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SECTOR REFORM AND UTILITY COMMERCIALIZATION (SRUC)

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

July 2015

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SECTOR REFORM AND UTILITY COMMERCIALIZATION (SRUC) PROJECT

BACKGROUND REPORT ON MOZAMBIQUE'S POWER SECTOR: UTILITY PERFORMANCE & LOSS REDUCTION

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INTRODUCTION

USAID's **Sector Reform and Utility Commercialization Project (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 scoping missions 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 insights 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 background information to support the trip, provide focus areas for meetings and guide scoping. The document provides insights into the Mozambique 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 Mozambique's economy
- (b) 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.
- (c) A review of other international donors' work in loss reduction in order to explore potential areas of collaboration, and reduce potential overlap.
- (d) 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.

BACKGROUND

Country Background and Economy

Mozambique is one of the world's poorest countries with GDP per capita at USD \$1,200 in 2013.¹ Despite being blessed with natural resources, the country is heavily reliant on foreign donor support and between 40%-55% of its budget comes from this assistance.²

Mozambique's GDP has maintained strong growth over the last decade, between 6% and 8% annually, driven by foreign direct investment in the mining, electricity, tourism, construction and telecommunication sectors.³ Due to the inexpensive power provided from the 2,075 MW Cahora Bassa hydropower station, energy intensive industries such as the Mozal aluminum smelter and related activities in mining, manufacturing, and construction have seen significant growth.⁴ The majority of investment has been driven by a few large "mega projects" or companies and there are few medium size enterprises.⁵

The country's economic growth is projected to continue as coal and gas reserves are developed, such as the on-shore reserves in Inhambane province of Pande Gas Field (discovered 1961/production 2004) and the Temane Gas Field (1967/2004) and the off-shore Rovuma basin in the north.⁶ Mozambique's proven natural gas reserves are estimated to be approximately 100 trillion cubic feet (Tcf). In addition to its gas reserves, Mozambique's Tete Province is projected to hold significant unexploited coal reserves in the order of 25 billion short tons. Estimates indicate these resources could lift Mozambique's economic growth rate by two percent annually from 2015-2023.⁷

Its population of more than 23.5 million people are spread across more than 309,495 square miles causing significant challenges for electricity access. While most live along the coast and in the south, the population is spread across much of the vast and often challenging environment. The transportation infrastructure is underdeveloped and during the rainy season heavy flooding results in impassable roads threatening the system. Given these factors and other described below, it has been a challenge to provide electricity access across the country. The World Bank estimates 15% of the population have access to electricity. In cities, it is slightly better with 26% coverage, compared to the extremely low 5% in rural areas. While Mozambique has plenty of room to improve access rates, electrification levels are about average within the southern African context, excluding South Africa.⁸

Net electricity generation in Mozambique was 16.7 billion kilowatt-hours in 2011, of which almost all was from hydropower and a very small amount from natural gas. The growth in demand for electricity in the country stood on average at 10% per annum between 2000 and 2010, and from 2011 to 2013 it grew 13%.⁹ The demand for electricity is expected to continue to grow at 8.2% annually for the next 15 years.¹⁰ As a result, Mozambique will need to address its electricity infrastructure challenges to be able to meet this demand and continue to increase access.

Electricity Sector Key Participants

The majority of the electricity sector in Mozambique is run by government owned entities, but there has been some introduction of private sector participation. There is historical precedence for why Mozambique supports state owned enterprises. After independence

¹ <https://www.cia.gov/library/publications/the-world-factbook/geos/mz.html>

² <http://www.itad.com/projects/multi-donor-evaluation-of-budget-support-in-mozambique/>

³ <http://www.bus-ex.com/article/hidroel%C3%A9ctrica-de-cahora-bassa-0p://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/Mozambique%20-%202011-15%20CSP.pdf>

⁴ <http://www.imf.org/external/pubs/ft/dp/2014/afr1404.pdf>

⁵ <http://omrmz.org/index.php/biblioteca/category/165-diversos?download=2399:dfid-2011-mozambique-procurement-study-economics-institutoins-reform-challenges>

⁶ <http://abarrelfull.wikidot.com/mozambique-oil-and-gas-profile>

⁷ <http://www.eia.gov/countries/country-data.cfm?fips=mz>

⁸ <http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>

⁹ Energy Strategy (2014 -2023) Ministry of Energy

¹⁰ http://www.iese.ac.mz/lib/publication/III_Conf2012/IESE_IIIConf_Paper16.pdf

from Portugal in 1975, the FRELIMO party took control and established a one-party state aligned to the Soviet bloc and supportive of communism. The country faced a bloody civil war until 1994 when the first democratic elections took place. After independence, a number of institutions were nationalized and a belief that the government should own certain industries such as electricity still exists in Mozambique today.

Below is a graphic that displays the major organizations and industry structure.

