DNV·GL

TECHNICAL MARKET REVIEW

Country Profile: South Africa

Climate Technology Centre & Network

Revised Report
Date: 23rd April 2018

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Overall Task and Objective of project:

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

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1 EXECUTIVE SUMMARY

This report looks at the potential for increasing the energy efficiency of products in South Africa by providing a technical market assessment of current conditions and policies. Five specific product categories have been looked at: 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. Within this context, DNV GL presents its best estimation of the technical potential for each product category and recommendations to achieve savings over standard equipment using assumptions based on the research undertaken during this study.

General remarks

South Africa is the driving force for energy efficiency in the Southern African regional market. By leading the way in driving energy efficiency and performance standards, the entire region benefits. But even more than that, the South African market holds a massive opportunity in its own right for energy savings by means of adopting energy efficient standards and technologies as usage continues to expand. Key challenges in the energy sector include the fact that South Africa's electricity system is constrained as the margin between peak demand and available electricity supply has been precariously narrow since 2008. Also, with increasing interest in renewable energy deployment in the country, existing grid infrastructure problems have come to the forefront. Increasing the adoption of energy efficient products can help mitigate this situation.

Underlying process

DNV GL conducted an initial desktop analysis before sending out data requests and setting up meetings with the local entities in South Africa. These included the Department of Energy, ESKOM, CSIR and other local stakeholders such as contractors, suppliers and installers of technologies. In-person meetings and interviews were conducted over several days within the country, with follow up conversations via email and phone.

National Designated Entity (NDE) prioritisation

Largest potential within a small market

Even though the entire continent of Africa consumes less than 5% of all electricity in the world, South Africa is the largest economy and consumes most of the energy among the ten Southern African nations. The government has made an effort to build local manufacturing capacity for such products as high efficiency lighting, to supply not only the RSA but the region.

Concluding remarks

While South Africa has been a regional leader in pursuing energy efficiency, given its strong economy and high level of electricity access, the country still has much to gain by adopting energy efficient standards and technologies. The market research and data collected by DNV GL provided insight into this potential for the five product categories.

The projected energy savings for South Africa 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 Figure 1.1 below. More detail on the underlying approach used to arrive at these can be found in the sections of the report related to 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 and BAT are show in the table below.

Table 1.1 Projected MEPS and BAT savings for South Africa.

	GWh savings (2025)	GWh savings (2030)	MUSD savings (2025)	MUSD savings (2030)	GHG savings (2025)	GHG savings (2030)
DNV GL Projected MEPS						
Lights	9 802	9 131	1 114	1 671	8 832	8 227
Aircon	167	309	7	21	150	278
Refrigeration	882	1 591	100	291	795	1 433
Motors	991	1 987	42	137	893	1 790
Transformers	2 749	3 107	118	215	2 477	2 799
Total	**14 592**	**16 125**	**1 381**	**2 335**	**13 147**	**14 528**
DNV GL Projected BAT						
Lights	17 265	16 173	1 962	2 959	15 556	14 572
Aircon	323	730	14	50	291	658
Refrigeration	1 260	2 273	143	416	1 136	2 048
Motors	1 404	3 766	60	260	1 265	3 394
Transformers	4 421	6 759	190	467	3 983	6 090
Total	**24 673**	**29 701**	**2 368**	**4 152**	**22 230**	**26 760**
U4E Targets						
Lights	10 291	10 448	545	554	10 209	10 365
Aircon	213	361	11	19	211	359
Refrigeration	823	1 596	44	85	816	1 584
Motors	3 300	6 878	66	138	3 274	6 823
Transformers	2 692	5 109	143	271	2 426	4 603
Total	**17 318**	**24 392**	**809**	**1 066**	**16 936**	**23 734**

The projections developed by DNV GL consider more detailed data than was available through the interview process used to develop the U4E targets and reveals higher levels of potential for savings across all five technology categories.

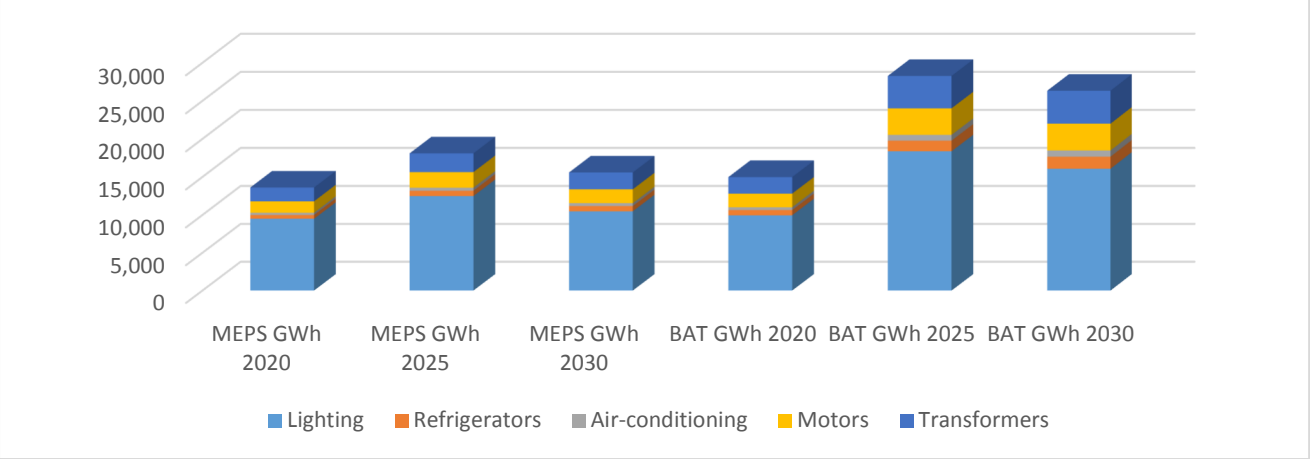

Figure 1.1 Projected annual energy savings for South Africa.

