authorities in energy sector regulation.

The Rural Electrification Act of 2003 established the REA and instituted a Rural Electrification Fund which the REA could use. Additionally, the REA was made accountable for realizing the Rural Electrification Master Plan (REMP) through formation and monitoring of rural electrification organizations or companies.

In 2013, the Zambia Grid Code was implemented hoping to facilitate open and non-discriminatory access to the transmission system in order to ensure a more liberalized electricity sector, through increased efficiency and faster paced electrification.

### **Electricity Regulatory Environment**

The ERB currently uses a “Revenue Requirement” pricing method to regulate tariffs of electricity utilities. Revenue requirement is calculated by taking the sum of all operating expenses and adding the “Rate Base” multiplied by the rate of return. The “Rate Base” is the amount of capital or assets ZESCO assigns to providing service. Rate of return is equivalent to the cost of capital.

The ERB determines the corresponding rate of increase to the tariff that will enable ZESCO to generate the approved revenue requirement. This rate of increase is then applied by ZESCO to its existing tariffs.

If ZESCO wishes to change the tariff, it can apply to the ERB for a review under the Automatic Tariff Adjustment Formula (ATAF). This process is reserved for major macroeconomic shocks such as significant currency depreciation or inflation.<sup>25</sup>

### **Zambia Utility Financial Position**

ZESCO’s financial position is difficult to get specific information on, as they do not release financial statements or annual reports. However, one can infer from the country’s tariff rates and the costs associated with ZESCO’s generation profile that the utility is not financially sustainable. The ERB’s 2014 tariff filing targeted a price increase of 24.63% for residential customers and 15.38% for commercial customers over four years on the principal of “recovery of prudently incurred cost by the utility”.<sup>26</sup> These increases will raise the price of electricity to \$0.04/kWh for residential (101-300 kWh) and commercial customers. ZESCO’s national average tariff stands at \$0.06/kWh The AICD estimated that ZESCO’s long-run marginal cost for power is \$0.08/kWh, and that the utility recovered only 39.1% of the full cost of electricity service.<sup>27</sup>

ZESCO has the second-lowest electricity tariffs in the SAPP. While hydropower generation keeps the long-run marginal cost for power lower than many of its SAPP neighbors, Zambia’s dams are old and in need of continued maintenance. These artificially-low tariffs create financial difficulties for the utility, leading to negative operating margins, and contribute to the deterioration of ZESCO’s financial stability. Aside from non-cost-reflective

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<sup>24</sup> Energy Sector Profile, Zambia Development Agency

<sup>25</sup> ERB Website, <http://www.erb.org.zm/content.php?viewpage=epris>

<sup>26</sup> ERB, ZESCO Tariff Filing 2014, June 1, 2014

<sup>27</sup> AICD, “Zambia’s Infrastructure: A Continental Perspective”, March 2010

tariffs, ZESCO suffers from aggregate technical and commercial (ATC) losses hovering around an estimated 20% every year, which further eat into the company's cash flow.<sup>28</sup>

## KEY PERFORMANCE INDICATORS

### Current Utility Performance Improvement Agenda

After the Electricity Act of 1995, ZESCO entered into a Performance Contract that was signed between the Government of Zambia and ZESCO, in 1996. The contract defined the commercialization issues and other operational benchmarks for ZESCO over the contract period of three (3) years. The ERB sets performance benchmarks called Key Performance Indicators (KPIs). Tariff awards are tied to ZESCO's prior year KPI performance. The last of these intervals was between 2011-2014. The KPIs which the ERB sets include operational targets for customer metering, cash management, staff productivity, system losses (ATC losses) and quality of service (frequency and duration of interruptions). ZESCO reports their progress against these KPIs to the ERB quarterly; the ERB uses these reports to assess ZESCO's performance. These results are also published in the ERB's annual Energy Sector Report.<sup>29</sup>

ZESCO reports KPIs to ERB in the following areas:

- Metering Customers
- Cash Management
- Staff Productivity
- Quality of Service Supply
- System Losses

During the most recent KPI review, which took place in 2013, ZESCO's scores were as shown below, in Figure 3, and as described in the paragraphs following. Specific scores were awarded based on predetermined criteria based on performance against the KPI.