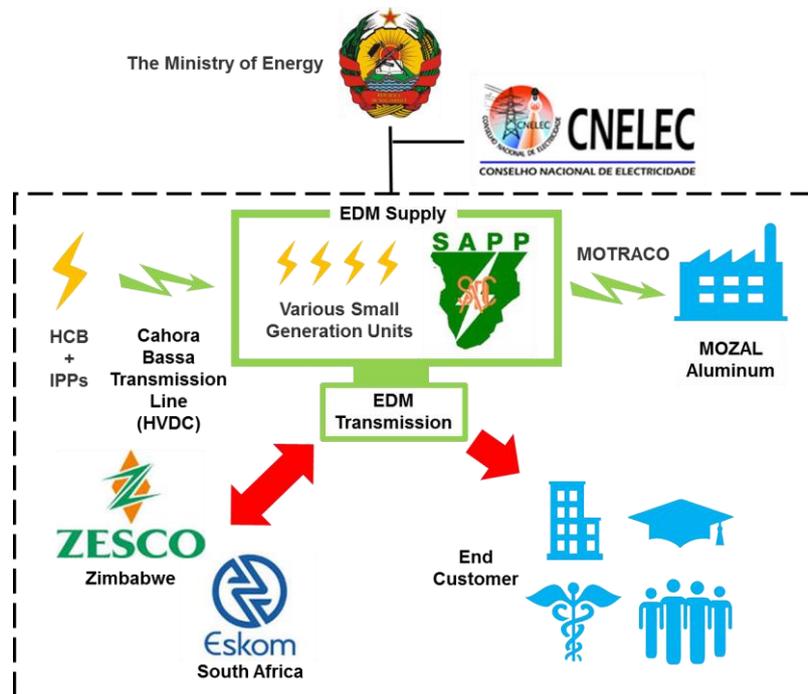


Figure 1: Electricity Sector Diagram

The chart and description below provide more detail on the value chain, role and ownership structure of the companies and organizations involved in the Mozambican electricity sector.

Agency	Primary Role	Description	Ownership
The Ministry of Energy (Ministerio de Energia, hereinafter, "ME")	Policy	Overall supervision of the electricity sector	100% government
National Directorate for Electrical Energy ("DNEE")	Policy	Central technical body within the ME responsible for the analysis, preparation and elaboration of energy policies	100% government
The Council of Ministers	Policy	Approve concessions for plants with rated capacity of >100MW	100% government
Electricidade de Mocambique ("EDM")	Generation, Delivery	The state-owned, vertically integrated electricity supplier	100% government
Hidroelectrica de Cahora Bassa ("HCB")	Generation	The major generator and largest hydroelectric scheme in Southern Africa	92.5% Mozambique government; REN 7.5%
Mozambican Transmission Company ("MOTRACO")	Transmission	Independent transmission company (ITC) owned by EDM, Eskom and Swaziland Electricity Board. Responsible for supplying electricity to the Mozal aluminum plant in Mozambique and the wheeling of	33% EDM 33% Eskom 33% Swaziland Electricity Board

		power to EDM in Mozambique and Swaziland Electricity Company	
Cahora-Bassa HVDC	Transmission	Transmission line service the Hidroelectrica de Cahora Bassa	Eskom, Hidroelectrica de Cahora Bassa (unknown breakdown)
Fundo de Energia (“FUNAE”, The Energy Fund)	Finance for Generation	Finances off-grid electrification	100% government
CNELEC	Regulation	National Regulatory / Advisory Board	100% government

Table 1: Mozambique Power Sector Value Chain Breakdown

Electricidade de Mocambique (EDM), the state-owned, vertically integrated electricity supplier, is the major player in the Mozambican electricity sector. While EDM is vertically integrated, it has limited generation capacity of its own, generating only around 6% of the total capacity it transmits, or 263 GWh.¹¹ The remainder it purchases from Hidroelectrica de Cahora Bassa (“HCB”), or on the Southern Africa Power Pool (SAPP), where EDM is an Operating Member. EDM operates 11,847 km of transmission and distribution lines (as of 2011). EDM has the highest level of employees per customer in the SADC region, a sign that there are areas for improvement in the operational efficiency of the utility.¹²

HCB, the major generator and largest hydroelectric dam in Southern Africa, is referred to as an IPP but is predominantly owned by the Mozambican government (92.5%), which also owns EDM. The private sector does retain a small, 7.5% ownership stake in HCB through REN (a publically traded (in Portugal) Portuguese grid operator. The president of Mozambique signed an agreement to purchase this equity interest from REN in 2016.¹³

The Mozambican Transmission Company (MOTRACO) is an independent transmission company owned by EDM, Eskom and Swaziland Electricity Board (each owning 33%) and is responsible for supplying electricity to the Mozal aluminum plant in Mozambique and the wheeling of power to EDM in Mozambique and Swaziland Electricity Company.

The Ministry of Energy (Ministerio de Energia “ME”) is responsible for all energy resources while the National Directorate for Electrical Energy (DNEE) is the central technical body within the ME responsible for the analysis, preparation and elaboration of energy policies. The ministry is divided into three directorates, and several “technical” units: The National Directorate for Electrical Energy (Direcção Nacional de Energia Eléctrica, DNEE), National Directorate of New and Renewable Energy (Direcção Nacional de Energias Novas e Renováveis) and the National Directorate of Fuel (Direcção Nacional de Combustíveis).

Additionally, the Electricity Law of 1997 laid the legal framework for the National Electricity Council (CNELEC). Created in 2004, it is a governmental consultative body functioning as a regulator for the generation, transmission and sale of electricity. CNELEC is a member of the Regional Electricity Regulators Association of Southern Africa (RERA).

Electricity System Overview

Mozambique has a total installed generation capacity of 2,308 MW, with 2,075 MWs from the Hidroelectrica de Cahora Bassa (“HCB”) hydroelectric facility located in western Mozambique, and remainder small units owned by EDM.¹⁴ ***There is no direct transmission line between the HCB facility and Mozambique’s main load center, Maputo.*** High voltage corridors transmit power from Tete to South Africa and then back to Mozambique through an HVDC line.