2 INTRODUCTION

2.1 General Information about South Africa

The Republic of South Africa (RSA) occupies the southern-most part of the African continent stretching from the Limpopo River in the north to Cape Agulhas in the south. Covering an area of 1,219,090 km², the country shares borders with Namibia, Botswana and Zimbabwe in the north, and with Swaziland and Mozambique in the north east. It also surrounds the Kingdom of Lesotho. To the west, south and east, South Africa borders the Atlantic and southern Indian oceans. The country's coastline covers some 2,968 km. Lying 1,920 km south east of Cape Town in the Atlantic Ocean are the isolated Prince Edward and Marion islands, which were annexed by South Africa in 1947. Pretoria, located in the Gauteng Province, is the administrative capital and the seat of the President of the Cabinet. Cape Town is the legislative capital and the seat of the nation's Parliament. Bloemfontein serves as the judicial capital, as the seat of the Supreme Court of Appeal.

Size (km²)	1,220,000
Population (Est, 2017)[1]	55,458,070

South Africa is a member of the United Nations, the Commonwealth of Nations and the Southern African Development Community (SADC). 16.56% 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 South Africa as a "upper-middle income" country because the annual gross national income (GNI) per capita levels is USD 4,126 to USD 12,735 [2] [3] [4] [5].

2.2 Climate and Topography

According to Wikipedia, the climate of South Africa is determined by South Africa's location in the Southern Hemisphere's subtropical zone, and its location between two oceans, Atlantic and Indian [6]. It therefore has a wider variety of climates than most other countries in sub-Saharan Africa, and it has lower average temperatures than other countries within this range of latitude, like Australia, because much of the interior (central plateau or Highveld, including Johannesburg) of South Africa is at higher elevation. Winter temperatures may reach the freezing point at high altitude, but are at their most mild in coastal regions, particularly the Eastern Cape. Winters in South Africa occur between June and August. The Western Cape has a Mediterranean climate with winter rainfall, most of the country experiences summer rainfall. Climate is mostly warm to hot days and cool to cold nights. During the summer months, the evergreen Caprivi Strip average temperature lies at 35° C during the day, dropping to about 20° C at night. In winter the day temperature rises to a cosy 28° C, but at night the temperature can drop to 7° C or even 1° C.

2.3 Electricity Sector

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) [7].

Figure 2.1 below shows the installed energy capacity for 2014 and 2030 in South Africa, which has been extracted from a 2013 IRENA report entitled, Southern Africa Power Pool: Planning and Prospects for Renewable Energy.

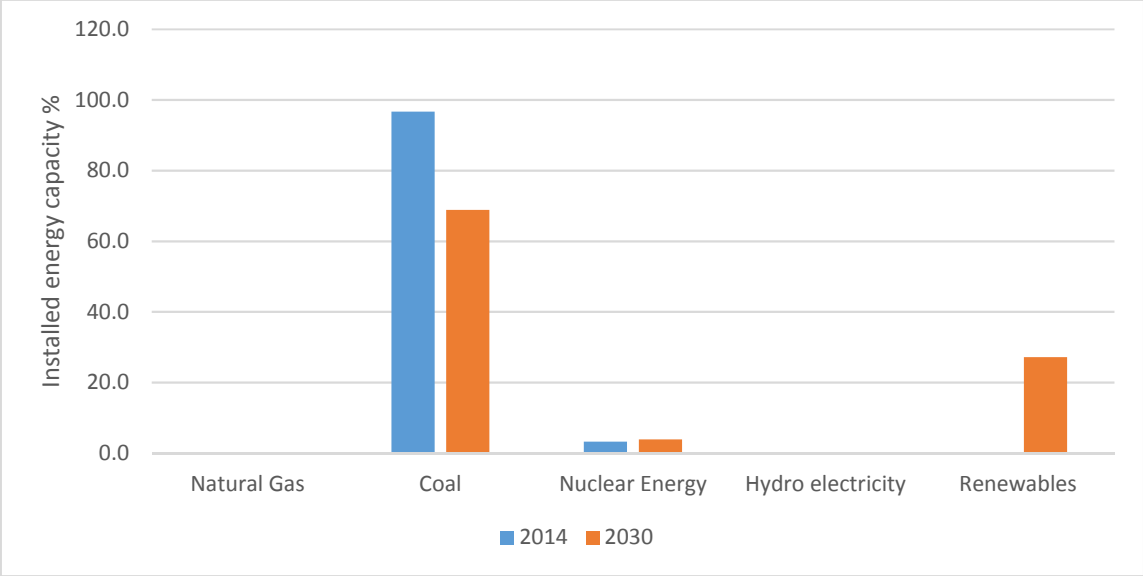

Figure 2.1 South Africa installed energy capacity[1] for 2014 and 2030.

Although the South African energy supply is dominated by coal, South Africa plans to expand renewable electricity capacity to 18,200 MW by 2030. In 2016 the renewable energy mix was Hydro 665 MW, wind 1,473 MW, Solar PV 1,549 MW, Solar (CSP) 200 MW, Bioenergy (solid biomass) 122MW, i.e. 4,009 MW. Six Renewable Energy Roadmaps were developed for electricity generation from wind, CSP and PV and for high and low SWH rollout programmes that reduce the demand for electricity. 85% of the population have access to electricity.

