DNV·GL

TECHNICAL MARKET REVIEW

Country Profile: Zimbabwe

CTCN

Report No.: REPORT NO, Rev. Draft
Date: 2018-06-06

CLIMATE TECHNOLOGY CENTRE & NETWORK

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Review of potential for implementation of energy efficiency policies and strategies for lighting, refrigerators, air-conditioning, motors and transformers

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1 EXECUTIVE SUMMARY

This report reviews the potential for increasing the energy efficiency of products in Zimbabwe, one of the larger energy consumers in Southern Africa, by providing a technical market assessment of current conditions and policies. Five specific product categories have been reviewed: lighting, air-conditioning, refrigerators, motors and transformers.

Research conducted by DNV GL during 2017 provides context and insight in relation to the barriers and opportunities, along with a set of recommendations to support Zimbabwe in achieving its sustainability goals. Within this context, DNV GL presents its best estimation of technical potential for each product category by policy recommendations intended to achieve savings over standard equipment using assumptions based on the research undertaken during this project.

General remarks

Energy efficiency is not a primary policy priority in Zimbabwe. Rather, electrification, food, water, housing and other key issues understandably take precedence. Zimbabwe's economy is growing, with improved living standards expected to result in increased energy demand. The state utility has made efforts to promote efficient lighting to replace incandescent bulbs. At the same time, significant barriers remain regarding expansion of access to electricity beyond present users and addressing a cultural shift from biomass to more modern fuels. In addition, there are economic constraints associated with financing of energy projects. Zimbabwe has a limited number of trained personnel for large scale energy systems. In order to effect meaningful change in the adoption of energy efficient equipment and products, a regional strategy would likely have a greater impact on product manufacturers and distributors, which in turn would result in impacts to Zimbabwean markets.

Underlying process

DNV GL conducted an initial desktop analysis before sending out data requests and setting up meetings with local entities within Zimbabwe. These included the Zimbabwe National Commission for Science and Technology, Ministry of Natural Resources, Energy and Environment, Zimbabwe Electricity Supply Authority (ZESA) and other local stakeholders such as contractors, suppliers and installers of technologies. Meetings and interviews were conducted over several days within the country, as well as via email and phone. Key findings are highlighted below.

National Designated Entity (NDE) prioritisation

In light of the power sector reform, energy efficiency (and this project in particular) is not the primary priority of the NDEs. Electrification, food, water, housing and other more pressing and relevant issues understandably take priority. Thus, very little capacity remains to track or research the data required for this survey. Further to that, the NDE's receive very little support and feedback from the other entities within their countries (Revenue Authorities, Trade Organizations, Utilities, Statistics Bureau etc.), which resulted in delayed turnaround, with limited feedback and uncertainty over the accuracy of the provided data.

Cost Sensitivity

Due to high levels of poverty in Southern Africa, the markets are extremely sensitive to upfront prices. Energy efficiency and lifecycle costing typically comes at a premium and any additional costs have large impacts on short-term cashflows. For example, additional costs for higher efficiency refrigerators must be secondary to ensuring existing versions are filled with supplies.

Africa is a small market

The entire African content consumes less than 5% of all electricity in the world. Therefore, it is understandable that manufacturers have little interest in spending time and resources to invest in, let alone track, the African market, and even less to specific countries.

Energy Efficiency is perceived as a conflict of interest for utilities

Reducing the sales of electricity by promoting energy efficiency effectively reduces some potential revenue from the utility. On a positive side, current lack of sufficient capacity results in regular power outages, so reduced consumption could be redistributed. Since the utility is state owned, this enables the state to use the utility to drive energy efficiency roll outs despite the apparent conflict.

Subsidised electricity tariffs

ZESA electricity charges are low compared to Europe at 0.085 USD per kWh for residential customers. These are government subsidised (therefore lower) tariffs, which result in longer payback periods for energy savings projects or energy efficient technologies than if full utility costs were charged. This will have negative impacts on the sales of higher efficiency units, compared to their cheaper but less efficient competitors. Unfortunately, the low average incomes prevent the state-owned utilities from increasing the tariffs to be fully cost reflective of generation, as many people would then not be able to afford electricity, which in turn would adversely affect both the economy and the uptake of electrification.

Energy Policies

Like several other countries in the region, Zimbabwe has an energy policy in draft, but this is at very high level, does not address any technologies, does not have any regulations, and provides no enforcement mandate.

Conclusions

Despite the limitations noted, including low population density and low incomes, Zimbabwe has much to gain by adopting energy efficient standards and technologies. The market research, data collection and analysis conducted by DNV GL during this study has been able to provide insight into the five product categories of primary energy-consuming appliances and equipment covered (lighting, air-conditioning, refrigerators, motors and transformers).

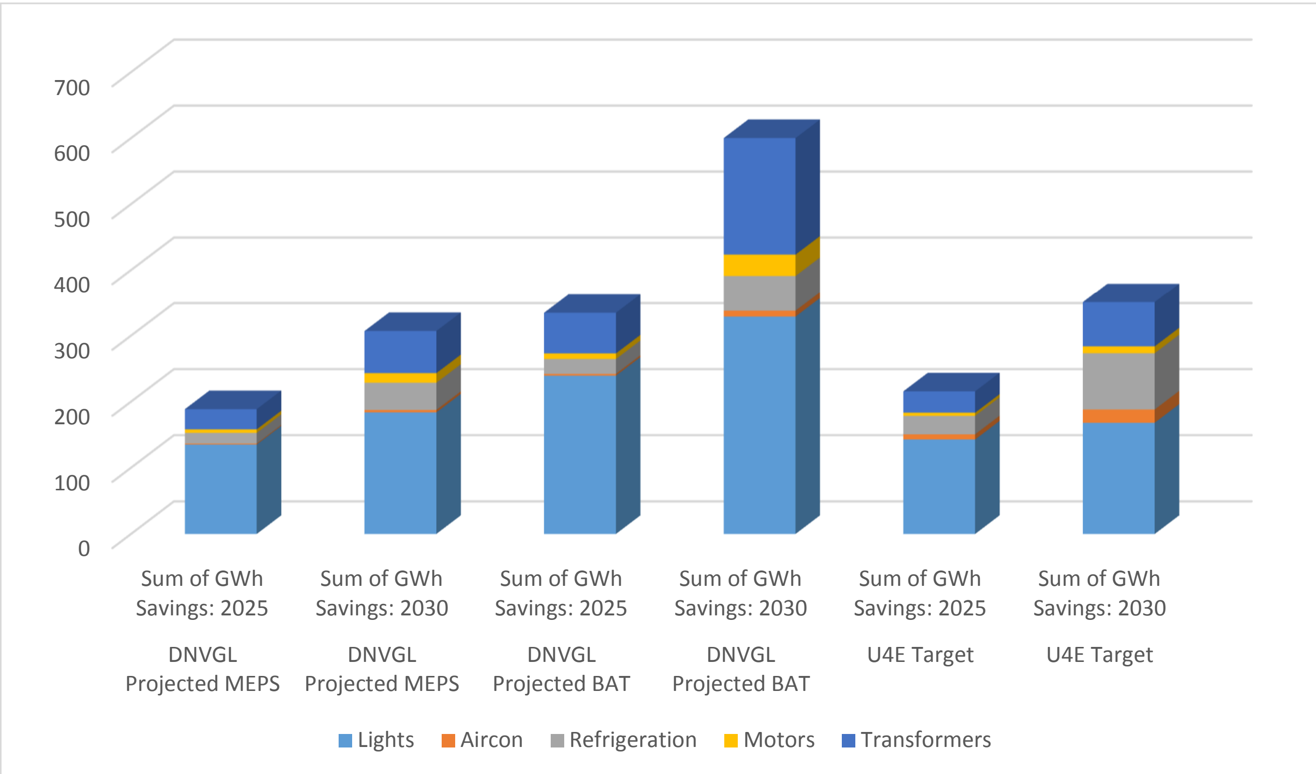
The projected energy savings for Zimbabwe when moving from the current state of technologies to Minimum Energy Performance Standards (MEPS) or to the Best Available Technologies (BAT) are shown in Table 1.1 and **Error! Reference source not found.** below. More detail on the underlying approach used to arrive at these can be found in the sections of the report for each of the individual product categories. Section 2.6 presents more detail as to the assumptions used in the modelling process.

The overall savings potentially yielded by the adoption of MEPS are expected to increase from 189 GWh (187t CO_2) per annum in 2025 to 307 GWh (305t CO_2) per annum in 2030. BAT projected savings for 2025 are projected as 335 GWh (332t CO_2) per annum while savings yielded in 2030 are projected as 600 GWh (595t CO_2).

Table 1.1 Projected MEPS and BAT savings for Zimbabwe.

	GWh savings (2025)	**GWh savings (2030)**	**MUSD savings (2025)**	**MUSD savings (2030)**	**GHG savings (2025)**	**GHG savings (2030)**
DNV GL Projected MEPS						
Lights	135	184	11	23	134	182

	GWh savings (2025)	GWh savings (2030)	MUSD savings (2025)	MUSD savings (2030)	GHG savings (2025)	GHG savings (2030)
Aircon	1	4	0	1	1	4
Refrigeration	16	41	1	5	16	41
Motors	5	15	1	4	5	14
Transformers	31	64	5	18	30	63
Total	**189**	**307**	**18**	**51**	**187**	**305**
DNV GL Projected BAT						
Lights	239	329	19	42	238	326
Aircon	3	9	0	2	3	9
Refrigeration	22	53	2	7	22	53
Motors	8	32	1	9	8	32
Transformers	62	177	11	49	61	175
Total	**335**	**600**	**33**	**109**	**332**	**595**
U4E Targets						
Lights	143	378	46	54	18	21
Aircon	80	120	11	17	5	7
Refrigeration	39	71	6	10	2	4
Motors	28	63	4	9	2	4
Transformers	67	140	10	20	3	7
Total	**537**	**773**	**76**	**110**	**30**	**43**



2 INTRODUCTION

2.1 General Information about Zimbabwe

Zimbabwe, formerly Rhodesia, is a landlocked country in southern Africa. It borders South Africa, Botswana, Zambia, and Mozambique. Zimbabwe is elevated in the central plateau at altitudes between 1,200m and 1,600m. The east is mountainous, with Mt. Nyangani the highest point in Zimbabwe at 2,592 meters. About 20 percent of Zimbabwe is low veld under 900 meters. Victoria Falls is located in the Northwest corner of the country.

Zimbabwe occupies 390,757 km² of land in south-central Africa, between the Limpopo and Zambezi rivers.

Size (km^2)	390,759
Population (Est, 2017)[1]	16,346,405

Harare is the capital city of Zimbabwe, a vital commercial and industrial business centre; other centres include Bulawayo and Mutare. Zimbabwe is a member of the United Nations and the Southern African Development Community (SADC), but is not a member of the Commonwealth of Nations. About 21% of the population survives on less than US$1.90 a day (the international poverty line), based on 2011 statistics. In 2016, the World Bank classified Zimbabwe as a "low income" country because the annual gross national income (GNI) per capita levels is USD 1,045 or less.