¹¹ EDM Annual Report

¹² Sumario Estatístico 2012 Final, 2012

¹³ <http://www.iol.co.za/business/international/mozambique-to-own-cahora-bassa-1.1276132#.VWdKuM9Viko>

¹⁴ “Executive Exchange on Developing an Ancillary Service Market.” ELECTRICIDADE DE MOÇAMBIQUE, 2012.

HCB must first sell power to Eskom, South Africa's utility, which in turn sells it back to Southern Mozambique at an increased rate. As a result, Mozambique is a net exporter of electricity. EDM receives only a small share (15%) of the plant's output which provides 90% of the electricity supplied to the country's grid. The electricity used in Maputo and Matola actually comes from the combined generation of South Africa and Mozambique. Power generated from HCB is therefore distributed as follows, South Africa (Eskom), 65%; Zimbabwe (ZESA), 19%; SAPP and Botswana (BPC), less than 1%.¹⁵ As a result, the dam plays an important role in Mozambique's economy as a source of foreign revenue, particularly after the country gained majority ownership (85% of the project shares).

Since 2011, load (particularly peak load) has exceeded capacity, forcing Mozambique to import from the SAPP to satisfy the country's increasing electricity demand. In 2013, available generation capacity was 614 MW including imports of 95 MW.¹⁶

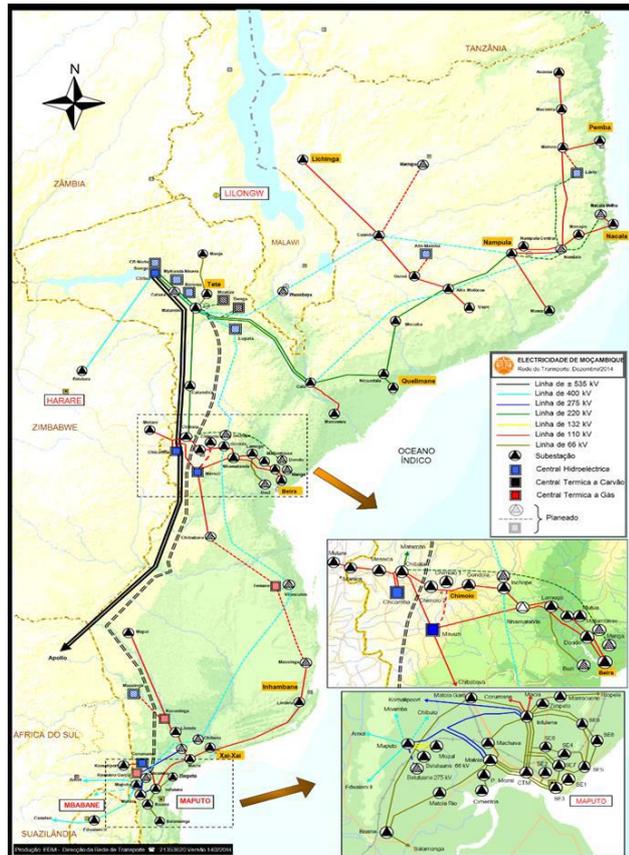


Figure 2: Mozambique's Transmission Network

Mozambique's participation in the SAPP is through EDM, which functions as an Operating Member, Hidro Electrica Cahora Bassa (HCB), which functions as an Observer Member and MOTRACO, an Independent Transmission Company (ITC), which also functions as an Observer Member.¹⁷ SAPP provide an opportunity to trade power in the region. Mozambique has three cross border connections, Zimbabwe to the west and South Africa and Swaziland to the south.

HCB and Eskom jointly own the HVDC transmission line which provides connection from Cahora Bassa to South Africa.

The country's large size and significant distances cause distribution challenges and considerable line losses making grid connectivity to the whole population almost unfeasible.

Electricity Projects

Generation

Mozambique hopes to expand its coal and gas fired power generation capacity on the order of US\$12 billion in new developments.

Gas-fired power plant. Gas being extracted from the Pande and Temane fields are driving three gas-to-power projects, as shown below:

¹⁵ RERA Tariff Report 2012-2013

¹⁶ http://www.speed-program.com/wp-content/uploads/2015/02/2014-SPEED-Report-042-Analysis-of-the-Power-Crisis-and-its-Impact-on-the-Business-Environment-EN_DRAFT2.pdf

¹⁷ RERA Tariff Report 2012-2013

1. **EDM/SASOL Central Térmica de Ressano Garcia (CTRG).** A 175 MW gas fired power plant on the border with South Africa that began operation in late 2014 and will supply electricity to more than two million Mozambicans (23% of demand) through a PPA with EDM.¹⁸ A joint venture between EDM (51%) and Sasol (49%) came together to replace the current 107 MW Aggreko-Shanduka power plant.
2. **Gigawatt Park/AGGREKO** (Ressano Garcia area). A Mozambican company developed an emergency containerized power plant of 100 MW (phase I) and 130 MW (phase II), to be fueled by natural gas and operated under a PPA with NamPower, ESKOM and EDM.¹⁹

At the same site, there is discussion to convert an existing diesel power plant to gas, with finance provided by the Japan International Cooperation Agency (JICA).²⁰

3. **Kuvaninga.** A 40 MW power plant as well as the associated gas pipeline and power transmission facilities required to connect the plant to the Republic of Mozambique Pipeline Investments Company gas pipeline and the EDM grid. Investec, Enventure Partners and Intelligence, Counselling & Research have partnered with Kuvaninga Mocambique Limitada (KDM) to co-develop the project.²¹ Operations were expected to commence in early 2015.²²