South Africa 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. South Africa also joined the International Renewable Energy Agency (IRENA) - a global initiative to promote and reduce barriers to the uptake of renewable energy.

Table 2.1 indicates the presence of significant energy efficiency and demand-side management (DSM) activities in South Africa.

Table 2.1 Energy efficiency and Demand-Side Management (DSM) activities[2] South Africa [7]

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
South Africa	X	X	X	X	X	X	X	X	X					X

[1] Note: Renewables includes Solar PV, Solar Thermal, and Biomass.

[2] Where 'X' indicates the presence of the listed policy type in the country.

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 South Africa's national energy efficiency targeted programmes [7]

Target type	Lighting retrofit	Reduce electricity distribution losses	Improved cooking devices	Load management	Standards and Labelling	Financing	Revised building codes
South Africa	X	X	X	X	X	X	X

Table 2.3 below indicates South Africa's targeted GWh savings per product type by 2030 as identified and proposed by United4Efficiency (U4E), assuming a successful implementation of the various energy efficiency strategies.

Table 2.3 South Africa's targets for energy savings [8]

U4E Pathway to Energy Efficiency	Targeted annual GWh savings by 2030				
	Lighting	Residential refrigerators	Room air conditioners	Industrial electric motors	Transformers
South Africa	10,447.6	1,596.3	361.4	6,877.6	5,109.2

(Extracted from the U44E Country Assessment, December 2016)

There is a major inter-regional transmission project underway in the form of the Mozambique-Zimbabwe-South Africa (MOZISA) transmission project. Eskom has received a USD180 million loan from the recently established New Development Bank BRICS in order to fund power lines that can transmit 670MW and transform 500MW of renewable energy generation.

South African municipalities are in the process of rolling out smart meters in certain areas. This includes City Power, which has recently installed 34,000 smart meters in Johannesburg and the City of Tshwane, which has installed in excess of 12,000 smart prepaid meters.

The country is also looking into the development of smart grids and several municipalities have already set up pilot projects in this regard. Furthermore, the South African National Energy Development Institute (SANEDI) has established the South African Smart Grid Initiative (SASGI) in order to develop a smart grid vision and related policies for South Africa.

2.4 Power Industry Regulation

An overview of the Power Sector Regulatory environment in South Africa is set out below in Figure 2.2.

Organizations responsible for energy policies	• Department of Energy (DOE)
Energy regulator	• National Energy Regulator of South Africa • National Nuclear Regulator
Energy policy	• Electricity Regulation Second Amendment bill

publications	• National Energy Regulator Amendment Bill • Electricity Regulation Act, 2006 (Act No. 4 of 2006) • Electricity Regulation Amendment Act • National Energy Regulator Act • Electricity Regulations on new energy generation capacity • Integrated Energy Plan • Integrated Resource Plan • Liquid Fuels Road Map • Gas Utilization Master Plan • National Energy Efficiency Strategy • White Paper on Renewable Energy • Electricity Pricing Policy
Main entities in the electricity market	• Eskom • IPPs • Local Municipalities

Figure 2.2 South Africa's power sector regulatory environment.

The National Energy Act (No 34 of 2008) is a first explicit legislative response to address the issues of energy efficiency as well as renewable energy. The Act establishes a significant platform for regulatory, legislative and institutional enablement. It also includes Electricity Regulations for Compulsory Norms and Standards for Reticulation Services (GN R773 in GG 31250 of 18 July 2008). These regulations are aimed at ensuring stability and security of electrical supply with respect to trading or distribution of electricity and includes services associated therewith. It focuses on electrical lighting, water heating, space heating, ventilation and cooling, as well as the remote reduction or increase of supply in existing buildings. In addition, The Act promoted the establishment of the South African National Energy Development Institute (SANEDI).

Interpretation Note 95 of the Income Tax Act NO. 58 OF 1962 Section 12L titled "Deduction for Energy Efficient Savings" allows any person who has a project which is registered with SANEDI to claim a deduction for energy-efficiency savings (by using energy-efficient machinery and equipment) that are derived from activities performed in the conducting a trade. It is an incentive for energy-efficiency savings and encourages taxpayers to convert old technologies to newer, more energy efficient technologies, which may involve substantial amounts of capital, and to claim a deduction for most forms of energy-efficiency savings.

A Policy to support the Energy Efficiency and Demand Side Management Program for the Electricity Sector through the Standard Offer Incentive Scheme also emanated from section 19 of the National Energy Act (Act No 34 of 2008) and has the intent to stimulate energy efficiency through (i) enabling regulations and institutional governance structures and (ii) introducing targeted financial incentives.

An energy efficiency strategy was published in 2005 by the South African Department of Minerals and Energy (DME) in support of the 1998 White Paper on Energy Policy and set a national target for energy efficiency improvement. The South African Bureau of Standards is developing Energy Performance Standards for, amongst others, refrigerators, freezers, air conditioners, fluorescent lamps, incandescent lamps, central air conditioners and lighting ballast fluorescent.

The White Paper on Energy Policy, the White Paper on Renewable Energy Policy and the Energy Efficiency Policy and Strategy all include objectives that focus on the protection of the environment.