[1] [2] [3] [4] [5] [6] [7]

2.2 Climate and Topography

The climate is tropical with a rainy season from November to March. The climate is markedly varied by altitude. There is a dry season, including a short cool season during the period May to September when the whole country has very little rain. The country is influenced by the Intertropical Convergence Zone during January. Much of the country is high plateau with higher central plateau (high veld) forming a watershed between the Zambezi and Limpopo river systems. The Limpopo and the lower Zambezi valleys are broad and relatively flat plains. The eastern end of the watershed terminates in a north-south mountain spine, called the Western Highlands.

[1] [2] [3] [4] [5] [6] [7]

2.3 Electricity Sector

Zimbabwe is a member of the Southern African Power Pool (SAPP), which began in 1996 as the first formal international power pool in Africa, with a mission to provide reliable and economical electricity supply to consumers in SAPP member countries. Zimbabwe also joined the International Renewable Energy Agency (IRENA) - a global initiative to promote and reduce barriers to the uptake of renewable energy.

The IRENA document titled Southern Africa Power Pool: Planning and Prospects for Renewable Energy documents the installed energy capacity for 2014 and projected for 2030. The Integrated Energy Planning operational branch of the Department of Energy, established in May 2009, develops, implements and maintains a National Integrated Resource Plan (IRP). The following graph shows the 2014 and 2015 data, as well as the IRP 2010 targeted energy mix for 2030.

Figure 2.1 Installed energy capacity for 2014 and 2030 [8]

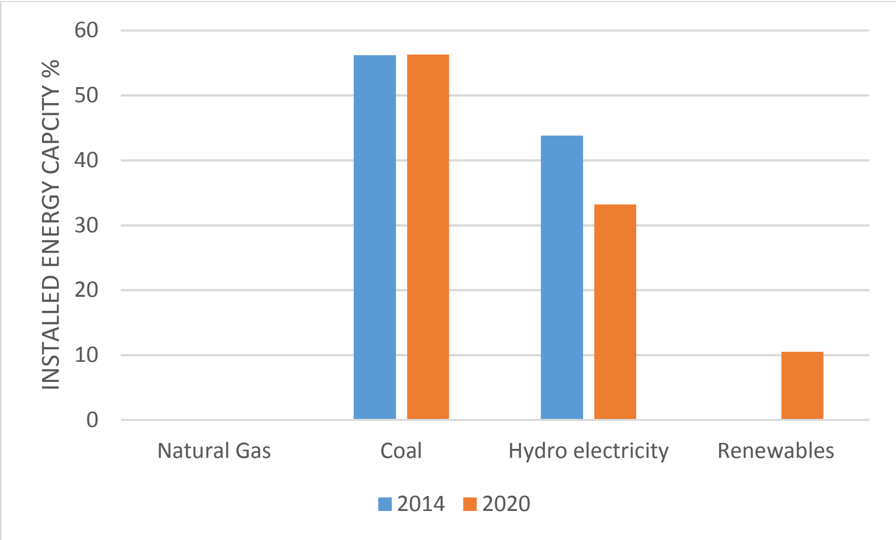


Figure 1.1: Installed Energy Capacity for 2014 and 2030

Note: Renewables includes Solar PV, Solar Thermal, and Biomass

Much of Zimbabwe's electricity is produced at the Kariba Dam Hydroelectric Power Station, at Hwange Thermal Power Station, at three minor coal-fired stations, at Rusitu Hydro mini-hydro plant and at about 8 small-hydro plants. The use of hydropower has also proved a major issue at the Kariba dam, which has experienced extremely low water levels (12% in February 2016). In the past, there has been severe load shedding in order to deal with power shortages due to droughts. As a result, the country utilises large power imports from neighbouring countries including Mozambique, South Africa, the Democratic Republic of Congo and other countries in the region.

	GW	*Approx.*
2015		**2.1**
2025		**3.6**

In 2014 around 42% of energy consumed was imported; in 2030 this may drop to around 12%.

Solar power is mostly installed in rural areas of Zimbabwe at service centres such as schools, clinics, police stations and hospitals. However, the private home market for solar is growing. Solar-powered ‘base stations’ for charging electrical appliances have also been installed through the national telecommunications company NetOne. More than 200 biogas plants have been installed in Zimbabwe, mainly by the Department of Energy, via African Energy Policy Research Network (AFREPREN). In the south of Zimbabwe, there are 2 sugarcane-crushing mills that use bagasse for electricity generation. Hwange Colliery Company (HCC) is the major coal company in Zimbabwe, 38% owned by the government.

All coal-fired stations in Zimbabwe need major upgrades as they have frequent production stops or are not producing at all. As a result, by 2016 Zimbabwe derived its electricity mainly from hydropower sources, which accounted for 68% of total generation capacity. Despite the droughts, 40% of the population has access to electricity, with access to electricity in rural areas (19%) much lower than in urban areas due to the prohibitive costs of extending national electricity grids. In rural Zimbabwe, 80-90% of people are heavily dependent on wood fuel, light their homes with kerosene, and carry out essential food processing tasks, such as milling grain, using diesel-powered systems. Regarding fuels for cooking, rural areas rely predominantly on traditional biomass and inefficient stoves. More than 60% of biomass is predominantly non-renewable, as seen from the large discrepancy of fuel-wood harvested annually and low rate of reforestation.

Table 2.1 provides a summary of major energy efficiency and demand-side management (DSM) activities in Zimbabwe.

Table 2.1 ENERGY EFFICIENCY AND DEMAND-SIDE MANAGEMENT (DSM) ACTIVITIES IN SADC MEMBER STATES AND UTILITIES [9]

PROGRAMME TYPE	CFL EXCHANGE	ENERGY-SAVING AWARENESS	DEMAND MARKET PARTICIPATION	TIME-OF-USE TARIFF	HOT WATER LOAD CONTROL	SOLAR WATER HEATING	ENERGY EFFICIENCY IN BUILDINGS	ENERGY EFFICIENCY AUDITS	PREPAID METERS	GENERAL REHABILITATION	TRANSMISSION LINE UPGRADE	POWER FACTOR CORRECTION	DISTRIBUTION LOSS REDUCTION	STANDARDS AND PRODUCT LABELLING
Zambia	X	X		X	X		X	X	X	X	X	X	X	

Note: The "X" indicates the presence of the listed policy type in the country.

The national utility ZESA (Zimbabwe Electricity Supply Authority) has implemented a CFL (compact fluorescent light) roll-out, with project performance monitoring and verification provided by the University of Zimbabwe. Under the pre-payment meter programme, the utility had installed 580,000 meters towards a target of 800,000 meters for residential customers. In 2015 the utility also planned to install 80,000 pre-payment meters for energy-intensive non-residential customers. A time-of-use tariff and rehabilitation of an existing hot water load control programme are also envisaged. According to the 2015 ZERA (Zimbabwe Energy Regulatory Authority) Annual Report, the results of the National Energy Efficiency Audit (NEEA) gave impetus to the development of strategic interventions in different sectors. Savings were made through demand-side management as the power utility surpassed the 40MW target, on the way to achieve 100MW by end of the year. To promote the deployment of energy efficient lighting technology, ZERA sponsored a demonstration project for installation of LED (light-emitting diode) lighting at the Ministry of Energy and Power Development Office complex, Harare Hospital Children's Ward and ZERA Offices. In 2015, ZERA also rolled out stakeholder engagement sessions for different sectors, resulting in it exceeding the set target of awareness campaigns during the year. The rollout was complemented by 16 radio programmes on different energy issues which aired on three national radio stations during the year. The Authority capped the energy efficiency drive by facilitating the training of 60 Certified Energy Managers from 26 different companies. This pool of resources is expected to inculcate an energy efficiency culture at an organisational level which will result in significant savings.

Table 2.2 below provides a summary of energy efficiency targets by type of programme. Because most targets are qualitative rather than quantitative, the table is simply an indication of whether a particular policy target has been, or soon will be, implemented.

Table 2.2 THE NATIONAL ENERGY EFFICIENCY TARGETED PROGRAMS [9]

TARGET TYPE	LIGHTING RETROFIT	REDUCE ELECTRICITY DISTRIBUTION LOSSES	IMPROVED COOKING DEVICES	LOAD MANAGEMENT	STANDARDS AND LABELLING	FINANCING	REVISED BUILDING CODES
Zimbabwe	X	X	X	X			

Note: The "X" indicates the presence of the listed policy type in the country.

TABLE 2.3 below indicates Zimbabwe's targeted GWh savings per product type by 2030, assuming a successful implementation of the various Energy Efficiency strategies.

Table 2.3 COMMITTED TARGETS FOR ENERGY SAVINGS [10]

U4E PATHWAY TO ENERGY EFFICIENCY	TARGETED ANNUAL GWh SAVINGS BY 2030				
	LIGHTING	RESIDENTIAL REGRIGERATO	ROOM AIR-CONDITIONERS	INDUSTRIAL ELECTRIC	TRANSFORMERS
Zimbabwe	624.3	191.4	84.2	37.3	280.9

(Extracted from the U44E Country Assessment, December 2016)

Zimbabwe is a member of the Southern African Power Pool (SAPP), which began in 1996 as the first formal international power pool in Africa with a mission to provide reliable and economical electricity supply to consumers in SAPP member countries. Zimbabwe also joined the International Renewable Energy Agency (IRENA) - a global initiative to promote and reduce barriers to the uptake of renewable energy.

Although encouraged by SAPP, the following activities were not yet initiated: general rehabilitation, power factor correction, transmission line upgrade and distribution loss reduction.

[11] [12] [13] [14] [10] [15] [16] [17] [8] [18] [9] [19] [20] [21]

2.4 Power Industry Regulation

The Power Sector Regulatory environment is displayed below:

Organizations responsible for energy policies	Ministry of Energy and Power Development (MOEPD) The Zimbabwe Electricity Regulatory Authority (ZERA)
Energy Regulator	The Zimbabwe Electricity Regulatory Authority (ZERA)
Energy policy publications	The Electricity Act, 2002 National Energy Policy 2012 The Rural Electrification Act, 2011 Energy Regulatory Act, 2011 Draft Renewable Energy Policy

Main entities in the electricity market	Zimbabwe Power Company Zimbabwe Electricity Distribution Company

Through the national energy policy, the government plans to ensure efficient utilization of energy resources. The International Energy Initiative has previously run programs to promote the efficient use of energy, most notably the Zimbabwe Energy Efficiency Project (ZEEP). Under the ZEEP, industrial efficiency has been increased, and efforts were undertaken to produce government standards for efficient appliances and equipment, specifically lighting, water heaters and refrigerators (MOEPD, 2008). In 2015, the Inefficient Lighting Products Ban and Labelling Regulations were submitted to MOEPD for promulgation. It sets the minimum performance standards for lighting products such as lumens, efficiency and service life and effectively bans incandescent lighting and other inefficient lighting products. The Ministry of Energy and Power Development is still developing a Renewable Energy Policy. This is being addressed through a number of initiatives. To date, there are no targeted programmes in the form of financial support schemes to assist the productive sectors to invest in energy efficiency and/or renewable energy projects.