Despite the progress demonstrated by these projects, there are some noteworthy obstacles to expanding gas-fired power generation in Mozambique. The large gas deposits are in the northern areas of the country, whereas the capital city and larger electricity load centers are in the southern regions. The transmission costs to account for the location disparity between generation and demand make these projects less appealing than coal fired options from simply a price perspective.²³

Coal-fired power prospects are also robust, with Mozambique's large coal deposits at Moatize-Minjova, Senangoe and Mucanha-Vuzi in Tete province. Mine-mouth projects are being considered by many mining companies with the intent of selling power predominantly to the South African market given the transmission line currently in place. In Tete province, Ncondezi Coal anticipates construction of a 1,800 MW coal-fired plant, with the 300 MW first phase due in 2017. Jindal Steel and Power of India aims to build a 2,640 MW coal-fired plant for domestic and export sales. Vale and Rio Tinto are separately planning 2,000 MW plants at Moatize and Benga respectively.²⁴

Hydroelectricity makes up the largest component of Mozambique's renewable energy. The total hydro capacity in Mozambique is approximately 12,000 MW. It is estimated that 1,000 MW of this could come from small-scale hydro projects. Mozambique's plan is to build 4,000 MW of hydroelectricity, dominated by two projects, Cahora Bassa North Bank and Mphanda Nikuwa plants, which constitute 75% of that capacity. The Cahora Bassa North Bank has a planned capacity of 1,245 MW and was anticipated to be operational in the middle of 2015, with the Mphanda Nikuwa plant following in 2017, and adding 1,500 MW.²⁵

¹⁸ <http://www.pnnewswire.com/news-releases/sasol-edm-inaugurate-new-gas-to-power-plant-in-mozambique-273008571.html>;

<http://www.sasol.com/media-centre/media-releases/sasol-edm-inaugurate-new-gas-power-plant-mozambique>

¹⁹ <http://af.reuters.com/article/mozambiqueNews/idAFL6N0P54K820140624>

²⁰ <http://www.fin24.com/Economy/Mozambiques-gas-power-station-nearing-completion-20150423>

²¹ <http://enventurepartners.com/kuvaninga-gas-fired-power-plant-begins-construction/>

²² http://www.grupovidere.com/focus/energis/KuvaningaEnergia_PIM_MinisteriodasFinancas.pdf

²³ <http://www->

wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2014/07/23/000333037_20140723125052/Rendered/PDF/896220WP0P1318040Box0385289B00OUO0900ACS.pdf

²⁴ <http://www.nortonrosefulbright.com/knowledge/publications/100579/investing-in-the-african-electricity-sector>

²⁵ <http://ppi-re.worldbank.org/data/project/hmnk-mphanda-nkuwa-hpp-6483>

Below is a table identifying the priority hydropower projects in Mozambique’s development pipeline:

Name	Size (MW)	Status
Mphanda Nkuwa (PPP)	1500	Under development, Commissioning in 2017
CB North Bank (IPP)	1245	Under development, Commissioning in earliest mid-2017
Lupata (PPP)	600	Under development, Commissioning in 2020
Boroma (PPP)	200	Under development, Commissioning in 2020
Lurio (PPP)	120	Feasibility Study Completed

Table 2: Mozambique Hydropower Pipeline^{26 27 28 29 30}

Similar to natural gas, a major issue with these projects is the difference between the location where the power is generated and the load. The two largest projects would be developed in Tete province. With Mozambique’s significant store of fossil fuels, developers must weigh the price of additional transmission infrastructure, transmission losses, and significant development time against developing fossil fuel plants closer to population centers.

In response to the large size and disparity between electricity location and load centers, **distributed generation, particularly solar**, may provide a valuable addition to Mozambique’s energy composition. The potential resource opportunities with solar, wind, and geothermal are great, but projects have yet to mature in Mozambique. The total installed capacity of solar is only around 1 MW mainly providing electricity to rural schools, health centers and some homes. Wind and geothermal projects are largely in the research stage in Mozambique.³¹ The installed base of renewables in Mozambique is significantly further behind other African countries and there is tremendous opportunity to leverage renewables to reach rural populations that are far from the grid.

Transmission

The Centre-South transmission backbone project (known as CESUL), involves designing and constructing a transmission system that can evacuate approximately 6,000 MW of power to be generated in the Zambezi Valley, and to facilitate future grid expansion to meet the requirements of the Mozambican market. The project is planned to connect northern and Southern Mozambique with sufficient transmission capacity to provide access to the central region as well. Additionally, the project intends to allow Mozambique to trade the evacuated power with other members of SAPP, particularly South Africa. With 2,600 km of transmission line with 8 new substations, this project is seen as a major opportunity to facilitate private sector investment by improving Mozambique’s limited transmission infrastructure. Norway funded the feasibility studies and the rest of the project’s US\$1.8 billion is expected to be funded by the shareholders: the China State Grid Corporation (CSGC) (46%), ESKOM (25%), EDM (15%) and Portugal’s REN (14%).³² The project is designed to be developed using a Build Operate Transfer (BOT) structure.³³

Another high priority transmission project is the Mozambique – Malawi interconnector. The project entails constructing a 220 kV (upgradeable to 400 kV) transmission line joining Matambo substation in Mozambique to the proposed Phombeya substation in Blantyre West in Malawi. This transmission line would also result in Malawi getting connected to the SAPP