Several government agencies are active in the energy sector. The Central Energy Fund Group (CEF) (Pty) Ltd is involved in the search for appropriate energy solutions to meet the future energy needs. National Energy Efficiency Agency (NEEA) was created in 2006 as a wholly-incorporated division within the CEF Group, it is responsible for the implementation of demand side management and energy

efficiency projects in the country; the management of strategies for improving efficiency; awareness-raising campaigns and training programs in energy efficiency and co-operation with all agencies involved in the sector to ensure best practice. The Energy Development Corporation (EDC) was established in January 2004 as a division of CEF and is involved in sectors where renewable energy and energy efficiency require catalysing and developing. The South African National Energy Development Institute (SANEDI) evolved from the merger of two public research agencies, namely the South African National Energy Research Institute (SANERI) and National Energy Efficiency Agency (NEEA). SANEDI is an implementing agency of the DoE, created to assist the country to reach its energy goals (SANEDI 2012). It focuses on awareness-raising and increased uptake of "green" energy. Its portfolio includes data and knowledge management on energy, energy efficiency, fuel technology, low-carbon energy and transport, CCS, as well as energy end use and infrastructure. The Department of Trade and Industry (DTI) is also important in the implementation for EE policy and especially standards and labelling (S&L), for two main reasons. First, the South African Bureau of Standards (SABS) and National Regulator for Compulsory Specifications (NRCS) falls under its authority, and second, the DTI's main goals are to enhance the competitiveness of South African industry and to advance international trade.

The NRCS, established on 1 September 2008, regulates compulsory specification like those for Energy Efficient Appliance Labelling Scheme in SA. The Electrotechnical Business Unit within the NRCS ensures the safety and energy efficiency of electrical and electronic apparatus, components and related products offered for sale in South Africa. The publication of South African National Standard (SANS) 941 in 2012, Energy Efficiency of Electrical and Electronic Equipment, introduced energy efficiency labelling on the apparatus to ensure that at the time of purchase buyers have all the energy efficiency information to make an informed choice.

ISO/SANS 50001, published in 2011, specifies requirements for establishing, implementing, maintaining and improving an energy management system, whose purpose is to enable an organisation to follow a systematic approach in achieving continual improvement of energy performance, including energy efficiency, energy use and consumption. ISO/SANS 50010, published in 2011, provides a methodology for the determination of energy savings that may be used in a range of voluntary or regulatory processes which may require the impact of interventions on energy use to be calculated. Both SANS 50001 and 50010 allow the Department of Energy to develop and promulgate the necessary regulations (under the National Energy Act) to have them become a mandatory requirement. They also have been written to respond to the existing energy efficiency tax incentives as well as future tax incentives introduced by the Treasury. The Department of Energy (DOE) has developed an Energy Efficient Monitoring System (EEMS) to track the efficient consumption of energy within South Africa and the trends involved. A pilot web portal has been made available and will require reliable data from all legal entities operating in the most intensive sectors of the economy and will set thresholds, which if exceeded will potentially result in penalties.

Table 2.4 and Table **2.5** indicate the significant range of energy efficiency and renewable energy and support policies in South Africa, as of 2016.

Table 2.4 Energy efficiency support policies initiated by 2016 in South Africa [7]

Policy Type	Industrial commercial load reduction	Residential incentives (lighting, hot water load control)	Support for efficient cooking and heating	Building efficiency guidelines	Solar water heater subsidies	Mandatory energy management for industry and buildings	Reduced distribution losses	Transport efficiency standards	Biofuels production incentives/ tax credits	Voluntary business energy efficiency programmes
South Africa	X	X	X	X	X	X	X	X	X	X

Table 2.5 Renewable energy support policies initiated by 2016 in South Africa [9]

Note: R = revised (one or more policies of this type), ○ = existing national (could also include subnational) and ★ = new (one or more policies of this type).

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
South Africa	○		○		R	○		★

Table 2.6 Renewable fiscal incentives & public financing initiated by 2016 in South Africa [10]

Note: ☐ = existing national (could also include subnational indicates the presence of the listed policy type in the country).

Policy Type	Capital subsidy, grant, or rebates	Investment or production tax credits	Reductions in sales, energy, vat or other taxes	Energy production payment	Public investment, loans or grants
South Africa	☐		☐		☐

2.5 Key Challenges and Recommendations

Key challenges in the energy sector include the fact that South Africa's electricity system is constrained as the margin between peak demand and available electricity supply has been precariously narrow since 2008. Also, with increasing interest in renewable energy deployment in the country, existing grid infrastructure problems have come to the forefront.

SACREE is the SADC Renewable Energy and Energy Efficiency and, as per details in Appendix A, it works towards addressing SADC country challenges w.r.t. renewable energy and energy efficiency. Funding available to the SADC countries for energy efficiency are listed in Appendix B.

Table 2.7 gives a high-level summary of remaining opportunities for market interventions to support energy efficiency in RSA.

Table 2.7 Energy efficiency opportunities and recommendations for South Africa.

	OPPORTUNITIES	RECOMMENDATION
Policies	None identified during this study	RSA already has a significant policy and regulatory framework to support energy efficiency. More aggressive targets might help spur additional or accelerated activity.
Economic and financial	Financing for energy efficiency investments; pricing offers to capture peak demand reduction potential	The gradual adoption of smart meters in some of the South African municipalities will present additional opportunity for engaging with customers re energy efficiency strategies. More important for addressing peak demand issues will be the opportunity for the use of control devices on appliances and equipment, and offering of variable pricing (critical peak pricing, load curtailment incentives, etc.)
Informational	None identified during this study	RSA already has a major informational drive through SANEDI which is responsible for consumer education around energy efficiency

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

Energy efficient lighting has, in South Africa as in the rest of the world, seen the highest adoption rates in comparison to other energy efficiency technologies. The relatively short time to market, large savings, scalability and low cost per item make lighting an attractive low hanging fruit for any energy consumer looking to cut down on consumption and costs.

3.1 Status and Trends of Lighting Products

3.1.1 Markets and drivers

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

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

Source: https://www.thelightbulb.co.uk/resources/light_bulb_average_rated_life_time_hours/

Figure 3.1 Life Expectancy of Lights.