Table 2.4 summarises the current energy efficiency support policies in Zimbabwe, as reported in 2016.

Table 2.4 POLICIES INITIATED BY 2016 [9]

POLICY TYPE	INDUSTRIAL COMMERCIAL LOAD REDUCTION	RESIDENTIAL INCENTIVES (LIGHTING, HOT WATER	SUPPORT FOR EFFICIENT COOKING AND HEATING	BUILDING EFFICIENCY GUIDELINES	SOLAR WATER HEATER SUBSIDIES	MANDATORY ENERGY MANAGEMENT FOR INDUSTRY AND	REDUCED DISTRIBUTION LOSSES	TRANSPORT EFFICIENCY STANDARDS	BIOFUELS PRODUCTION INCENTIVES/ TAX	VOLUNTARY BUSINESS ENERGY EFFICIENCY
Zimbabwe	X	X	X						X	

Note: The "X" indicates the presence of the listed policy type in the country.

Table 2.5 RENEWABLE ENERGY SUPPORT POLICIES INITIATED BY 2016 [19]

POLICY TYPE	RENEWABLE ENERGY TARGETS	FEED-IN TARIFF / PREMIUM PAYMENT	ELECTRIC UTILITY QUOTA OBLIGATION	NET METERING / NET BILLING	TRANSPORT OBLIGATION / MANDATE	HEAT OBLIGATION / MANDATE	TRADING REC	TENDERING
Zimbabwe	O				O			

Note: The O "EXISTING NATIONAL (could also include subnational)" indicates the presence of the listed policy type in the country.

The current power tariff stands at 9.86 cents US per kWh. ZETDC had previously proposed that the tariff be increased to 14.6 cents US per kWh, which was granted by ZERA but reduced to 11.2 US cents per kWh in mid-2017. The figure was later frozen after industrial customers complained that the tariff was too high to sustain their operations. [21]

[11] [12] [13] [14] [10] [15] [16] [17] [8] [18] [9] [19] [20] [21]

2.5 Key Challenges and Recommendations

Key challenges in the energy sector include the ageing and insufficient generation infrastructure, a low-quality grid, high transmission and distribution losses, theft and vandalism of equipment such as transformers and cables, as well as a shortage of spares. Gaining access to the grid for new generation projects can also be extremely challenging and ZERA remains concerned with the poor performance of the thermal stations. The exodus of trained and experienced staff to neighbouring and overseas countries is also of concern.

SACREE is the SADC CENTRE FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY and, as per details in Appendix A, works towards addressing SADC country challenges with respect to renewable energy and energy efficiency. Funding sources available to the SADC countries for energy efficiency are listed in Appendix B.

Table 2.6 Energy Efficiency (EE) Opportunities and Recommendations

	OPPORTUNITIES	RECOMMENDATION
POLICIES	Processes and procedures to enforce and prioritize energy efficiency requirements should be put in place.	• As per Table 2.1 above, policies for standards & product labelling should be implemented. • Table 2.2 indicates 'Financing' is not an EE targeted program. Evaluate reasons why not and determine if policies are required to initiate this. • As per Table 2.4 above, building efficiency guidelines and voluntary business energy efficiency programmes may be considered.
ECONOMIC AND FINANCIAL	Some funding is already available regionally for energy efficiency, as per Appendix B. These may need to be supplemented by providing affordable financing for energy efficiency investment and/or by leveraging funding from the public (government and development partners) and private stakeholders. There may be limited exposure of local Financial Institutions to RE/EE investment projects and limited experience on special purpose soft loans for RE/EE	• Clarify if any funding is currently used for EE. • Determine what barriers exist preventing the use of available funding, as summarised in Appendix B. • Harmonize donor support by source affordable financing for energy efficiency investment. • Develop guarantee funds to cover for deflationary risk.

	projects for SMEs and low-income sections of the population.	
INFORMATIONAL	Limited information and knowledge about the benefits of energy efficiency. Expertise on energy efficiency opportunities and benefits assessments is currently inadequate.	• Provide funding to promote energy-saving awareness. • Provide funding to strengthen local capacities and to support RE/EE entrepreneurship.

Note: Recommendations should be considered after checking with SACREE if any new initiatives have started.

2.6 Modelling & Savings Projections

For a simple savings calculation, each of the technologies have been grouped into three categories:

1. Substandard efficient units (low efficiencies, old technologies etc.)
2. Standard efficiencies that comply with or fall within industry accepted Minimum Energy Performance Standards (MEPS).
3. Best available technologies (BAT)

All Scenarios

For all the scenarios, an average increase in the electrification of the specific country per year was used. These are long-term averages for the specific countries as provided by the electric utilities and conservative interpretations of this data was used by DNV GL.

Increases of the quantities of units were used in direct correlation with the increase in electrification. Increases and decreases in adoption rates were taken from the country visits, averaged and rounded.

BAU

The "Business as Usual" case assumes that the current adoption rate of energy efficient technologies continues the same trend due to the normal rate of rising costs of electricity and increased public awareness.

The information gathered during the country visits indicated an adoption of efficient technologies (MEPS & BAT) reducing less efficient products (below MEPS) by specific percentage of the current market share by 2025 and 2030.

MEPS

If "Minimum Energy Performance Standards" are to be implemented by means of regulations or incentives, an increased adoption of both the MEPS and BATS will take place. Current stock in the market is assumed to be sold, but no new stock of lower standard technologies will be allowed into the market. Currently, installed units are expected to last their normal operating lifetime, after which they will be replaced with MEPS or BAT.

BAT

Best Available Technology implementation assumes that all implementation of new lighting is driven towards BAT standards while allowing MEPS and disallowing new sub-MEPS installation and sales.

Results

The information gathered during the country visits included the expected adoption of efficient technologies (MEPS & BAT) reducing less efficient products (below MEPS) by specific percentages of the current market share by 2025 and 2030. The resultant quantity of lights and market shares are shown in the following sections.

3 LIGHTING

A law that bans all trade, manufacture and use of inefficient incandescent bulbs was enacted via Statutory Instrument 21 of 2017 and went into effect on May 1, 2017. Zimbabwe expects this to save up to 40 megawatts of electricity [22].

It is estimated that 10 to 15% of electricity users (roughly 1 million people) in Zimbabwe currently still use incandescent light bulbs.

3.1 Status and Trends of Lighting Products

3.1.1 Market Drivers

Lights have a relatively short life expectancy compared to other electrical equipment considered in this project.

Table 3-1: Zimbabwe Lighting Imports and Exports

Average Rated Lifetime Hours					
	INCANDESCENT	FLUORESCENT	CFL	HALOGEN	LED
TYPICAL RANGE (HOURS)	750-2,000	24,000-36,000	8,000-20,000	2,000-4,000	35,000-50,000

It is estimated that 10 to 15% of electricity users (roughly 1 million people) in Zimbabwe currently still use incandescent light bulbs.

3.1.2 Purchase of lighting products, including where and availability of energy efficient products

Light bulbs in Zimbabwe are typically purchased in retail stores and supermarkets such as Pick n Pay and TM Supermarkets. According to a 2015 study, only 40% of the citizens were connected to the grid. This is confirmed by the stakeholder survey that indicates that less than 60% of households have electric light bulbs. The survey also revealed that the market penetration of CFLs and LEDs in households is low but is expected to increase due to the recent ban on incandescent light bulbs.

3.1.3 Local manufacturers, suppliers, retailers and other stakeholders

According to the stakeholder survey, 10% of the light bulbs are manufactured locally. The majority of the bulbs are imported.

The most popular brands are Philips and Osram and there are also various Chinese brands.

3.1.4 Import/export – Principle ports of entry and primary sources of products

As stated above, Zimbabwe has a small number of local lighting manufacturers, covering roughly 10% of the local market, while exporting to some of the neighbouring countries.

Table 3-2: Zimbabwe Lighting Imports and Exports

Year	Export	Import
2012	1 171	5 439 966
2013	10 638	6 357 453
2014	3 944	6 475 604
2015	58 824	6 562 977
2016	6 375	32 316 121

Zimbabwe imports over 50% of its lighting products from China. Main countries of imports are shown below.

Table 3-3: Zimbabwe Lighting Imports

Source	% of Imports
Other	3%
South Africa	14%
The United Arab Emirates	33%
China	51%

3.1.5 Barriers to overcome

Cost

Due to the low average income per household, consumers are very sensitive to costs. The typical consumer will likely not be able to afford or justify the additional short-term expenses to gain energy efficiency and even long-term cost savings.

According to a May 2017 Thomson Reuters news report[1] , the upfront cost of efficient lighting may be off-putting to many consumers, despite the long-term cost reduction.

Perception of Health Risk

In 2011 and 2012, during the development of the CFL distribution campaign, several news articles questioned the health and environmental impact of CFLs, mainly related to their mercury content and their impact on the environment upon disposal.

Availability

Shop visits indicated very small quantities of LEDs available for public consumers.

Education

During the country visits, it was apparent that consumers are not aware of environmental and cost impacts on buying low-efficiency products.

Import duty & tax

There is no reduction or waiver of import duty or taxes on energy efficient lights (CFL or LED). This is likely to protect the local manufacturing market, which makes up a negligible portion of market share. The result is that buyers are paying a premium for energy efficient products.

Emergency lighting

[1] http://www.reuters.com/article/us-zimbabwe-energy-climatechange/can-zimbabwes-switch-to-led-bulbs-curb-power-crisis-meet-climate-goals-idUSKBN17Y13Z

LEDs are often only seen as emergency lighting solutions, rather than energy saving solutions. In this case, the LED would come paired with a battery as a stand-alone unit, rather than to replace inefficient lights in fixtures.

Perception of unreliability

LEDs and CFL are generally perceived to be of lesser quality and shorter lifespan than older inefficient light technologies. This is likely due to low quality or fake products entering the market.

3.1.6 New vs. used equipment

Where lighting retrofits are implemented, replaced lights should be disposed of, but instead are often sold or donated to schools/charities.

3.2 Potential Savings from Energy-Efficient Lighting

3.2.1 Benefits, including energy, financial and GHG of EE products – 3 scenarios are included

Modelling of the different scenarios are explained in Section 2.

For a simple savings calculation, lights have been grouped into three categories:

1. All lights except: Fluorescent (FL), Compact Fluorescent (CFL) & LEDs
2. Fluorescent (FL) & Compact Fluorescent (CFL)
3. LEDs.