²⁶ <http://constructionreviewonline.com/2014/09/construction-of-lupata-and-boroma-dams-in-mozambique-to-start-in-2015/>

²⁷ <http://ppi-re.worldbank.org/data/project/hmnk-mphanda-nkuwa-hpp-6483>

²⁸ http://www.iisd.org/pdf/2013/investment_%20incentives_%20mozambique.pdf

²⁹ http://www.irena.org/DocumentDownloads/Publications/IRENA_Africa_CEC_infrastructure_2015.pdf

³⁰ www.intpow.no/?id=1339&download=1

³¹ <http://www.irena.org/DocumentDownloads/Publications/IRENA%20Mozambique%20RRA.pdf>

³² <http://www.macauhub.com.mo/en/2014/11/17/feasibility-studies-of-cesul-project-nearing-completion-in-mozambique/>

³³ <http://invest-tripartite.org/wp-content/uploads/2013/06/8-Mozambique-Transmission-Backbone-Project-Brief-26-05-20131.pdf>

network. Although the project is a priority for the two Governments and has been on the agenda for a long time there have been delays in its implementation. Mozambique submitted a formal request for funding the project to World Bank, Norwegian Government, African Development Bank and European Investment Bank for their consideration, while Malawi is understood as yet to submit theirs.

In addition, the ZIZABONA project connecting Zimbabwe, Zambia, Botswana and Namibia, is an important transmission project for Mozambique despite its indirect involvement. It would decrease the traffic along the north-south corridor from Zimbabwe to South Africa helping Mozambique's power transmission to South Africa. The ZIZABONA project is expected to be implemented in two phases, the first phase will cover the construction of a 120 km, 330 kV line and the second phase will involve the construction of a 300 km, 330 kV line.³⁴

Electricity Laws and Regulations

The Electricity Law of 1997 allows for private sector participation in the electricity sector through concession agreements granted by the government for the construction and/or operation of electricity assets. Approval by the Council of Ministers is required when rated capacity is more than 100 MW. In addition to obtaining a concession contract, the project must enter into a PPA with EDM for the sale of its capacity and electricity. There is no prescribed PPA type and as such tariffs are essentially set by contract, rather than being set through a blanket policy or regulatory authority. The Energy Law simply requires that tariffs are fair and reasonable. Given the lack of clarity on how this could be interpreted, it could be discouraging to private sector participation. The law has not been updated since its inception in 1997.

The Mozambican Energy Strategy of (2000) defines the responsibilities and regulations of the government owned institutions. It outlines the processes and regulations for: Price setting; service quality regulation and control; protection of consumer interests; awarding electricity concessions; ensuring the lowest cost, reliable power supply; quality and efficiency of power supply; and promotion of a more efficient, dynamic and competitive business sector.³⁵ The strategy was updated in 2015, establishing high level goals and guidance for electricity production, transmission, finance, prices, access, environment, and gender concerns.

The Strategy supplements Mozambique's Energy Policy by clearly outlining the role of government in the construction of programs, projects and investments. CNELEC, as a consultative body acting as the regulator, has the authority to ensure that some of the Energy Strategy components are met. Capacity building and more clearly defined regulatory authority for CNELEC would be helpful.

The 2010 Procurement Regulations apply to procurement undertaken by all state entities, including companies in which any state entity owns 100% of the equity, or where their financial activities are linked to state budgets (including funds provided from foreign governments or multilateral agencies). Electricity project bids are evaluated by the procuring authority (frequently EDM) and CNELEC.³⁶ The regulations are designed to ensure transparency, equality, competitiveness, impartiality and sound financial management by the government. However, anti-corruption institutions and the legal system in Mozambique are weak and corruption, especially in procurement continues to be rampant. It is unclear how significant an impact corruption has had on the electricity sector, but it has recently been a major discussion for extractive industries in the country.

³⁴ http://sadc-energy.sardc.net/index.php?option=com_content&view=article&id=188:south-africa-interested-in-joining-zizabona&catid=37&Itemid=143

³⁵ <http://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/documents/mozambiqueenergyLawEnglishVersion.pdf>

³⁶ <http://www.nortonrosefulbright.com/knowledge/publications/100579/investing-in-the-african-electricity-sector>

Electricity Tariffs and Pricing

According to Norton Rose, the price or tariff that ECM pays for electricity generation is not subject to regulatory approval, but is set by the concession contract for each project. The Energy Law says that tariffs are fair and reasonable as long as the structure ensures the minimum potential cost to customers given the service provided while allowing for a return on the capital investment of developers. Determining the minimum potential cost is relative and without a strong regulator to oversee this process this will be difficult to maintain as more IPPs come on-line.³⁷ Thus, tariff “fairness” is determined by negotiations with ECM.

EDM tariffs to customers are unified across the country. In impoverished and distant regions (central and northern parts of Mozambique), where supply and distribution are more expensive than the tariff charged due to long distances and low customer density, combined with low consumption per customer, cross-subsidy takes place from the more profitable southern region. In addition, there is a tariff subsidy extended to all customers irrespective of their location, which means that EDM operates at a loss.

Additionally, the tariff structure across user categories is progressive, the greater the domestic consumption, the higher the unit rate.³⁸ This provides a rate subsidy for the lower income users. The tariffs are broken into 4 categories, social, household, farming, and general. There is an increasing tariff based on consumption charged to all customers except the social tariff customers and pre-payment participants. The social tariff is for users who use fewer than 100 kWh/month, and is a flat rate of 107 Mt/month.³⁹ With a conversion rate of 37 metical to 1 USD, the general tariff for 0 to 100 kWh is \$0.08/kWh.