Short life expectancies lead to high replacement frequencies which are opportunities to change to newer, more efficient technologies within lighting. The small size of individual units, adoption of new technologies and the sheer volume of sales continually drive down the costs of both old and new types of lights.

Offices, factories and other operations that require light during daytime (Mon – Fri, 07h00 – 19h00) would have lights on for roughly 3000 hours per annum. In South Africa, residential lights (lighting in and around private dwellings) are often on for 4 hours in the evening and two hours in the morning all year round, clocking up 2190 hours per annum.

Current prices found during the shop visits in South Africa show that halogen lamps are still the cheapest (since banning of incandescent) and a 60W lamp costs between 1 – 2 USD. A CFL lamp with comparable output (typically 15W) is in the range of $2 - $3, while the LED (6W) would cost just under $5.

Light bulbs, lamps or just "lights" are generally available in supermarkets and retail stores all over South Africa. The bulk of stock is split between CFLs and LEDs, with limited quantities of halogen and other types of lighting available.

Table 3.1 General indication of stock based upon visits to several retail stores in South Africa.

LED	38%
CFL & FL	43%
Other	19%

3.1.2 Local manufacturers, suppliers, retailers and other stakeholders

There are at least 18 LED Lighting Manufacturers in South Africa. An Environmental Levy on Electric Filament Lamps (i.e. non-energy-saving light bulbs) is payable by South African manufacturers of these products. Brands include Pick & Pay, Philips, Eurolux and Ellies with other brands (Chinese imports) taking up a comparatively small portion of shelf space in stores.

3.1.3 Import/Export

Roughly 70% of all lights sold in the South African market during 2016 was imported from China. As for quantities, South Africa imported between 50 million and 100 million units annually from 2011 to 2015 with a sharp rise to over 200 million in 2016, as shown in Figure 3.2 below [8]. Electric Filament Lamps (i.e. non-energy-saving light bulbs) are subjected to the payment of an Environmental Levy if used in the RSA.

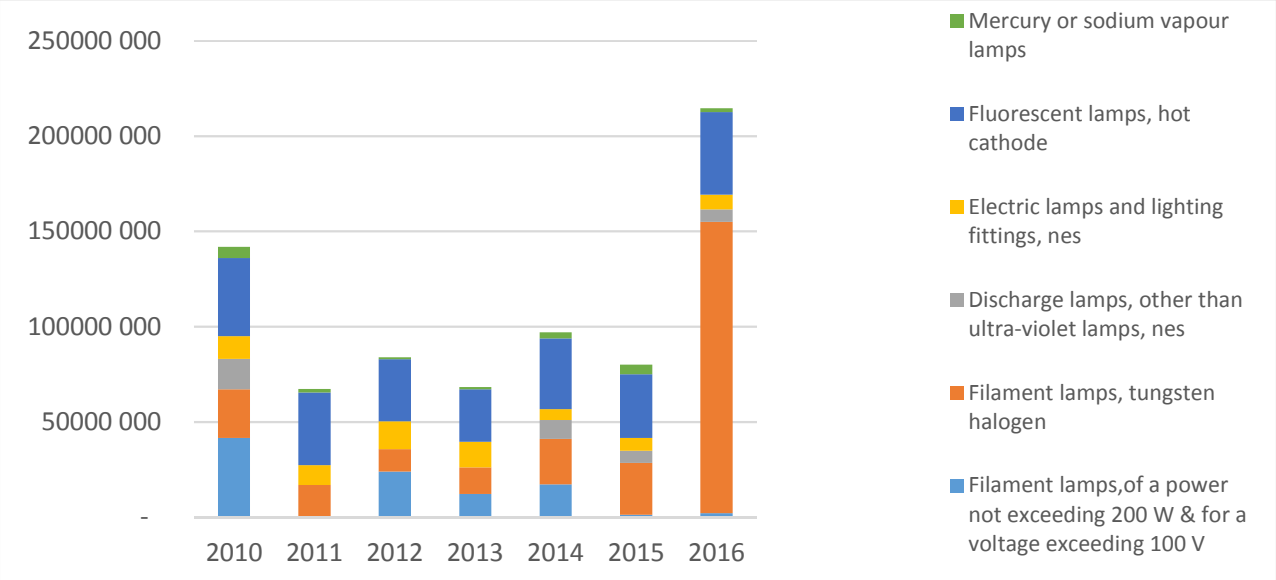

Figure 3.2 South Africa annual light unit imports during 2010 to 2016 [8].

3.1.4 Barriers to overcome

Bad reputation of cheap products

There has been an aggressive importing of cheaper products from China and South Korea that do not last the claimed time and do not yield the claimed level of light. An earlier effort was made through an ICF initiative called Efficient Lighting Initiative (ELI) whereby a quality label was attached to CFLs that had been tested and certified by an independent lab. BONESA was the name of the agency that promoted the program, which was successful in directing the public toward qualifying lamps during the period that the program operated. The organization eventually morphed into SANEDI as responsible for consumer education surrounding energy efficiency products and practices.

Import Duty & Tax

The South African government does not want to reduce, or waiver import duty or taxes on energy efficient lights (LED) to protect the local manufacturing market, which constitutes a negligible portion of market share. The result is that buyers are paying a premium for energy efficient products.

Emergency Lighting

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 stand-alone unit, rather than to replace inefficient lights in fixtures.

3.1.5 New vs. Used equipment

Lights are mostly replaced on burn-out and with life expectancies of around 2 years on average, there is practically no market for used equipment. One scenario where lights are re-used, is when lights are replaced for energy savings reasons and the old lights are donated to organizations that rely on public funding or charities such as hospitals, schools or libraries.