KPI	Assigned weight	2013	2012
Customer Metering	25%	25%	22%
Cash Management	10%	0%	0%
Staff Productivity & Staff costs	15%	15%	13%
Quality of Service	25%	23%	25%
System Losses	25%	22%	20%
<b>Total</b>	<b>100%</b>	<b>85.3%</b>	<b>79.50%</b>

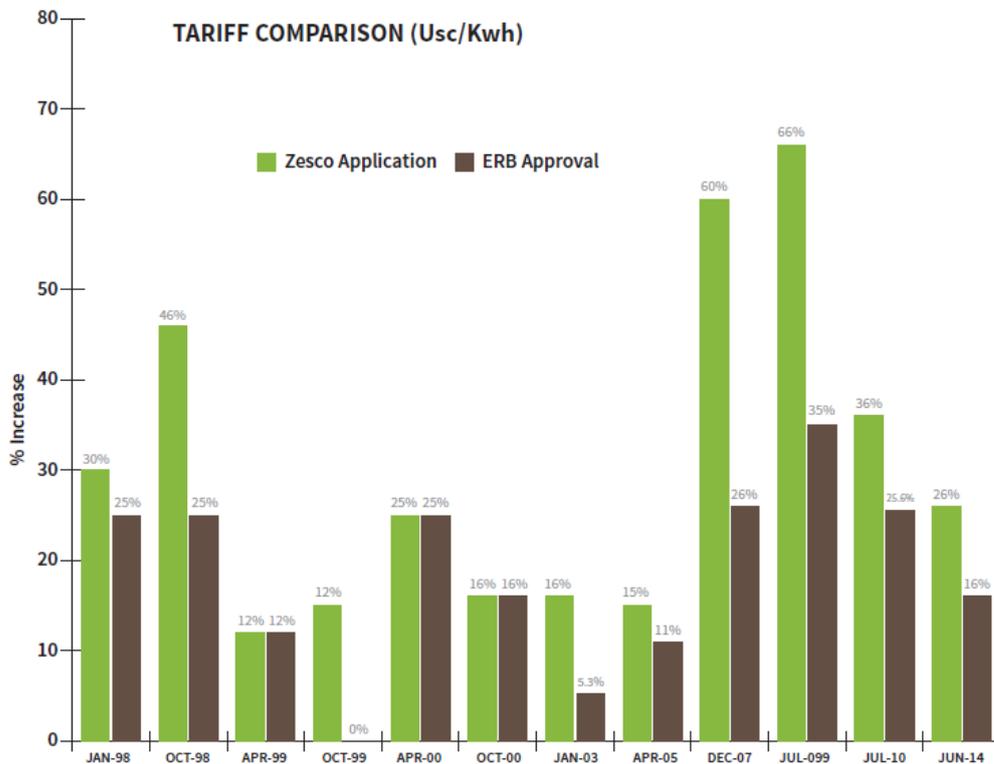
Figure 2: ZESCO KPI Scores 2012-2013<sup>30</sup>

In 2014, ZESCO secured a 16% tariff increase.

<sup>28</sup> ERB Energy Sector Report 2013, <http://www.erb.org.zm/reports/EnergySectorReport2012-2013.pdf>

<sup>29</sup> The most recent ERB Energy Sector Report was completed for the year ending in 2013.

<sup>30</sup> ERB Sector Report, 2013, <http://www.erb.org.zm/reports/EnergySectorReport2012-2013.pdf>



Source: Adapted by Policy Monitoring and Research Centre (PMRC) 2014 from the ERB Economic Regulation (2014) Lusaka.

Figure 3: Tariff Comparison of ZESCO Application and ERB

## Metering Customers

### ZESCO KPIs 2011-2014

- All unmetered customers are metered by March 2013;
- Meter 25,000 prepaid customers per quarter; and
- All new standard residential meter installations should be done within 30 days after customer pays the connection fees from April 2011.