3.2.2 Benefits of Energy Efficiency – 3 Scenarios

Table 3.1 BAU, MEPS, BAT scenarios for lighting.

Scenario	Description	QTY (2017)	QTY (2020)	Tech. Adopt (2025)	QTY (2025)	Tech. Adopt (2030)	QTY (2030)
Business as Usual	QTY Halo, Inc etc.	7 271 550	8 639 329	-10%	11 963 411	-20%	14 725 753
Business as Usual	QTY CFL & FL	4 443 540	5 279 370	13%	9 186 379	10%	15 566 053
Business as Usual	QTY LED	1 454 310	1 727 866	10%	2 924 390	50%	6 749 305
DNV GL Projected MEPS	QTY Halo, Inc etc.	7 271 550	8 639 329	-50%	6 646 339	-20%	8 180 973
DNV GL Projected MEPS	QTY CFL & FL	4 443 540	5 279 370	75%	14 237 596	-2%	21 497 258
DNV GL Projected MEPS	QTY LED	1 454 310	1 727 866	20%	3 190 243	50%	7 362 876
DNV GL Projected BAT	QTY Halo, Inc etc.	7 271 550	8 639 329	-80%	2 658 536	-20%	3 272 390

Scenario	Description	QTY (2017)	QTY (2020)	Tech. Adopt (2025)	QTY (2025)	Tech. Adopt (2030)	QTY (2030)
DNV GL Projected BAT	QTY CFL & FL	4 443 540	5 279 370	115%	17 427 839	-8%	24 565 123
DNV GL Projected BAT	QTY LED	1 454 310	1 727 866	50%	3 987 804	50%	9 203 596

Data & Assumptions:

- *Exchange Rate: 1 USD = 12.5 ZAR = 360 ZWD.*
- *Average Residential marginal Electricity Tariff: 0.098 USD/kWh.*
- *Average Industrial marginal Electricity Tariff: 0.098 USD/kWh.*
- *Electricity Cost Increase: 10% per annum.*
- *Electrification Rate Increase: 9%*
- *Operating hours: 2 hr in morning (6-8am) and 4hr in the evening (6-10pm), 365 days per annum.*

Assuming these adoption rates are accurate, the following savings (Table 3.2) are projected to be achieved under the MEPS and BAT scenarios. The U4E targets are also shown as benchmarks.

Table 3.2 Projected savings for lighting under MEPS And BAT scenarios.

	Sum of GWh Savings (2025)	Sum of GWh Savings (2030)	Sum of Million USD Savings (2025)	Sum of Million USD Savings (2030)	Sum of GHG Savings (2025)	Sum of GHG Savings (2030)
DNV GL Projected MEPS	540	670	114	227	193	240
DNV GL Projected BAT	956	1 197	201	405	342	428
U4E Targets	532	624	52	61	210	246

3.2.3 Job creation / elimination from EE products.

The implementation of energy savings initiatives such as lighting retrofits by ZESA, combined with distribution of lights, have proven to generate a large number of jobs in Zimbabwe. Temporary jobs covering a wide variety of skills from sales, practical labour, Measurement & Verification and more will be created.

3.3 Status of Policies and Initiatives

3.3.1 Standards and regulations

Statutory Instrument 21 of 2017 (Ban of Inefficient Lighting Products and Labelling) regulations address the lighting products performance issues in several ways:

1. Ban on importation, manufacturing, distribution or sale of
    a. inefficient lighting products (products which do not meet the Minimum Energy Performance Standards (MEPS) specified in the regulations)
    b. T10 and T12 halophosphate fluorescent lamps and/or magnetic ballasts

    c. High mercury content light bulbs
    d. Incandescent light bulbs

2. Mandate for the safe disposal of light bulbs that contain mercury and lead according to local regulations (Statutory Instrument 10 of 2007 – Environmental Management Hazardous Waste Regulations, 2007 and ISO 14001, Environmental Management Systems)
3. Define the minimum information to be provided on the light bulb label (including energy efficiency labelling (A to G rating) [23]

3.3.2 Supporting Policies – Labelling and consumer awareness campaigns

An energy efficiency label (A to G) is mentioned in the Statutory Instrument 21 of 2017

3.3.3 Financial Mechanisms

Other than the handing out of free CFL bulbs, no financial mechanisms are in place to promote energy efficiency.

3.3.4 Monitoring, Verification and Enforcement

No monitoring, verification and enforcement measures have been reported.

3.3.5 Environmentally Sound Management

Disposal of light bulbs with mercury or lead is mentioned in the Statutory Instrument 21 of 2017.

3.3.6 Other on-going projects/initiatives

An estimated 1 million CFLs were distributed in 171 905 houses for a verified savings of 42 MW.

ZESA CFL distribution program in 2012-2013; [24] [25][22] [26] [23]

4 AIR-CONDITIONING

Room air-conditioning units in Zimbabwe are almost exclusively used in non-residential buildings. There are a variety of types of air-conditioning systems used in buildings, with room air-conditioning being the most dominant. Room air-conditioners can be segmented into window air-conditioners, portable air-conditioners and at least 3 sub-categories of split systems per cooling capacity (e.g. 9’000 btu/h, 12’000 btu/h and 18’000 btu/h).

It is estimated that air-conditioning accounts for up to 70% of the electrical load of office buildings, with commercial buildings and hotels having a similar profile. This implies that significant gains can be made by improving the efficiency of air-conditioners and possibly controlling their loads. Commercial load contributes a large part of the daytime national peak.

4.1 Status and Trends of Air-conditioning Products

4.1.1 Stock, sales, sale price, lifetime, projected growth rates, repairs and time of use

Replacement cycles are typically 10 years for outdoor units exposed to elements such as sun and rain, while well-maintained indoor units can last 15 or even up to 20 years.

Lower-end brands are sold at between 650 – 750 USD for a medium sized (12000 Btu/h or 3.5kW) split unit, which includes supply and installation. Due to the lower initial costs, these units are increasing in market share in an industry dominated by a few well-established household names. More well-known brands such as LG, DAIKIN or SAMSUNG are sold and installed for around 900 – 1200 US$ for the same capacity unit, depending on the model of choice. [25,26,27]

4.1.2 Purchase of air-conditioning products, including where, and availability of energy efficient products

Air-conditioning units are not “off-the-shelf” items, as these are typically supplied and installed by a solution or service provider. Most of these service providers will partner with one or a few brands and act as local distributors and installers. A wide variety of brands provide almost all sizes and performance ratios available.

4.1.3 Local manufacturers, suppliers, retailers and other stakeholders

Local stakeholders are mostly retailers, distributors and installers, as no local manufacturing or air-conditioning units takes place in Zimbabwe. All major international brands are well represented by local distributors and are contactable via phone or web. Air-conditioning units require annual service and are often repaired when broken, rather than replaced. Some stakeholders are included (but are not limited to) the table below.

4.1.4 Import/export – Principle ports of entry and primary sources of products

Air-conditioning units are imported mostly from South Africa and China.

Table 4-1: Zimbabwe Air-conditioning Imports

Country	% of Imports
South Africa	58%
China	36%
Singapore	4%
Other	2%

4.1.5 Barriers to overcome

Lack of proper maintenance often results in early system failure or significant decreases in efficiency. The perception that the cost of services outweighs the benefits, which often results in little to no regular maintenance on air-conditioning units. Further, the financial pressure on industry results in cost cutting exercises, with maintenance often the first item to have it budget cut. Lastly, common perception is that items are only expected to last a very short period and regular replacements (rather than repair) are common practice.

4.1.6 New vs. used equipment

Re-use of equipment is not applicable to air-conditioning units, as the units are typically installed in a fixed location and the costs and effort of dismantling and relocating is likely to be more than 50% of a new unit.

4.2 Potential Savings from Energy-Efficient Air-conditioning

Modelling of the different scenarios has been explained in Section 2.

For a simple savings calculation, units have been grouped into three categories:

1. Below Class B
2. Class B - A
3. Class A+ and better.

4.2.1 Benefits of Energy Efficiency – 3 Scenarios

Table 4.1 BAU, MEPS, BAT scenarios for air-conditioning.

Scenario	Description	QTY (2017)	QTY (2020)	Tech. Adopt (2025)	QTY (2025)	Tech. Adopt (2030)	QTY (2030)
Business as Usual	Lower than Class B	10 733	13 224	-6%	20 946	-7%	32 825
Business as Usual	Class B - Class A	8 348	10 285	4%	17 975	2%	30 795
Business as Usual	Class A+ & Above	4 770	5 877	7%	10 596	11%	19 819
DNV GL Projected MEPS	Lower than Class B	10 733	13 224	-28%	16 044	-19%	21 898
DNV GL Projected MEPS	Class B - Class A	8 348	10 285	24%	21 490	1%	36 502
DNV GL Projected MEPS	Class A+ & Above	4 770	5 877	21%	11 983	24%	25 038
DNV GL Projected BAT	Lower than Class B	10 733	13 224	-35%	14 484	-33%	16 352
DNV GL Projected BAT	Class B - Class A	8 348	10 285	14%	19 782	-14%	28 795
DNV GL Projected BAT	Class A+ & Above	4 770	5 877	54%	15 251	49%	38 291

Data & Assumptions:

- *Exchange Rate: 1 USD = 12.5 ZAR = 360 ZWD.*
- *Average Residential marginal Electricity Tariff: 0.098 USD/kWh.*
- *Average Industrial marginal Electricity Tariff: 0.098 USD/kWh.*
- *Electricity Cost Increase: 10% per annum.*

- *Electrification Rate Increase: 9%*
- *Operating hours: 8 hours per day x 125 days per annum = 1 000 hours.*
- *Average cooling capacity: 3.5kW.*

QTY and adoption of technologies based on information from stakeholder interviews.

Assuming these adoption rates are accurate, the following savings are projected (Table 4.2) to be achievable under the MEPS and BAT scenarios. The U4E targets are also shown as benchmarks.

Table 4.2 Projected savings for air-conditioning under MEPS And BAT scenarios.

	Sum of GWh Savings (2025)	Sum of GWh Savings (2030)	Sum of Million USD Savings (2025)	Sum of Million USD Savings (2030)	Sum of GHG Savings (2025)	Sum of GHG Savings (2030)
DNV GL Projected MEPS	540	670	114	227	193	240
DNV GL Projected BAT	956	1 197	201	405	342	428
U4E Targets	532	624	52	61	210	246

4.2.2 Job creation / elimination from energy efficient products

No direct impact on the Zimbabwe market is expected, as the bulk of units are imported. Importation of more efficient devices requires the same level of services from the local market.

4.3 Status of Policies and Initiatives

4.3.1 Standards and regulations

On 28 November 2014, the South African Government Gazette No. R944 was published by the minister of trade and industry, specifying the compulsory specifications relating to the 'Labelling of Electrical and Electronic apparatus' (VC 9008). On 13 August 2015, an amendment was published (Government Gazette No. 38232) that accelerated the implementation phase for air-conditioners and heat pumps, requiring compliance by 28 November 2016.