3.2 Potential Savings from Energy-Efficient Lighting

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

All lights except Fluorescent (FL) and Compact Fluorescent (CFL) & LEDs
Fluorescent (FL) and Compact Fluorescent (CFL)
LEDs.

3.2.1 Benefits of Energy Efficiency – 3 Scenarios

Table 3.2 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.	196 792 057	208 776 693	-10%	217 826 467	-20%	202 016 461
Business as Usual	QTY CFL & FL	108 235 631	114 827 181	16%	154 495 438	18%	211 602 889
Business as Usual	QTY LED	22 959 073	24 357 281	10%	31 060 441	50%	54 011 346
DNV GL Projected MEPS	QTY Halo, Inc etc.	196 792 057	208 776 693	-50%	121 014 704	-20%	112 231 367
DNV GL Projected MEPS	QTY CFL & FL	108 235 631	114 827 181	87%	248 483 525	3%	296 477 861
DNV GL Projected MEPS	QTY LED	22 959 073	24 357 281	20%	33 884 117	50%	58 921 468
DNV GL Projected BAT	QTY Halo, Inc etc.	196 792 057	208 776 693	-80%	48 405 882	-20%	44 892 547
DNV GL Projected BAT	QTY CFL & FL	108 235 631	114 827 181	135%	312 621 318	-4%	349 086 314
DNV GL Projected BAT	QTY LED	22 959 073	24 357 281	50%	42 355 147	50%	73 651 836

Data & Assumptions:

- *Exchange Rate: 1 ZAR = 13.5 USD.*
- *Average Residential Electricity Tariff: 0.053 USD/kWh.*

- *Average Industrial Electricity Tariff: 0.020 USD/kWh.*
- *Electricity Cost Increase: 8% per annum.*
- *Operating hours: 2 hr in morning (6-8am) and 4hr in the evening (6-10pm), 365 days per annum.*

If these adoption rates are accurate, the following savings (Table 3.3) are projected to be achieved under the MEPS and BAT scenarios. The U4E targets are also shown as benchmarks.

Table 3.3 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	9 802	9 131	1 114	1 671	8 832	8 227
DNV GL Projected BAT	17 265	16 173	1 962	2 959	15 556	14 572
U4E Targets	10 291	10 448	545	554	10 209	10 365

3.2.2 Job creation / elimination from energy efficient products.

The implementation of energy savings initiatives such as lighting retrofits combined with manufacturing and distribution of lights have proven to generate a large amount of jobs in South Africa. ESKOM's rollout of CFLs alone created more than 30 000 temporary jobs nationally, covering a wide variety of skills from sales, practical labour, measurement & verification and more [9].

3.3 Status of Policies and Initiatives

3.3.1 Standards and regulations

Compulsory Specification for Incandescent Lamps (VC 8043), dated 7 February 2014. The specification includes performance, quality and energy efficiency requirements. No similar specifications were found for CFL or LED. Redundant and replaced waste management is governed by the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) which came into effect on 1 July 2009. Fin November 2011 the National Waste Management Strategy (NWMS) was established to achieve the objects of the Act. See also Appendix A.

3.3.2 Supporting Policies – Labelling and consumer awareness campaigns

Labelling requirements for lighting, namely ballasts fluorescent, compact fluorescents, lighting incandescent and lighting systems, are reportedly under development. Certification and labelling are currently voluntary.

3.3.3 Financial Mechanisms

Programmes are being implemented where municipalities and Eskom are implementing energy efficiency technologies on items like streetlights.

3.3.4 Monitoring, Verification and Enforcement

Other than the banning of incandescent lights (which took place on a global scale and filtered through to Africa), lighting standards in current buildings are seen as voluntary with very little enforcement. OSHACT standards require certain minimum light levels but does not specify any technologies. Other

than that, new buildings are constructed and fitted according building regulations which prescribe a certain level of energy efficiency. These are verified by building inspectors.

3.3.5 Environmentally Sound Management

South Africa 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 redundant replaced energy units is addressed in the Environmental Management Act 7 of 2007 and related regulations. An Industry Waste Management Plan for Lamps is under consideration for development.

3.3.6 Other on-going projects/initiatives

The Southern African Power Pool (SAPP) started developing a specific programme for Utilities with respect to CFL replacement and commercial lighting retrofits. South Africa started promoting and distributing CFLs to customers free of charge in 2008, even before the SAPP programme. In 2008, about 20 million CFLs were replaced in the residential sector. CFLs also were given to large commercial companies in South Africa to facilitate bulb replacement among employees, including at Eskom's major offices, and some CFLs were given to the South African National Defence Force. This allowed penetration of CFLs into higher-income groups, as the door-to-door programme was targeted mainly at lower-income groups. In 2008, a retail programme was launched where Eskom concluded agreements with large national retailers to sell CFLs at discounted prices.

4 AIR-CONDITIONING

Due to a mild weather in South Africa, very few homes have air-conditioning units. The primary market for small air-conditioning units are offices and small commercial buildings.

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 looked after indoor units can last 15 or even up to 20 years.

Lower end brands such as Midea 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 taking ground in the 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 [10] [11] [12].

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

Air-conditioning units are not "of-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.

MEPS require all air-conditioning units to be at least Class B. However, the bulk of units available in South Africa are Class A or better.

4.1.3 Local manufacturers, suppliers, retailers and other stakeholders

No small residential or commercial air-conditioning units are manufacture locally. Some brands claim local manufacturing, but in fact, these are merely assembled in South Africa. All major international brands are well represented by local distributors and are contactable view phone or web.

Air-conditioning units require annual services and are often repaired when broken, rather than replaced.