According to the ERB, access to grid electricity in 2013 was 22% across Zambia, and only 5% in rural areas. Urban access is 47% and only 3% of those below the global poverty line have grid access. While distributed energy is growing more popular through the yearly distribution of over \$2M in solar panels through World Bank and other donor programs, the large majority of Zambians live without electricity. The ERB's targets do not currently require electrification of new customers, but rather focus on metering existing customers.

ZESCO does not regularly publish data on customers and metering, but it is estimated that ZESCO had 563,600 customers in 2012. ZESCO began piloting prepaid meters in 2002 and currently reports that 120,000 customers use prepaid meters.<sup>31</sup> The World Bank reports that 0.5% of the population is electrified each year, with 36% of these new customers being supplied as pre-paid. USAID investigations show that in 2010 only 33% of new customers were metered and new customers were not connected until 85 days after first payment of the connection fee. It is typical for developing country utilities to have a large backlog of new customers, as they lack the capability to support the procurement and dispatch functions necessary to maintain an organized registry of labor, customers, and equipment. Prepaid

<sup>31</sup> ZESCO website, <http://www.zesco.co.zm/DSAndCS/Customerservice/PrepaidMetering.html>

meters are an important solution for ZESCO because they will regularize customers and also pose a solution to some of ZESCO's cash management difficulties.

## Cash Management

ZESCO KPIs 2011-2014

- Non-GRZ trade receivables should not exceed 17% of revenue by March 2013;
- GRZ trade receivables should not exceed 25% of revenue by March 2013;
- Reduce Non-GRZ debtor days to not more than 60 days by March 2013;
- Reduce GRZ debtor days to not more than 90 days by March 2013; and
- Improve the debt-equity ratio to 70:30 by March 2016. Kindly note that this will just be monitored during this period and will not be scored.

The ERB scored ZESCO at 0 of 10 in the latest review of KPIs. While ZESCO and the ERB do not publish the associated financial data, it is apparent that cash management is one of ZESCO's weakest areas. USAID reported that ZESCO maintained an average of 118 debtor days in 2010 and trade receivables at 121% of turnover in 2009. Obviously cash management is a key area of concern for ZESCO. Key concentration areas could be in implementing a customer relationship management (CRM) software platform to improve oversight of revenue management or move to a performance-based compensation system for revenue collectors.

## Staff Productivity

ZESCO KPIs 2011-2014

- Improve the customer-employee ratio to 100:1 by March 2012; and
- Reduce staff costs to 45% or less of total costs by March 2013.

ZESCO reportedly had over 5,800 staff members in 2013 for a customer base of 560,000, supporting a customer-employee ratio of 97:1, achieving the staff productivity target set by the ERB. ZESCO currently has 7 directorates and these are Corporate Affairs & Business Development, Finance, Transmission, Generation, Distribution Supply and Customer Service, Human Resources & Administration and Legal. ZESCO does not publish staff costs or its organizational structure, but news reports indicate that there are significant organizational inefficiencies that are characteristic of government-owned utilities.<sup>32</sup> These may include: decentralized (regional) rather than functional internal divisions, high concentration of decision-making in single departments, lack of workforce planning, and overstaffing.