SANS 941:2014 'Energy efficiency of electrical and electronic apparatus', which states:

> "1.1 Air-conditioners not exceeding 7.1kW (24 000btu/h) cooling capacity, of the wall mounted split, window and portable types and heat pumps for space heating and cooling…"

Further to that, the National Regulator for Compulsory Specifications (NRCS) GG 944 specification states under section 4, 4.1 that:

> "Air-conditioners and heat pumps shall comply with SANS 941, shall have a minimum energy efficiency rating of Class B."

Since a large portion of air-conditioning units are imported from South Africa, these regulations have a direct impact on Zimbabwe.

4.3.2 Supporting Policies – Labelling and consumer awareness campaigns

As stated above, the compulsory specification for Energy Efficiency and Labelling of electrical and electronic apparatus (VC 9008), dated 28 November 2014 includes air-conditioners. Companies are encouraged to manufacture and sell appliances which are energy efficient Samsung and Phillips have already signed the voluntary accord and other companies are following suit. Air-conditioners shall comply with SANS 941, and shall have a minimum energy efficiency rating of Class B.

See also Appendix A.

4.3.3 Financial Mechanisms

No financial mechanisms are available to consumers, manufacturers or importers to drive the adoption of energy efficient models.

4.3.4 Monitoring, Verification and Enforcement

In South Africa, the National Regulator for Compulsory Specifications (NRCS) GG 944 specification states under section 4, 4.1 that:

> "Air-conditioners and heat pumps shall comply with SANS 941, shall have a minimum energy efficiency rating of Class B."

However, testing and verification of compliance is expected but not enforced in Zimbabwe.

4.3.5 Environmentally Sound Management

Zimbabwe is bound by the SADC Protocol on Energy 1996, which states that "energy efficiency and conservation applications have minimal adverse impact on the environment, relative to other energy applications". The handling of removed equipment is addressed in the Environmental Management Act 10 of 2008 and related regulations, but it was unclear whether these are enforced.

4.3.6 Other on-going projects/initiatives

No current projects or initiatives exist to drive the adoption of energy efficient air-conditioning units rather than standard efficiency units.

5 REFRIGERATORS

General indications of the average life expectancy for a properly maintained refrigerator is between 14 and 17 years depending on the model and size. Compact refrigerators typically run for 14 years on average, while a standard refrigerator will run up to 17 years. The life expectancy of refrigerators is affected by how well it is maintained and its construction. Some models may last only about 10 years, while others may run for up to 19 years [29].

5.1 Status and Trends of Refrigeration Products

5.1.1 Market Drivers

According to a Zimbabwean demographic and household survey (2010 – 2011), 18.3% of the households in Zimbabwe have refrigerators. This means that there are roughly 750 000 fridges in operation in Zimbabwe.

5.1.2 Purchase of refrigeration products, including where and availability of energy efficient products

Refrigerators are typically sold at furniture or white good stores. Some of the large retailers include GAME, Home & Electrical, Furniture Warehouse, Russel's, House & Home and HiFi Corporation. Most refrigerators have the standard energy efficiency markings displayed on the outside front and a variety of efficiencies were available at all the stores, ranging from MEPS (Class B) to BAT (Class A+++).

5.1.3 Local manufacturers, suppliers, retailers and other stakeholders

Information from the survey questionnaire indicated that a number of local fridge manufacturers have managed to capture a cumulative market share of roughly 30%. The biggest of these are IMPERIAL and CAPRI.

5.1.4 Import/export – Principle ports of entry and primary sources of products

Zimbabwe imports roughly 70% of their refrigerators from South Africa. The small size of the market likely makes the country an unattractive market for aggressive importation competition.

5.1.5 Barriers to overcome

Refrigerators were built to last. Therefore, some very old units are still in operation throughout Zimbabwe and the users are typically not willing to let these go. When new refrigerators are bought, old units are often kept as "backup" but are left running in the pantry. Alternatively, old refrigerators are given to friends or family who do not have the financial means to purchase their own units. The result is that these inefficient units are not removed from the system and the purchase of new units simply increases the overall number of refrigerators in the market.

5.1.6 New vs. used equipment

Refrigerators are very seldom repaired in Zimbabwe. Very small refrigerator repair industries can be found in low-income areas, but accurate data is not available.

5.2 Potential Savings from Energy-Efficient Refrigeration Products

The tables below consider the current scenario (BAU- Business as Usual) as well as the adoption of improved minimum energy performance standards (MEPS) and best available technologies (BAT) if these were to be driven by policies and regulations [35].

For a simple savings calculation, fridges have been grouped into three categories:

1. Below Class B
2. Class B - A
3. Class A+ and better

5.2.1 Benefits of Energy Efficiency – 3 Scenarios

Table 5.1 BAU, MEPS, BAT scenarios for refrigerators.

Scenario	Description	QTY (2017)	QTY (2020)	Tech. Adopt (2025)	QTY (2025)	Tech. Adopt (2030)	QTY (2030)
Business as Usual	Lower than Class B	883 469	1 049 649	-5%	1 534 264	-7%	2 195 409
Business as Usual	Class B - Class A	316 466	375 994	9%	628 892	10%	1 068 185
Business as Usual	Class A+ & Above	118 675	140 998	14%	247 315	17%	445 214
DNV GL Projected MEPS	Lower than Class B	883 469	1 049 649	-52%	775 207	-61%	465 173
DNV GL Projected MEPS	Class B - Class A	316 466	375 994	128%	1 320 698	27%	2 575 717
DNV GL Projected MEPS	Class A+ & Above	118 675	140 998	45%	314 567	38%	667 920
DNV GL Projected BAT	Lower than Class B	883 469	1 049 649	-69%	500 655	-80%	154 064
DNV GL Projected BAT	Class B - Class A	316 466	375 994	165%	1 530 168	6%	2 485 775
DNV GL Projected BAT	Class A+ & Above	118 675	140 998	75%	379 650	83%	1 068 974

Data & Assumptions:

- *Exchange Rate: 1 USD = 12.5 ZAR = 360 ZWD.*
- *Average Residential marginal Electricity Tariff: 0.098 USD/kWh.*
- *Average Industrial marginal Electricity Tariff: 0.098 USD/kWh.*
- *Electricity Cost Increase: 10% per annum.*
- *Electrification Rate Increase: 9%*
- *QTY and adoption of new technologies based on information from stakeholder interviews.*

Assuming these adoption rates are accurate, the following savings are projected to be achievable under the MEPS and BAT scenarios. The U4E targets are also shown as benchmarks.

Table 5.2 Projected savings for refrigerators under MEPS And BAT scenarios.

	Sum of GWh Savings (2025)	Sum of GWh Saving (2030)	Sum of Million USD Savings (2025)	Sum of Million USD Savings (2030)	Sum of GHG Savings (2025)	Sum of GHG Savings (2030)
DNV GL Projected MEPS	106	245	22	83	38	88
DNV GL Projected BAT	146	309	31	105	52	111
U4E Targets	92	191	9	19	36	75

5.2.2 Job creation / elimination from energy efficiency products

The adoption of energy efficiency has no specific impact on the local job market.

5.3 Status of Policies and Initiatives

5.3.1 Standards and regulations

Zimbabwe Energy Policy suggests several desired outcomes achievable by implementation of standards and regulations, but the regulations or policies themselves have not yet been defined.

5.3.2 Supporting Policies – Labelling and consumer awareness campaigns

Compulsory Specification for Energy Efficiency and Labelling of electrical and electronic apparatus (VC 9008), dated 28 November 2014 (includes refrigerators). Companies are encouraged to manufacture and sell appliances which are energy efficient Samsung and Phillips have already signed the voluntary accord and other companies are following suit. Refrigerators shall comply with SANS 941 and shall have a minimum energy efficiency rating of Class B, as adopted from South Africa.

5.3.3 Financial Mechanisms

No financial mechanisms are currently in place to promote the adoption of energy efficient refrigerators.

5.3.4 Monitoring, Verification and Enforcement

MEPS standards are monitored and enforced on imported and locally manufactured items by ensuring compliance to SANS, in line with ISO and IE standards.

5.3.5 Environmentally Sound Management

Zimbabwe is bound by the SADC Protocol on Energy 1996, which states that: "energy efficiency and conservation applications have minimal adverse impact on the environment, relative to other energy applications". The handling of removed equipment is addressed in the Environmental Management Act 10 of 2008 and related regulations, but it was unclear whether these are enforced.

5.3.6 Other on-going projects/initiatives

There are no ongoing projects or initiatives to drive the improvement of energy efficiency in the refrigerator market.

6 MOTORS

Many factors affect the life expectancy of an electric motor. These factors include input power problems, improper mechanical installations, malfunctions in the load and environmental factors, among others.

6.1 Status and Trends of Motors

6.1.1 Life Expectancy

If motors are operated under normal conditions, sized correctly for the application and within the manufacturer's design requirements, they can last 15 years or more. Failure of motors can generally be grouped into electrical failure (windings, drives, etc) and mechanical failure (bearings, mountings etc).

Repair of electrical failures can be done by rewinding the motor. This typically only takes place after failure in the motor's insulation and winding, which usually happens due to a thermal breakdown. Motors are frequently replaced rather than rewound due to costs, convenience and the claim that rewinding may reduce the motor's efficiency.

When looking at the mechanical failures, motor bearings or mountings might fail due to improper mechanical installation, causing undesirable forces acting on the bearings and mountings, or simply due to poor maintenance.

A rough guide as to when to repair or replace is given in this image below (provided by ABB).