According to the Electricity Master Plan, considering current electricity tariff levels, a substantial increase is required (to about \$0.13-14 kWh) to support the development of generation and transmission upgrades to meet estimated demand growth.⁴⁰

Electricity Sale Price, Metical per kWh					
Recorded Consumption (kWh)	Social Tariff (Mt/kWh)	Household Tariff (Mt/kWh)	Farming Tariff (Mt/kWh)	General Tariff (Mt/kWh) (USD/kWh)	Flat Rate (Mt/kWh)
From 0 to 100	1.07	N/A	N/A	N/A	N/A
From 0 to 200	N/A	2.50	2.68	2.97	85.35
From 201 to 500	N/A	3.53	3.81	4.24	85.35
Above 500	N/A	3.71	4.17	4.64	85.35
Pre-Payment	1.07	3.18	3.71	4.26	
Electricity Sale Price, Dollars per kWh (at 37 Metical/\$)					
From 0 to 100	0.029	N/A	N/A	N/A	N/A
From 0 to 200	N/A	0.068	0.072	0.080	2.307
From 201 to 500	N/A	0.095	0.103	0.115	2.307
Above 500	N/A	0.100	0.113	0.125	2.307
Pre-Payment	0.029	0.086	0.100	0.115	

Table 4: EDM Tariffs

³⁷ <http://www.nortonrosefulbright.com/knowledge/publications/100579/investing-in-the-african-electricity-sector>

³⁸ http://www.iisd.org/tkn/pdf/energy_security_mozambique.pdf

³⁹ http://www.edm.co.mz/index.php?option=com_content&view=article&id=121&Itemid=83&lang=pt

⁴⁰ http://www.speed-program.com/wp-content/uploads/2015/02/2014-SPEED-Report-042-Analysis-of-the-Power-Crisis-and-its-Impact-on-the-Business-Environment-EN_DRAFT2.pdf

LOSS REDUCTION

Loss Reduction Strategy

Mozambique's Energy Strategy outlines a goal of reducing combined transmission and distribution losses to 15%.⁴¹ While reports of the extent of losses vary, a 2012 report we have reviewed indicates them to be in the range of 21%-23%.⁴² Losses of this magnitude are supported by Sergio Parruque, the commercial Director of EDM, who stated in recent conversations with USAID that the majority of the roughly 23% losses in the system are mainly attributed to technical losses rather than non-technical.⁴³

EDM's current priority appears to be more focused on continuing to increase its customer base from its current ~1.2 million connections, rather than loss reduction. However, like all utilities in the SADC region, EDM has stated an intention to reduce losses, and it has implemented some loss reduction programs, including a successful prepaid system called CREDELEC, which we describe below. Since we have been unable to locate an Annual Report after 2012, or financial statements, it is difficult to ascertain the exact efficacy of such initiatives, but reports are positive.

Current Loss Landscape

It is difficult to establish the value of EDM losses given the lack of accessible data. In 2011, publically available documents report that illegal connections, illegal use of electricity, fraud on electrical installations, corruption of electric meters and other non-technical losses amounted to an annualized amount ~\$26 million USD⁴⁴. However, this seems low, given headline national consumption and loss data, even accounting for the availability of very cheap (i.e. fully depreciated hydro) power. Electricity theft may be driven by the desire for free electricity, but also because of the difficulty to secure a connection. Prior to the installation of a meter, an interested party must first contact the Ministry of Energy to request authorization for the connection, followed by external inspections by both EDM and the provincial energy directorate.⁴⁵ In addition to commercial losses, EDM also attributed an additional ~\$2 million to vandalism of distribution and transmission infrastructure in 2011.⁴⁶ In 2014, EDM reported 50 separated instances of theft and sabotage of electrical material.⁴⁷

Additionally, compensation programs for local residents living in the area of new transmission lines have been largely unsuccessful, and have prevented the proper construction and operation of infrastructure. Dwellings in areas requiring right of way and access can be illegal and are often rebuilt after compensation is provided for relocation.⁴⁸

While the extent of technical losses is also the subject of some disagreement, where data was available for regional breakdown for EDM service territory, the lowest losses were recorded in the Centro Norte region at 3% (the region where the HCB plant generates), and highest in the Norte region at 13%.⁴⁹ We have seen reports that put distribution loss averages for the entire EDM system at around 23%, with the lowest percentage of loss also in the Centro Norte region at 19%, and the highest losses found in the densely populated Sul (southern) region.⁵⁰ The Centro Norde region understandably has the lowest losses as the infrastructure in the area has been developed and maintained for the HCB station. The Norde region is far less densely populated than other regions contributing to the increase in transmission losses, as investment in the system has been low. The Sud region, by contract,

⁴¹ Energy Strategy (2014 -2023) Ministry of Energy

⁴² Sumario Estatístico 2012 Final, 2012

⁴³ Personal Correspondence

⁴⁴ <http://www.macauhub.com.mo/en/2011/07/28/mozambique%E2%80%99s-electricity-company-edm-loses-us13-million-through-power-and-equipment-theft-in-first-half/>

⁴⁵ OECD Investment Policy Reviews OECD Investment Policy Reviews: Mozambique 2013