## Quality of Service Supply

ZESCO KPIs 2011-2014

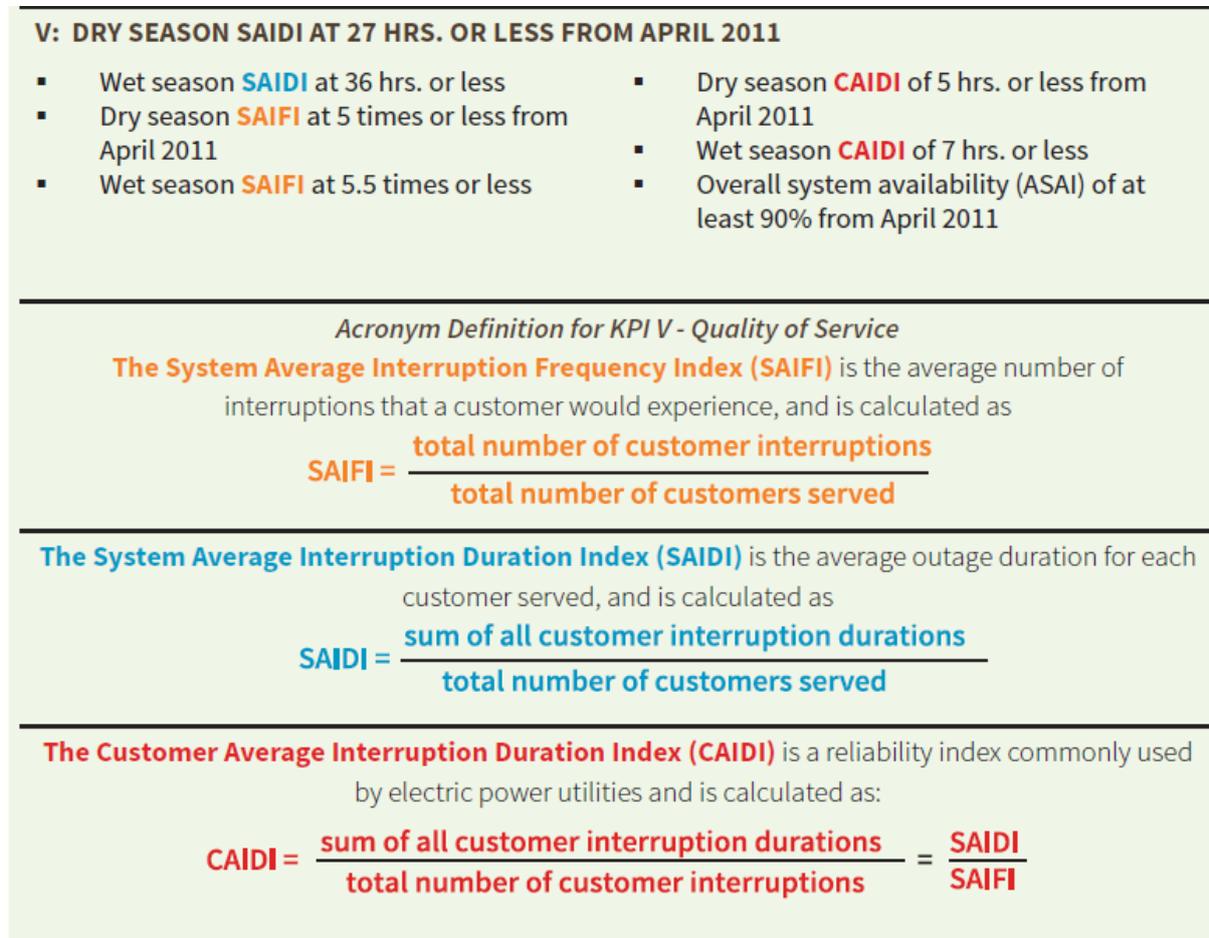
- Maintain the Dry Season System Average Interruption Duration Index (DS-SAIDI) i.e. from April to September, at 27 hours or less from April 2011 onwards;
- Maintain the Wet Season SAIDI (WS-SAIDI) i.e. October to March the following year, at 36 hours or less from April 2011 onwards;
- Maintain the DS- System Average Interruption Frequency Index (DS-SAIFI) at 5 times or less from April 2011 onwards;

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<sup>32</sup> Lusaka Times, Aug 21, 2012 <http://www.lusakatimes.com/2012/08/21/zesco-urged-revisit-salary-structure-hiking-tariffs/> and May 1, 2013, <http://www.lusakatimes.com/2013/05/01/zesco-tariffs-increase-supported-current-low-rates-dont-encourage-energy-saving/>

- Maintain the WS-SAIFI at 5.5 times or less from April 2011 onwards;
- Maintain the DS Customer Average Interruption Duration Index (DS-CAIDI) at 5 hours or less from April 2011 onwards;
- Maintain the WS-CAIDI at 7 hours or less from April 2011 onwards; and
- Maintain the Average System Availability Index (ASAI) at 90% or more from April 2011 onwards.