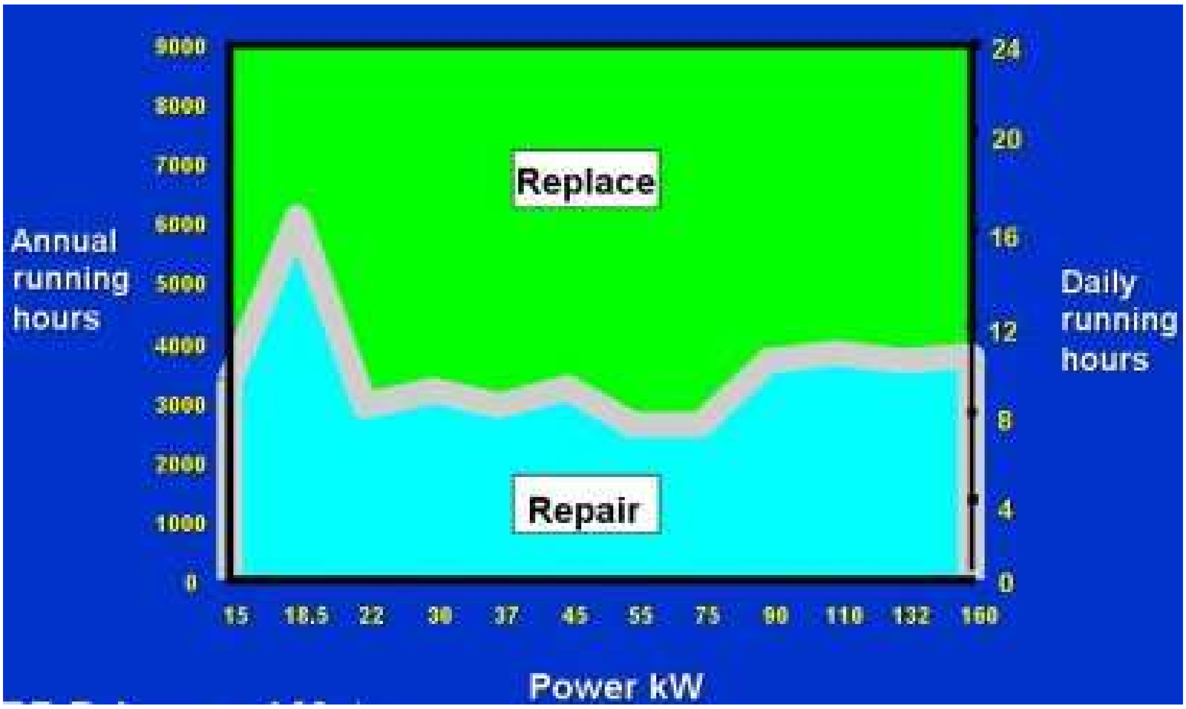
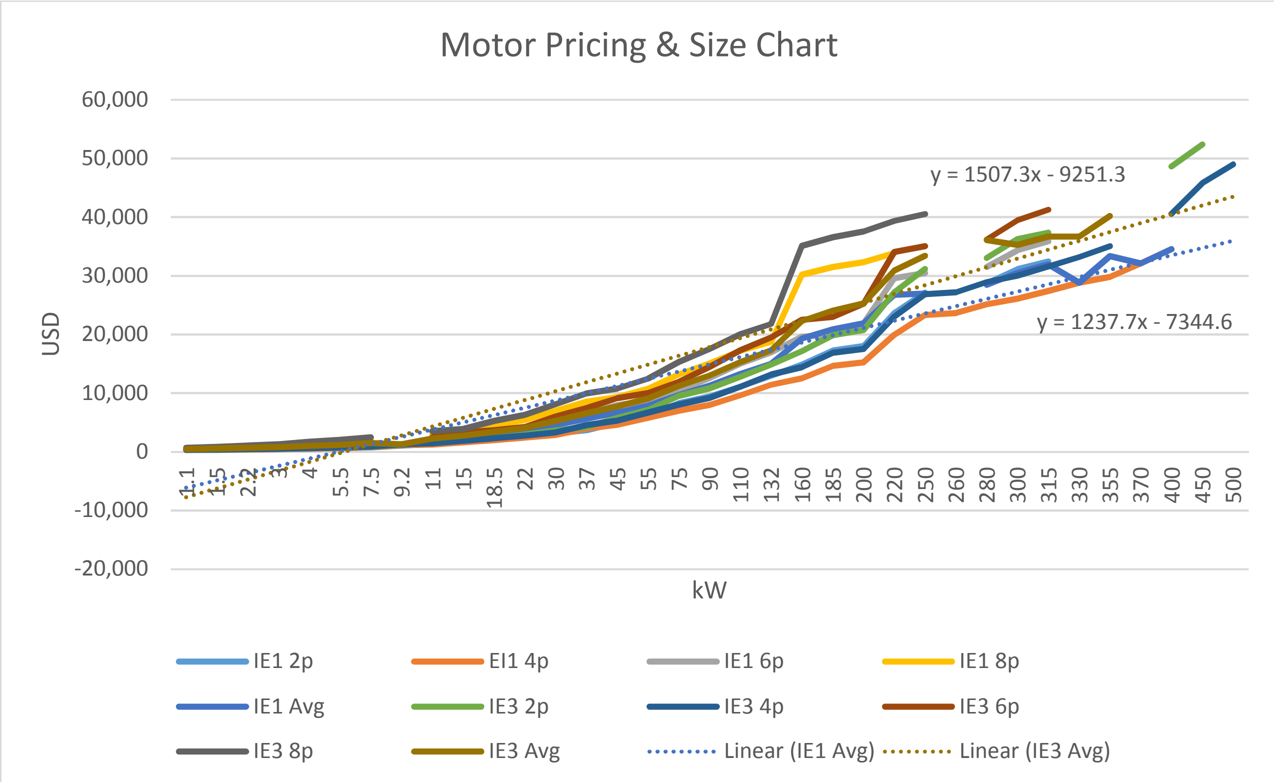


Figure 6-1: Repair or Replace

6.1.2 Price

Motors are categorized as IE1 (least efficient), IE2 (more efficient) and IE3 (most efficient). A list of comparative motor prices is shown in the chart below.



IE3 motors are typically between 15 – 20% more expensive than their IE1 counterparts. Even though the operating costs of a typical motor is roughly 50% of the annual cost, in countries where initial capital plays a major factor, this is one of the biggest market barriers.

6.1.3 Purchase of motors, including where and availability of EE products

Electrical motors are generally available from a wide variety of distributors and installers and include anything from old rewound motors to new premium efficiency motors.

Motors are not "off the shelf" items and are usually sold as part of a project, machine or installation. Therefore, the end user is often not in direct contact with the motor manufacturer or supplier during new installations. The motors are typically procured by a "project company" or solution provider selling the motor as part of a solution to the end user. The project companies are likely to provide "back to back" guarantees as provided by the motor manufacturers and are likely to administrate the service, repair and replacement of these motors on behalf of the client.

After the initial maintenance period provided by the motor supplier/installer, the client would typically take ownership of maintenance of the motor and might deal with the OEM suppliers or other local service companies to maintain the motors.

6.1.4 Local manufacturers, suppliers, retailers and other stakeholders

No local manufacturing of motors takes place in Zimbabwe, but many motor rewinders make a living from the refurbishing of electric motors.

6.1.5 Import/Export

Zimbabwe has a very small commercial and industrial market. Therefore, the importation of motors is generally on a case-by-case basis and results in very small totals, as noted in the table below.

Table 6-1: Zimbabwe Air-conditioning Imports [27]

Year	QTY
2013	1 339
2014	9 145
2015	6 687
2016	12 341

6.1.6 Barriers to overcome

<u>Overall Inefficient Systems</u>

Due to the low (subsidized) historical price of electricity in Zimbabwe, most industrial and commercial systems and processes (which include electrical motors) were designed for low installation costs which did not necessarily take efficiency into consideration.

<u>Negligible Savings</u>

Apart from the fact that more efficient motors are more expensive, there is a general perception that the savings from high-efficiency motors are negligible when added to an overall inefficient system.

<u>Rewinding Perception</u>

Further to the above, the fact that motors can be rewound to perform at the same efficiency reduces the drive to buy new equipment. However, very few rewinders actually perform the rewinding to the same standards and optimal efficiencies are hardly ever reached.

6.1.7 New vs. Used

Motors are typically used at their point of installation until failure occurs. In the cases where repair or rewinding takes place, motors are mostly re-installed in their initial position and will continue to be used there until the end of life. Therefore, there is little to no second-hand electrical motor industry.

6.2 Potential Savings from Energy-Efficient Motors

Modelling of the different scenarios has been explained in Section 2.

Even though Zimbabwe does not explicitly list any motor standards, the country general complies with IEC standards and, therefore, the suite of IEC 60034 standards for motors are likely to prevail. The tables below consider the current scenario (BAU-Business as Usual) as well as the adoption of improved MEPS and best available technologies (BAT) if these were to be driven by policies and regulations.

For a simple savings calculation, motors have been grouped into three categories:

1. IE1 and below
2. IE3
3. IE4 and premium.

6.2.1 Benefits of Energy Efficiency – 3 Scenarios

Table 6.1 BAU, MEPS, BAT scenarios for motors.

Scenario	Description	QTY (2017)	QTY (2020)	Tech. Adopt (2025)	QTY (2025)	Tech. Adopt (2030)	QTY (2030)
Business as Usual	Class IE1 & below	115 223	136 896	-5%	200 100	-7%	286 327
Business as Usual	Class IE3	89 618	106 475	2%	166 867	1%	259 630
Business as Usual	Class IE4	51 210	60 843	8%	101 104	12%	174 228
DNV GL Projected MEPS	Class IE1 & below	115 223	136 896	-11%	187 462	-13%	250 937
DNV GL Projected MEPS	Class IE3	89 618	106 475	7%	174 825	9%	293 465
DNV GL Projected MEPS	Class IE4	51 210	60 843	13%	105 784	8%	175 783
DNV GL Projected BAT	Class IE1 & below	115 223	136 896	-13%	183 249	-20%	225 561
DNV GL Projected BAT	Class IE3	89 618	106 475	4%	170 612	6%	278 481
DNV GL Projected BAT	Class IE4	51 210	60 843	22%	114 210	23%	216 143

Data & Assumptions:

- *Exchange Rate: 1 USD = 12.5 ZAR = 360 ZWD.*
- *Average Residential marginal Electricity Tariff: 0.098 USD/kWh.*
- *Average Industrial marginal Electricity Tariff: 0.098 USD/kWh.*
- *Electricity Cost Increase: 10% per annum.*
- *Electrification Rate Increase: 9%*
- *Operating hours: 8 hours per day x 125 days per annum = 1 000 hours.*

- *Average cooling capacity: 3.5kW.*
- *QTY and adoption of technologies based on information from stakeholder interviews.*

Assuming these adoption rates are accurate, the following savings are projected (Table 6.2) to be achieved under the MEPS and BAT scenarios. The U4E targets are also shown as benchmarks.

Table 6.2 Projected savings for air-conditioning under MEPS And BAT scenarios.

	Sum of GWh Savings (2025)	Sum of GWh Savings (2030)	Sum of Million USD Savings (2025)	Sum of Million USD Savings (2030)	Sum of GHG Savings (2025)	Sum of GHG Savings (2030)
DNV GL Projected MEPS	14	35	3	12	5	13
DNV GL Projected BAT	22	78	5	26	8	28
U4E Targets	19	37	2	4	7	15

6.2.2 Job creation/elimination from energy efficiency products

Strict implementation of high energy efficient standards might result in a reduced amount of motors being rewound. This will have a negative impact on the local motor rewinding industry. On the other hand, this will drive the import of new, high-efficiency motors, which in turn will result in jobs in the distribution and sales sectors.

6.3 Status of Policies and Initiatives

6.3.1 Standards and regulations

No specific standards related to the energy efficiency of motors are in place in Zimbabwe.

6.3.2 Supporting Policies – Labelling and consumer awareness campaigns

All electric motors are required to comply with IE/SANS labelling standards.

6.3.3 Financial Mechanisms

Currently, no funding mechanisms are in place to drive minimum energy performance standards.