4.1.4 Import/Export

South Africa is primarily an importer of air-conditioning units, but some neighbouring countries (mostly Lesotho & Swaziland) rely on cross border trade for their markets. The most prominent brands are LG, DAIKIN, SAMSUNG, Carrier, Fujitsu and Mitsubishi.

Table 4.1 Air-conditioning Unit import/export [13].

Year	Export QTY	Import QTY	Net QTY
2000	14 603	56 283	41 680
2001	19 594	75 521	55 927
2002	24 585	94 760	70 174
2003	29 577	113 998	84 421
2004	34 568	133 236	98 668
2005	39 560	152 475	112 915
2006	44 551	171 713	127 162

2007	49 542	190 951	141 409
2008	54 534	210 190	155 656
2009	59 525	229 428	169 903
2010	64 517	248 666	184 150
2011	69 508	267 905	198 397
2012	81 864	215 342	133 478
2013	67 618	225 403	157 785
2014	95 201	460 020	364 819
2015	74 196	356 456	282 260
2016	103 532	512 515	408 983

4.1.5 Barriers to overcome

Low average household incomes and poverty in general leads to decision-making that is very sensitive to cashflow and therefore against high initial cost of energy efficient equipment, even though the lower overall lifetime cost may be well known. This often results in the purchase of cheapest items, rather than energy efficient items.

Due to this mindset, the distribution and retail companies bring in products to satisfy the perceived needs of the clients, resulting in a lack of energy efficient options (variety & stock) available on the market.

4.1.6 New vs. Used Equipment

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

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 4.2 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	2 154 504	2 285 713	-6%	2 490 782	-7%	2 685 374
Business as Usual	Class B - Class A	1 675 725	1 777 777	4%	2 137 480	2%	2 519 360
Business as Usual	Class A+ & Above	957 557	1 015 873	7%	1 260 112	11%	1 621 505
DNV GL Projected MEPS	Lower than Class B	2 154 504	2 285 713	-28%	1 907 833	-19%	1 791 478
DNV GL Projected	Class B - Class A	1 675 725	1 777 777	24%	2 555 554	1%	2 986 343

MEPS							
DNV GL Projected MEPS	Class A+ & Above	957 557	1 015 873	21%	1 424 987	24%	2 048 419
DNV GL Projected BAT	Lower than Class B	2 154 504	2 285 713	-35%	1 722 349	-33%	1 337 772
DNV GL Projected BAT	Class B - Class A	1 675 725	1 777 777	14%	2 352 405	-14%	2 355 769
DNV GL Projected BAT	Class A+ & Above	957 557	1 015 873	54%	1 813 620	49%	3 132 699

Data & Assumptions:

- *Exchange Rate: 1 ZAR = 13.5 USD.*
- *Average Residential Electricity Tariff: 0.053 USD/kWh.*
- *Average Industrial Electricity Tariff: 0.020 USD/kWh.*
- *Operating hours: 8 hours per day x 125 days per annum = 1 000 hours.*
- *Average cooling capacity: 3.5kW.*
- *Electricity Cost Increase: 8% per annum.*

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

If these adoption rates are accurate, the following savings are projected (

Table **4.3**) to be achieved under the MEPS and BAT scenarios. The U4E targets are also shown as benchmarks.

Table 4.3 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	167	309	7	21	150	278
DNV GL Projected BAT	323	730	14	50	291	658
U4E Targets	213	361	11	19	211	359

4.2.2 Job creation / elimination from EE products.

No direct impact on the South African market, as the bulk of units are imported.

4.3 Status of Policies and Initiatives

4.3.1 Standards and regulations

On 28 November 2014, the Government Gazette No. R944 was published by the Minister of Trade and Industry, in which the compulsory specifications relating to the 'Labelling of Electrical and Electronic apparatus' (VC 9008) were specified. 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." Full list in Appendix A.

4.3.2 Supporting Policies – Labelling and consumer awareness campaigns

As stated above, 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 i.e. 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.

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

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

4.3.5 Environmentally Sound Management

South Africa 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 redundant replaced energy units is addressed in the Environmental Management Act 7 of 2007 and related regulations. An Industry Waste Management Plan for Lamps is under consideration for development.

4.3.6 Other on-going projects/initiatives

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

5 REFRIGERATORS

5.1 Status and Trends of Refrigeration Products

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

During 2016, refrigerator sales were just under an estimated 2.5 million units. The average life expectancy of a refrigerator is determined by the quality of construction and how the item is cared for. Properly maintained refrigerator can last between 14 and 17 years, depending on model and size. Source: Stakeholder interviews: DEFY, Whirlpool.

Market surveys and census done between 2008 and 2010 indicated just under 10 million household in South Africa with refrigerators. This does not consider the households with multiple refrigerators. Source: South African Household Census 2011

The increase of sales volumes combined with increased access to grid electricity, especially in rural areas, have significantly increased this value and early indicators show that the total number of fridges are in the order of 22 million. Source: DNV GL stakeholder interviews.