The ERB uses a system of calculated averages to track ZESCO service quality standards, which are explained in the graphic below.



**Figure 4: ZESCO Reliability KPI Explanation**

While ZESCO and the ERB do not publish the relevant data to make the reliability known, the ERB scored 23% out of 25% in this category. However, the World Bank reports that in 2011, Zambia had 49.8 days of aggregate load shedding throughout the grid during the year, well below the system reliability targets which took hold in April of that year.<sup>33</sup> Part of the difficulty of maintaining system reliability in Zambia is that the market is undersupplied, leading to forced load shedding throughout the country. The reliance on hydropower, though adjusted in the wet/dry season targets, creates additional volatility for the utility, which does not have significant backup in the event of water shortages. In order to increase system reliability, ZESCO should target improvements in power planning, technology-specific resource plans to hedge their hydropower portfolio with clean and traditional generation, and work to maintain substations, which in the recent past have caused significant system-wide

<sup>33</sup> SE4ALL Report, 2012, [http://www.se4all.org/wp-content/uploads/2014/01/Zambia-DRAFT-Rapid-assessment\\_gap-analysis-June-14-2012\\_V1.pdf](http://www.se4all.org/wp-content/uploads/2014/01/Zambia-DRAFT-Rapid-assessment_gap-analysis-June-14-2012_V1.pdf)

instability. On April 28, 2015, a transmission substation near the largest HPP in Zambia faltered, causing a voltage spike and blackouts throughout the majority of the nation's electricity distribution network.<sup>34</sup>

## System Losses

ZESCO KPIs 2011-2014

- Maintain transmission losses at 5% or less; and
- Reduce distribution losses to 14% by March 2012.

According to available data, ZESCO's ATC losses have stayed around 23% each year since 2008, well above the 19% target.<sup>35</sup> It is estimated that approximately 4% of electricity is lost due to technical constraints on the transmission and distribution infrastructure, and the remaining percentage (between 16% and 20% of electricity production) is non-technical losses.<sup>36</sup> Because ZESCO does not regularly report financial or operational performance data, it is difficult to quantify the impact of annual electricity losses on the company's cash flow.

The technical losses are mostly a result of lack of maintenance on the transmission and distribution infrastructure, including the power transformers.

The non-technical loss profile of the utility is difficult to ascertain from desktop research because there is no publically-available loss-reduction agenda or strategy from the utility. The ERB annual sector updates do not mention losses, and the ERB publishes the annual KPI reports but displays the progress against the indicators as weighted scores rather than releasing the data. Furthermore, the lack of company data provides little insight into the commercial operations of ZESCO. There are no comparable benchmarks in Zambia. The only other transmission and distribution entity, CEC, serves only large-scale mining customers. These customers, with access to foreign exchange and a high demand for power, are capable and willing ratepayers, resulting in ATC losses of around 2.7% annually for CEC.<sup>37</sup>

## Zambia Loss Reduction Initiatives

ZESCO does not publish any loss reduction activities, although their website does have a report line. News reports show that, in 2009, ZESCO Customer Service Manager Bassie Banda initiated a data verification campaign to understand the profile of illegal connections in order to begin a campaign to meter customers.<sup>38</sup> However there is no communication from ZESCO that this project was ever implemented. There are reports of criminalization of electricity theft from various news sources within Zambia periodically. The major electricity activities are focused around metering new customers rather than securing payments. ZESCO has undertaken loss reduction activities namely as a means to achieve the KPIs, which in turn allow the utility to increase its tariffs. While the first set of KPIs were successful in some areas (significant reduction in technical and non-technical losses as a result of

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<sup>34</sup> News article, April 28, 2015, <http://www.tiozambia.com/kitwe-substation-caused-power-blackout-zesco/>

<sup>35</sup> ZESCO does not annually publish Loss Data, nor does the ERB. Historical data provided by the World Bank.