⁴⁶ RELATÓRIO E CONTAS 2011 ANNUAL REPORT

⁴⁷ <http://allafrica.com/stories/201411200984.html>

⁴⁸ <http://constructionreviewonline.com/2015/03/mozambique-construction-of-infulene-marracuene-transmission-line-affected-by-illegal-buildings/>

⁴⁹ RELATÓRIO E CONTAS 2011 ANNUAL REPORT

⁵⁰ RELATÓRIO E CONTAS 2011 ANNUAL REPORT

is the most densely populated and the population is increasing rapidly, making it difficult for EDM to keep up with the power infrastructure needs of the region, which may be contributing to higher loss rates here.⁵¹

Loss Reduction Initiatives

Non-technical/commercial loss reduction

EDM is focused on decreasing non-technical losses by taking a combined technological and community based approach. EDM has been in the news for the last few years **promoting campaigns to “dismantle or stop” electricity theft**. EDM has advised community members to condemn fellow members of their communities who steal electricity through formal reporting to EDM.⁵² In fact, EDM has actively worked to support community leaders in their efforts to combat the losses, although the extent of the support is difficult to calculate.⁵³ A potential key contact for revenue management is Dr. Celestino Pedro Siteo, a lawyer in the Department of Prevention and Combating of Vandalism that has been active in the press speaking out against the rise in equipment dismantling for scrap metal markets.⁵⁴ In addition, EDM communicates on its website the breakdown of fines for destruction/tampering with metering equipment, fraud, electricity theft and for non-payment.⁵⁵

Technologically, EDM has established a relatively successful **prepaid system** called **CREDELEC**, which EDM reports reached 80% of customers by 2011 and helped them maintain a collection rate of 97% across all of EDM’s accounts (while these numbers may be overly optimistic, the meters have improved EDMs revenue management).⁵⁶ Customers have the ability to purchase prepaid credits at gas stations, vending machines, ATMs, promotional vouchers, mobile phones, and over the internet on EDM’s website.⁵⁷ Growth in electricity theft in the form of non-payment has been reduced.⁵⁸ CREDELEC is managed by EDM’s Department of Technology and Information Systems (DTSI) in conjunction with the Commercial Division (DIC).⁵⁹ The prepaid system has higher tariffs for household, farming, and general use for use of less than 200 kWh, but maintains a constant (i.e. lower) rate for social users.⁶⁰ Following on the original implementation of prepaid meters, EDM has launched a second phase to help customers to manage their bills and improve collections.⁶¹ Originally EDM adopted vending system prepaid meters in 1995, but the new system is a more advanced Itron system that allows for all electricity vending sites to operate in real time over the network. All new customers in Maputo are required to use the new pre-paid system. The second phase of implementation will be rolled out in the Central provinces of Mozambique in 2015.

The Supply, Installation & Training of an Integrated Business Management System (SIGEM) program, funded in large part by the World Bank, provided significant capacity building, operational and organizational help for EDM. The program drove initiatives around metering, collections, and data management practices which all strived to support a major tenant of the procurement: combatting non-technical losses. Assistance was provided to EDM to help it better understand a variety of commercial processes which directly affect EDM’s revenue management including, post and pre-paid meter collections, client debt management, customer service, and non-technical energy losses. EDM also looked to improve data management in the hopes that the company would be able to easily identify and profile

⁵¹ RELATÓRIO E CONTAS 2011 ANNUAL REPORT

⁵² <http://allafrica.com/stories/201411200984.html>

⁵³ <http://www.jornalnoticias.co.mz/index.php/provincia-em-foco/35191-manica-fabrica-de-sumos-retoma-atividades-em-macate>

⁵⁴ <http://www.clubofmozambique.com/solutions1/sectionnews.php?secao=mozambique&id=1265&tipo=one>

⁵⁵ http://www.edm.co.mz/index.php?option=com_content&view=article&id=121&Itemid=83&lang=en

⁵⁶ RELATÓRIO E CONTAS 2011 ANNUAL REPORT

⁵⁷ http://www.edm.co.mz/index.php?option=com_content&view=article&id=63&Itemid=67&lang=en

⁵⁸ Sumario Estatísticos 2012

⁵⁹ http://www.edm.co.mz/index.php?option=com_content&view=article&id=521%3Aedm-discute-pao-para-2015&catid=53%3Anoticias&Itemid=78&lang=en

⁶⁰ http://www.edm.co.mz/index.php?option=com_content&view=article&id=121&Itemid=83&lang=en

⁶¹ <https://www.is.co.za/press-release/is-mozambique-supports-prepaid-rollout>

debtors, including their location, to help inform non-technical loss reduction initiatives⁶² EDM has **continued to focus on its management functions, making more attempt to** align its technical and commercial business units. Following on this, at EDM's 2015 annual budget meeting there was consensus that EDM needs to invest in its human resources, including better training its staff in order to cut losses that are a result of improper management.

DONOR LOSS REDUCTION INITIATIVES

It will be important to coordinate with the World Bank and the African Development Fund, the two most active donor organizations in the Mozambican electric utility reform assistance, to determine the other international development agencies and programs that are currently active. Under the World Bank programs a number of different development agencies including the Swedish International Development Agency (SIDA), the Norwegian Agency for Development (NORAD) and KfW were involved, but it is unclear whether or not they are still active and whether the programs they may be implementing continue to move forward.