6.3.4 Monitoring, Verification and Enforcement

Verification of motor specification compliance is enforced by the SABS. See Appendix A for the comprehensive list of applicable standards.

6.3.5 Environmentally Sound Management

Zimbabwe is bound by the SADC Protocol on Energy 1996, which states that: "energy efficiency and conservation applications have minimal adverse impact on the environment, relative to other energy applications". The handling of removed equipment is addressed in the Environmental Management Act 10 of 2008 and related regulations, but it was unclear whether these are enforced.

6.3.6 Other on-going projects/initiatives

No ongoing initiatives or projects are in place.

7 TRANSFORMERS

The power network in Zimbabwe is owned and operated by the "Zimbabwe Electricity Supply Authority", commonly referred to as ZESA. The power networks are mostly distributed at the endpoints by pole mounted distribution transformers.

7.1 Status and Trends of Transformers

7.1.1 Stock, sales, sale price, lifetime, projected growth rates, repairs and time of use

ZESA provided information indicating that they have 4 548 distribution transformers on their distribution network, most of which are pole mounted and in rural areas.

In 2017, the bulk of these transformers will be 20 years or older. A transformer is expected to last roughly 20 years during normal operating conditions so many can be expected to be at the end of their useful life.

7.1.2 Purchase of transformers, including where and availability of EE products

Transformers are ordered or purchased directly from the manufacturers and are often part of competitive tender processes, especially when being bought by ZESA. Very low standards (compared to other international standards) for energy efficiency of transformers are enforced. Thus, there is no drive to adopt or produce energy efficient transformers.

7.1.3 Local manufacturers, suppliers, retailers and other stakeholders

Transformers are ordered or purchased directly from the manufacturers and are often part of competitive tender processes, especially when being bought by ZESA. Very low standards (compared to other international standards) for energy efficiency of transformers are enforced. Thus, there was no drive to adopt or produce energy efficient transformers.

Some of the local stakeholders include:

- Synergy Transformers.
- HPCS Global Power Systems Private Limited

7.1.4 Import/export – Principle ports of entry and primary sources of products

Some manufacturing of transformers does take place in Zimbabwe; however, very little information is available related to the sales volumes and market share of the local manufacturers.

7.1.5 Barriers to overcome

Costs of energy efficient transformers are still significantly higher than standard efficiency units and the relatively low cost of electricity, combined with a general acceptance of system losses, results in the very slow adoption of energy efficient transformers in South Africa. Further to that, the long-life expectancy of typical transformers further reduces the potential uptake of energy efficient units.

7.1.6 New vs. used equipment

Due to the nature of transformer installations, transformers are typically not resold and it is therefore little to no market for second-hand distribution transformers.

7.2 Potential Savings from Energy-Efficient Transformers

Modelling of the different scenarios has been explained in Section 2.

Due to the variable load on distribution transformers, it is very hard to build a hypothetical simulation. However, an attempt has been made and is shown in the table below.

The tables below consider the current scenario (BAU- Business as Usual), as well as the adoption of improved minimum energy performance standards (MEPS) and best available technologies (BAT) if these were to be driven by policies and regulations.

For a simple savings calculation, transformers have been grouped into three categories:

1. Not Rated
2. SEAD[2] Tier 3 or similar
3. SEAD Tier 5 or similar.

7.2.1 Benefits of Energy Efficiency – 3 Scenarios

Table 7.1 BAU, MEPS, BAT scenarios for transformers.

Scenario	Description	QTY (2017)	QTY (2020)	Tech. Adopt (2025)	QTY (2025)	Tech. Adopt (2030)	QTY (2030)
Business as Usual	Not Rated	8 571	10 183	-8%	14 414	-20%	17 742
Business as Usual	SEAD Tier 3 or similar	24 625	29 257	-5%	42 861	-14%	56 625
Business as Usual	SEAD Tier 5 or similar	16 949	20 137	11%	34 391	26%	66 673
DNV GL Projected MEPS	Not Rated	8 571	10 183	-46%	8 461	-25%	9 764
DNV GL Projected MEPS	SEAD Tier 3 or similar	24 625	29 257	-1%	44 477	-27%	49 640
DNV GL Projected MEPS	SEAD Tier 5 or similar	16 949	20 137	25%	38 729	37%	81 637
DNV GL Projected BAT	Not Rated	8 571	10 183	-63%	5 797	-66%	3 033
DNV GL Projected BAT	SEAD Tier 3 or similar	24 625	29 257	-20%	35 987	-73%	15 207
DNV GL Projected BAT	SEAD Tier 5 or similar	16 949	20 137	61%	49 883	60%	122 802

Data & Assumptions:

- *Exchange Rate: 1 USD = 12.5 ZAR = 360 ZWD.*
- *Average Residential marginal Electricity Tariff: 0.098 USD/kWh.*
- *Average Industrial marginal Electricity Tariff: 0.098 USD/kWh.*
- *Electricity Cost Increase: 10% per annum.*
- *Electrification Rate Increase: 9%*
- *Average Transformer Size: 315 kVA, 11kV/0.4kV*
- *Average Operating Hours: 24 hours per day, 365 days per annum.*

[2] The Super-efficient Equipment and Appliance Deployment (SEAD) Initiative is a voluntary collaboration among governments working to promote the manufacture, purchase, and use of energy-efficient appliances, lighting, and equipment worldwide. SEAD is an initiative under the Clean Energy Ministerial (CEM) and a task of the International Partnership for Energy Efficiency Cooperation (IPEEC).

- *QTY and adoption of new technologies based on information from stakeholder interviews.*

Assuming these adoption rates are accurate, the following savings are projected (Table 7.2) to be achieved under the MEPS and BAT scenarios. The U4E targets are also shown as benchmarks.

Table 7.2 Projected savings for transformers under MEPS And BAT scenarios.

	Sum of GWh Savings (2025)	Sum of GWh Savings (2030)	Sum of Million USD Savings (2025)	Sum of Million USD Savings (2030)	Sum of GHG Savings (2025)	Sum of GHG Savings (2030)
DNV GL Projected MEPS	142	271	30	92	51	97
DNV GL Projected BAT	287	749	60	254	103	268
U4E Targets	135	281	13	28	48	101

7.2.2 Job creation/elimination from EE products

Implementation of strict energy efficiency standards might result in an increase in replacements of current distribution transformers, which in turn will result in jobs in the local manufacturing industry.

7.3 Status of Policies and Initiatives

7.3.1 Standards and regulations

Power efficiency is generally an efficiency level determined by the instantaneous load power and the power losses in a system. However, since SANS 780 is based on the IEC transformer standards, the transformer rating is based on the rated input (primary side) parameters and not load side parameters or roadside measurements.

7.3.2 Supporting Policies – Labelling and consumer awareness campaigns

There is no labelling scheme in Zimbabwe to differentiate between the performances of transformers

7.3.3 Financial Mechanisms

There are no visible and effective state or industry-funded programmes or initiatives to drive the adoption of energy efficient distribution transformers.

7.3.4 Monitoring, Verification and Enforcement

SANS 780:2009 specifies energy performance standards for distribution transformers and is enforced by the South African Bureau of Standards (SABS) and adopted by the Zimbabwe government and the ZESA.

7.3.5 Environmentally Sound Management

Zimbabwe is bound by the SADC Protocol on Energy 1996, which states that: "energy efficiency and conservation applications have minimal adverse impact on the environment, relative to other energy applications". The handling of removed equipment like lighting, is addressed in the Environmental Management Act 10 of 2008 and related regulations, but it was unclear whether these were enforced.

7.3.6 Other on-going projects/initiatives

No ongoing initiatives or projects are currently in place to drive the adoption of energy efficient transformers.

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9 APPENDICES

APPENDIX A: SACREE DETAILS

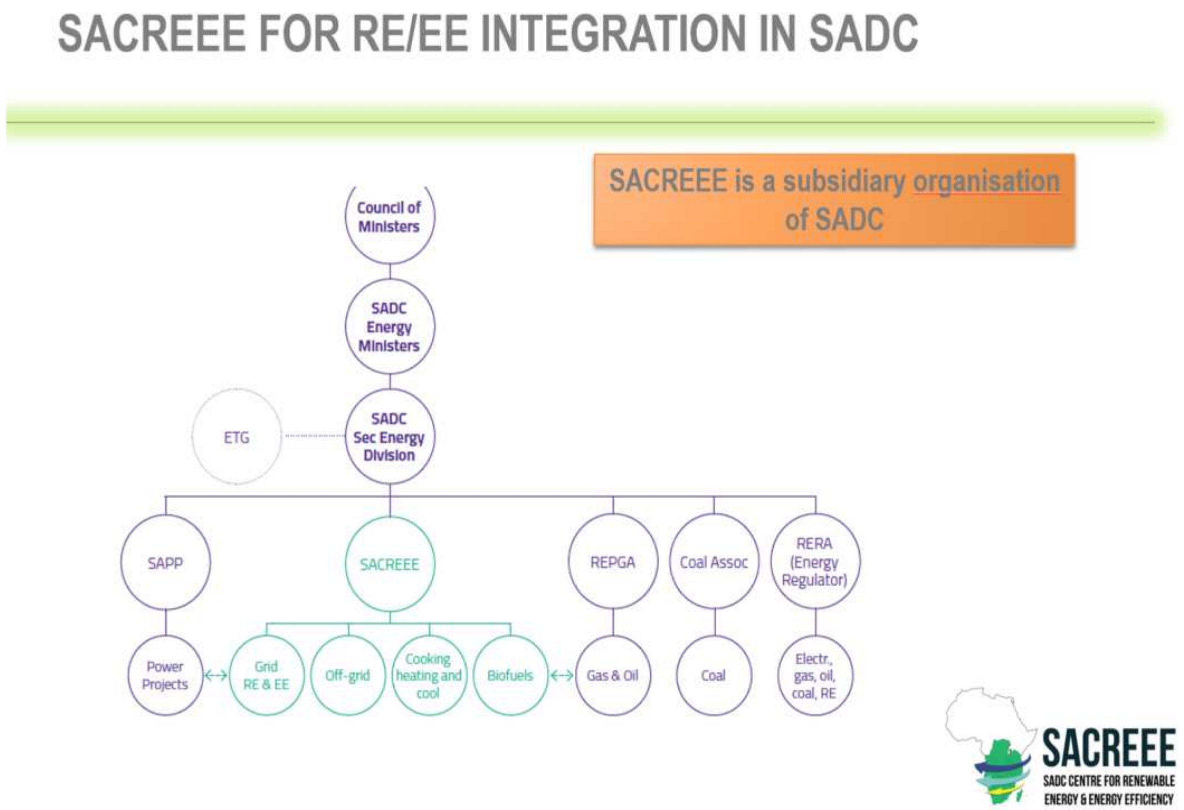
Extracted from the SACREEE_GNSEC_VEF2017.ppt

SACREEE is the **SADC CENTRE FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY** – for market-based adoption of renewable energy and energy efficiency. SACREEE was established in 2016 by the SADC Energy Ministers and endorsed by 35th SADC Council of Ministers Meeting.