<sup>36</sup> AICD Report, 2010 [http://siteresources.worldbank.org/INTAFRICA/Resources/Zambia-Country\\_Report\\_03.2011.pdf](http://siteresources.worldbank.org/INTAFRICA/Resources/Zambia-Country_Report_03.2011.pdf)

<sup>37</sup> ERB Sector Report, 2013, <http://www.erb.org.zm/reports/EnergySectorReport2012-2013.pdf>

<sup>38</sup> Lusaka Times, November 14, 2009, <http://www.lusakatimes.com/2009/11/14/zesco-set-to-strengthen-data-base-to-identify-non-paying-clients/>

updated infrastructure and pre-paid metering<sup>39</sup>) progress on loss reduction seems to have stagnated after the KPIs were revised in 2011.

## **Gaps**

### **Strengths**

The ERB has a clear mandate to enforce the KPIs, which are clearly-defined and achievable targets that will significantly improve the operations of ZESCO. The KPIs themselves are targeted towards areas that represent costly problems for ZESCO; this further encourages ZESCO to diligently and accurately collect data important for operations as part of the basis for the tariff rate adjustment. According to the ERB, ZESCO's strengths include metering, quality of service, and system losses. Given the data that has been collected on these targets, however, the scores provided by the ERB may be a sign of aspirational improvement rather than achievement of the KPI target.

### **Improvement Areas**

The lack of quality data on losses makes it difficult to know where there is and is not room for improvement. Collecting and publishing this data is the necessary first step to all future improvements. The second priority improvement area is creating and publishing a loss-reduction plan, which uses the KPIs as a starting point and drills into deeper detail about the strategy for loss reduction in order to meet these targets. This could include customer segmentation, loss mapping, and improving the utility asset registry. Aside from improving basic data collection and strategy definition, there are a few other insights which should be addressed. It is obvious from the KPIs that cash collections are a large problem for the utility, especially between government agencies. The utility would do well to create and/or publicize their loss-reduction efforts and make strides to structure outstanding bills in a way that allows the utility to recoup some costs without putting unmanageable financial stress on customers.

## **REVIEW OF DONOR ACTIVITY**

### **Donor loss reduction initiatives**

The donor community does not have a large presence in electricity loss reduction in Zambia. There are a few significant programs which have a secondary focus on loss reduction as it relates to installing pre-paid meters or rehabilitating transmission and distribution wires. The two predominant projects in this space are the World Bank's Power Rehabilitation Process (ended 2006) and the Zambia Increased Access to Electricity program.

Under the World Bank's Power Rehabilitation Process a variety of power sector improvements, the two most relevant to loss reduction being transmission improvements and customer service programs. During the project, 110 km of lines were constructed to provide electricity to communities along the lake shore. In addition, four clinics, a number of elementary schools, and one secondary school have been electrified. The availability of electricity improved commercial activities along the stretch of the power line. In terms of customer service improvements for ZESCO, including establishing client service centers, bulk meters services, installation of 900 prepayment meters, and conducting customer surveys in residential communities.

The Zambia Increased Access to Electricity program has established a connection fee subsidy program under which ZESCO has connected 51,000 households in low income

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<sup>39</sup> USAID Report, 2010

[http://www.naruc.org/international/Documents/Electricity%20utility%20performance\\_Zesco.pdf](http://www.naruc.org/international/Documents/Electricity%20utility%20performance_Zesco.pdf)

areas. An additional 25,000 households in low income areas are expected to be closed in the period of performance. The project has completed construction of the two substations in Lusaka and Livingstone. The program also supported the Rural Electrification Authority in installing solar photovoltaic systems in over 100 schools and health centers and more than 470 staff houses in rural areas, benefiting over 35,000 students and teachers. The program has also trained over 290 ZESCO staff and 40 REA in various technical and operational areas. All outstanding works are expected to close June 30, 2015.

## **ANNEX A: AREAS OF INTEREST FOR SCOPING TRIP**

1. ZESCO has not released a financial or operational report in some years, and there is a need to confirm:
  - a. Distribution network structure and assets
  - b. Financial performance/status
  - c. Loss figures and explanation
2. Loss Reduction initiatives
  - a. ZESCO initiatives (non-technical breakdown)
  - b. ERB initiatives (non-technical breakdown)