World Bank

Energy Development and Access Project (EDAP APL-2)

Funding from the World Bank and Agence Francaise de Developpement (AFD) for Component 1 of this initiative supports the rehabilitation and reinforcement of primary network and grid extension and customer connections. In addition, one of the components is implemented by EDM and relates to the improvement of the utility's data management tools and to physical activities for reinforcement of the primary network and grid extension, including considerations of technical and non-technical loss reduction. The goal of the program is to meet loss reduction targets by 2015-2016 but targets are still being determined. The Government of Mozambique (GoM) requested to use US\$4.5 million of the existing project funds for priority and urgent investments in improvements to infrastructure.⁶³ Part of this is for EDM to adopt a smart meter system. With credit from IDA (International Development Association), EDM is implementing an integrated management system for EDM's internal processes (SIGEM, described above).⁶⁴ This funding will help EDM to implement Smart Meters, aiming to achieve permanent protection of the revenues generated from sales to all its largest customers. In addition to the Smart Meter program, the SIGEM project supported the installation of a commercial management system for meter reading, billing, collection, and customer service concerns related to disconnection and reconnection for commercial debts and new contracts respectively.

World Bank Energy Reform and Access Program (ERAP) Phase I

Co-financed by the AfDB, NDF and the World Bank, ERAP includes a sector reform component to further address many of the outstanding electricity sector reform issues. One of the objectives of ERAP was to unbundle and privatize EDM, which has not happened and the program has shifted instead to improving EDM performance, including by reducing power losses.⁶⁵

⁶² http://www.edm.co.mz/index.php?option=com_docman&task=doc_download&gid=112&Itemid=41&lang=en

⁶³ http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/02/23/000442464_20150223092853/Rendered/PDF/RES140500PJPR00385422B00PUBLIC00ACS.pdf

⁶⁴ http://www.edm.co.mz/index.php?option=com_docman&task=doc_download&gid=112&Itemid=41&lang=en

⁶⁵ http://www.afdb.org/fileadmin/uploads/afdb/Documents/Evaluation-Reports_-_Shared-With-OPEV_/Mozambique%20-%20PPER%20-%20Electricity%2011%20Project.pdf

African Development Fund

African Development Fund (Electricity I-IV Projects)

Starting in the late 1990s, the ADF has been working with Mozambique on the electricity sector. The fourth project was financed in 2006 with an ADF loan. The major aim of the program was to improve the financial viability of EDM and the loan terms included loss reduction goals as well as other utility reforms such as EDM staff reductions, improvements in collection days, asset maintenance improvements and implementing tariff and regulatory reform. The AfDB Program Evaluation of the Electricity Projects conducted in 2006 mentioned that it has been very hard to tie loss reduction to loans and that while reforms were implemented impact was hard to measure.⁶⁶

INITIAL REVIEW

Strengths

Recognizing that controlling commercial losses is important for its financial position, EDM has successfully implemented strict and transparent laws and penalties while at the same time investing in technologies to support customer payment. Additionally, there is financial and political support within EDM and the Ministry for improving the transmission and distribution of electricity.

The utility has determined that combatting theft in their system should include both social and technological solutions and EDM has been focused on implementing programs through both channels. This strategy has been received positively from the communities harmed by theft and vandalism, as customers have been increasingly voicing their desire for consistent, reliable service which was previously not expected in many parts of the country.

In terms of specific revenue management units, EDM has established a dedicated Department of Prevention and Combating of Vandalism and Directorate of Energy Efficiency. The figureheads of these units are active in news reports on vandalism and theft, a function which is essential for public awareness in the absence of consistent reporting on losses. In addition, Mozambique includes loss reduction in its Energy Master Plan. While focused on generation and larger scale transmission and distribution infrastructure, it includes the plan for technical and non-technical loss reduction and how it should tie into the overall electricity sector plan.

Improvement Areas

Mozambique's power sector is not in good shape. Symptoms range from the low level of electrification to an overstuffed utility, high losses and little private participation. There are many areas for improvement, such as:

Developing and Budgeting for Loss Reduction Programming. Despite recognition of the issue by EDM, and some success with the CREDELEC initiative, losses remain very high yet there does not seem to be evidence of a further or significant formal loss reduction program. Perhaps understandably given the low levels of electrification, EDM is largely focused on increasing its customer base and the access rates, rather than protecting its supply and infrastructure from theft and dismantlement. EDM has certainly recognized that the growth in their transmission and distribution network will not be sustainable without a decrease in losses, and have hinted at slowing the development of projects if the problem continues. Compared to some peers, EDM's losses may not be extreme, but a cost benefit analysis of investment in access versus a loss reduction program should be conducted.

⁶⁶ http://www.afdb.org/fileadmin/uploads/afdb/Documents/Evaluation-Reports_-_Shared-With-OPEV_/Mozambique%20-%20PPER%20-%20Electricity%2011%20Project.pdf

Fostering Leadership in the Community. While the societal view of their loss problem has been able to galvanize local support, EDM has yet to provide detailed reports on their backing for local communities working to prevent service disruptions. While this does not indicate an absence of a program, EDM's support for local communities was announced within the last quarter (April 2015) in off handed remarks, indicating any programs that do exist are nascent.

Building Capacity within EDM Departments to coordinate and adopt more targeted loss reduction strategies. While the departments within EDM are encouraging the development of loss reduction initiatives, they are not always in coordination. This is exacerbated by the different funding sources for projects that at times have different and contradictory priority goals. In addition, given the geographical spread of Mozambique, loss reduction may need to be targeted and thought of differently for each region to ensure that the actual reasons behind the losses are addressed. This will take capacity building not only at the central level but in the regions.