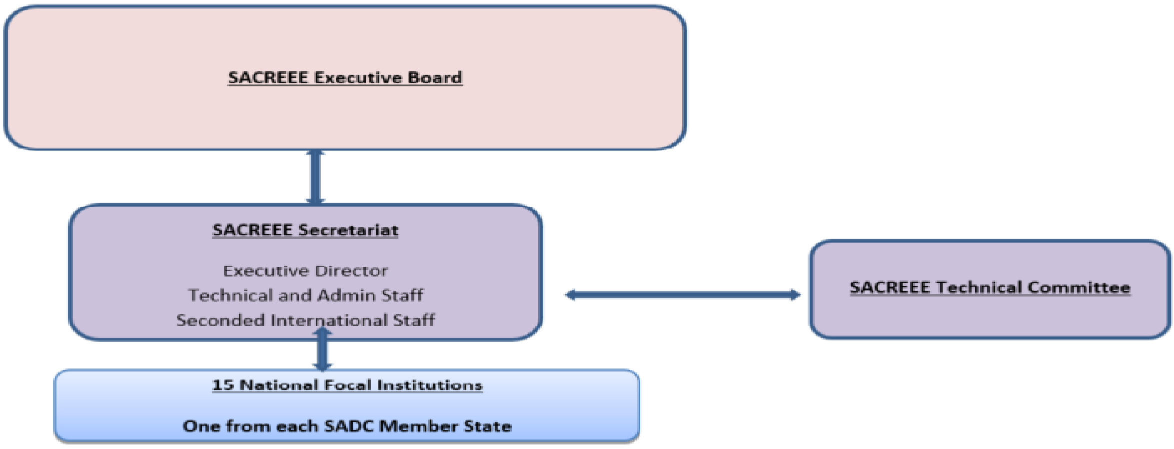
SACREEE's mandate is to implement the Regional Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP) through the promotion of market based adoption of renewable energy and energy efficient technologies and energy services

SACREEE is established on a sustainable basis through the following sources of support:

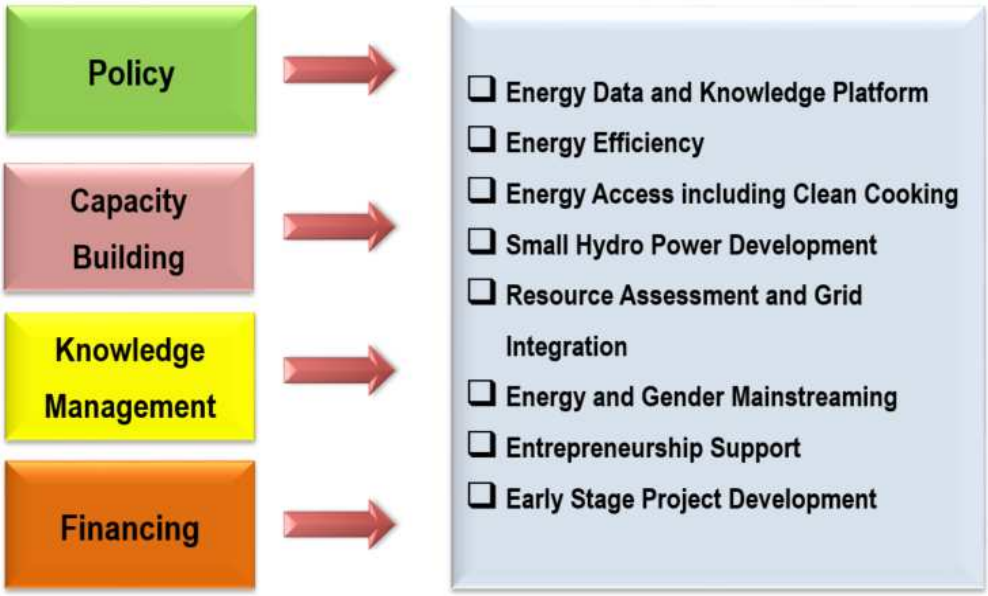
- Member States contributions
- Donor funding
- Cost recovery from services offered to projects.
- SACREEE Secretariat is based in Windhoek, Namibia



SACREEE GOVERNANCE STRUCTURE



SHORT-TO-MEDIUM TERM SACREEE FOCUS AREAS



SACREEE
SADC CENTRE FOR RENEWABLE ENERGY & ENERGY EFFICIENCY

PROVIDING REGIONAL SUPPORT TO NATIONAL ACTIONS - SACREEE ACTIVITIES

SACREEE develops and executes regional programs and projects in order to support SADC Member States

- To increase access to sustainable energy services;
- To develop sustainable energy markets;
- To improve the legal and regulatory framework and ensure policy coherence and alignment of RE & EE activities with national/regional and international policies;
- To align the national actions with international commitments and climate change actions (e.g. NDCs)
- To support donor harmonization, coordination and to create synergies with other ongoing initiatives;
- To strengthen local capacities through capacity building activities
- To foster networks between research and training institutions (*Network of Energy Excellence for Development (NEED), SOLTRAIN, etc*) as well as organize train-the-trainers workshops;
- To improve the availability of quality energy data and information for sound decision making on policy and investment

SACREEE
SADC CENTRE FOR RENEWABLE ENERGY & ENERGY EFFICIENCY

SADC Industrial Energy Efficiency Programme (SIEEP)

SIEEP contributes to the competitiveness of the industrial sectors of SADC Member States by building their capacity to adopt, invest and utilise energy efficient technologies and practices.

Target group are medium and large scale industries.
SIEEP is in line with the SADC Industrialization Strategy and Roadmap, 2015-2063.

Current Activities (in cooperation with the European Union)

- Assessment of EE potential in Industries
  - potential on electricity energy saving opportunities,
  - potential for renewable energy heating and cooling applications in industry,
  - capacity to implement energy and efficiency measures
  - capacity of industries on implementing ISO 50001
- Development of a regional program for Industrial Energy Efficiency to be endorsed by the Member States

SACREEE
SADC CENTRE FOR RENEWABLE ENERGY & ENERGY EFFICIENCY

SADC CENTRE FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY – SACREEE

MAIN CHALLENGES IN THE SADC REGION:

POLICY AND REGULATION

- Lack of enabling policies and regulations that stimulate markets for RE and EE
- Energy policy developed in isolation with regional and international trends leading to disharmony
- Standards and labeling of equipment are not harmonized across the region to allow an integrated market
- Need to integrate into the post- 2015 Inclusive and Sustainable Industrial Development (ISID) agenda highlighting the importance of energy

TECHNICAL

- Weak and limited electricity grid infrastructure that limits possible grid connection of RE generated electricity
- Knowledge and experience not shared across borders
- Low local content of technology leading to high RE equipment maintenance costs

CAPACITY

- Limited capacity and awareness of the technical and economic possibilities of RE/EE technologies and their applications
- Low R&D capacity and funding and little regional cooperation between R&D institutions
- Technical capacity for installation, and operation and management of RE systems is limited
- Limited capacity to initiate, implement and manage Public- Private Partnership (PPP) projects effectively
- Limited capacities to identify, develop, and implement innovative RE/EE projects

MARKETS

- Limited information on availability of RE resources on which to base decision to invest
- Potential EE improvement technologies not widely known in the Region
- Limited information on the social and environmental impacts and acceptability of the technology
- Markets for RE/EE technologies and energy services fragmented along national boundaries
- Lack of knowledge at vocational and university level

FINANCING

- Limited support available for bankable project preparation
- Limited exposure of local Financial Institutions to RE/EE investment projects
- Limited experience on special purpose soft loans for RE/EE projects for SMEs and low income sections of the population.
- Perceived risky nature of the RE/EE projects

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APPENDIX B: ENERGY EFFICIENCY FUNDING INITIATIVES IN SADC REGION [20]

a) **EREF ECOWAS Renewable Energy Facility -** TANZANIA

b) **EU-Africa Infrastructure Trust Fund (ITF)) / Africa Investment Facility (AfIF) -** Sub-Saharan Africa

Attract and leverage financial resources and technical expertise to support infrastructure investments in Sub-Saharan Africa - Grants in the energy sector are for example used for: geothermal, hydropower, solar power and wind power plants, transmission lines, improvement of energy efficiency and energy savings, etc.

c) **European Development Finance Institutions (EDFIs) Private Sector Development Facility -** Sub Saharan African countries that are committed in reaching the Sustainable Energy for All (SE4ALL) objectives, except South Africa
The Facility aims to contribute to poverty reduction and economic development in Sub-Saharan Africa through the mobilisation of resources for projects in the sector of energy. In particular, the Facility aims to increase access to modern energy services and investments in renewable energy and energy efficiency, by promoting private sector investments and providing additional dedicated financial resources to African countries committed to meet the objectives of the SE4All initiative.

d) **Regional Technical Assistance Programme (RTAP) -** Tanzania
Make renewable energy and energy efficiency financing a standard business model that can be adopted by the local banks to support and diversify their revenue stream. RTAP is the TA component of a credit line established by AFD for financing renewable energy and energy efficiency projects

e) **Africa-EU Energy Partnership (AEEP) -** European and African member states –
AEEP 2020 includes energy efficiency (increase energy efficiency in all sectors)

f) **World Bank Energy Sector Management Assistance Program (ESMAP) - Africa Renewable Energy Access Program (AFREA I & II) -** Mozambique, Tanzania and Zambia
Promoting increased access to energy, ith an emphasis on renewable energy, energy efficiency and energy access.

g) **ACP-EU Energy Facility -** Most countries in sub-Saharan Africa
To increase access to modern, affordable and sustainable energy services in rural and peri-urban poor areas by focusing on renewable energy solutions and energy efficiency measures; To improve governance and framework conditions in the energy sector at regional, national and local levels, in particular in respect of promoting access to energy services, renewable energy and energy efficiency;

h) **Clean Technology Fund (CTF) -** South Africa (and DPSP – Mozambique?)
Highly concessional resources to scale up the demonstration, deployment, and transfer of low carbon technologies in renewable energy, energy efficiency, and sustainable transport.

i) **Global Energy Efficiency and Renewable Energy Fund (GEEREF)** - Sub-Saharan Africa (African Renewable Energy Find L.P.)
Increase access to, capital for and the share of renewable energy and energy efficiency project developers and companies in developing countries and economies in transition;

j) **AREF - Africa Renewable Energy Fund -** GEEREF has committed USD 19.6 million to THE AFRICA RENEWABLE ENERGY FUND, MANAGED BY BERKELEY ENERGY
AREF is a private equity fund focusing on renewable energy infrastructure investments across Sub-Saharan Africa, excluding South Africa.

APPENDIX C: PRICE LISTS

(Will be supplied as separate file)

ABOUT DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.