5.1.2 Purchase of refrigeration products, including where and availability of EE products

Refrigerators are sold at typical furniture or white good stores. Some of the large retailers include GAME, BEARS, Furniture City, Morkels, 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

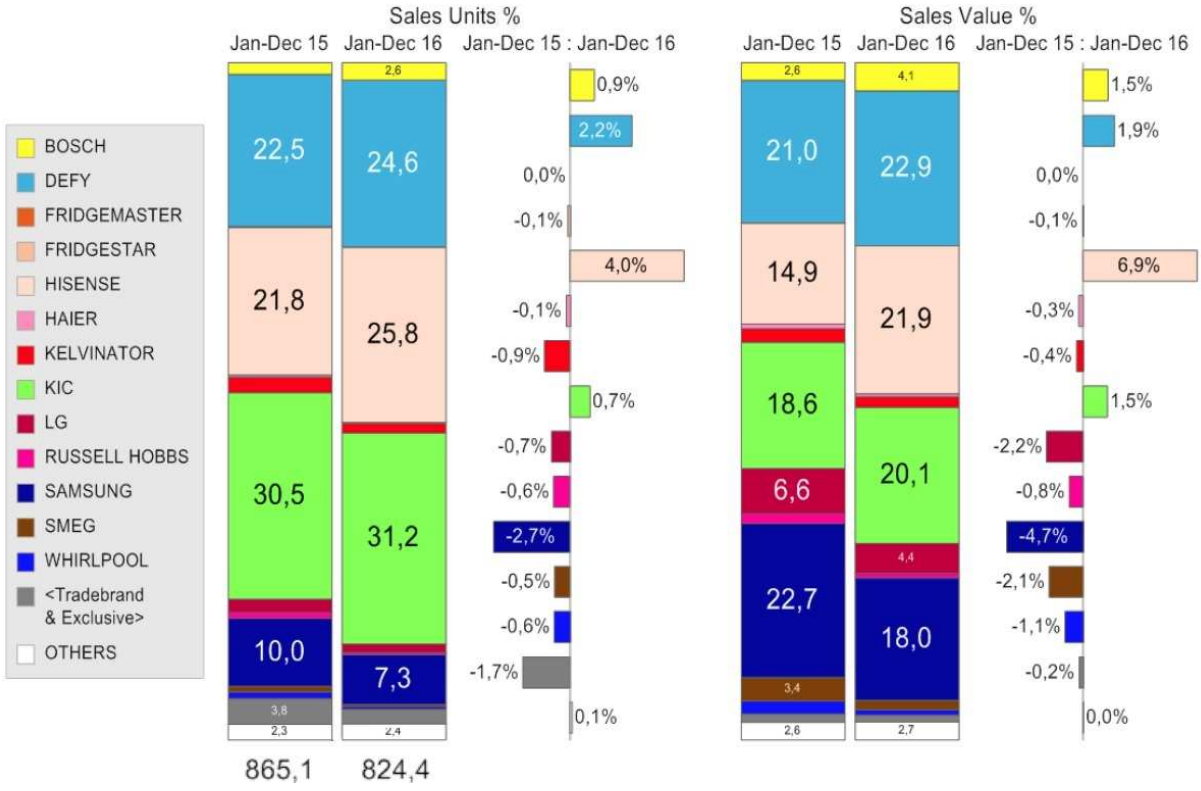

Figure 5.1 Refrigerator Market Share (provided by DEFY, initial source: GFK).

DEFY is the largest manufacturer of refrigerators in Southern Africa and holds a market share of 24.6%. Other strong competitors include Hisense and KIC, both of which come at lower prices.

5.1.4 Import/Export

Due to a strong local manufacturing sector in South Africa, around 89% of the total sales were locally manufactured products during the years 2012-2016.

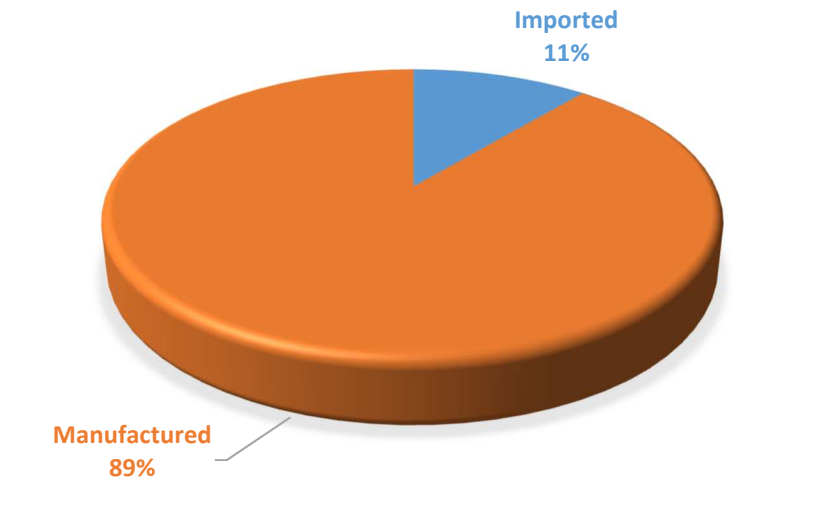

Figure 5.2 Refrigerator sales in South Africa.

Even though the local manufacturing industry is strong and competitive, the percentage of manufacturing has decreased from 87% in 2015, with the overall manufacturing market dropping from 2.3 million units to just over 2 million.

Table 5.1 Refrigerator import/export QTY [14].

Year	Export	Imported	Manufactured	Total sales
2012	81 864	215 342	1 240 685	1 374 163
2013	67 618	225 403	1 223 215	1 381 000
2014	95 201	460 020	2 317 767	2 682 586
2015	74 196	356 456	2 325 851	2 608 111
2016	103 532	512 515	2 043 589	2 452 572

5.1.5 Barriers to overcome

Old refrigerators were built to last. Therefore, some very old units are still in operation throughout South Africa 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 garage or 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 increase the overall number of refrigerators in the market.

5.1.6 New vs. Used

Refrigerators are very seldom repaired in South Africa after their warranty period. A very small appliance repair industry can be found in low income areas, but accurate data is not available.

5.2 Potential Savings from Energy-Efficient Refrigeration Products

Current minimum energy performance standards in South Africa requires fridges to be at least of Class B. 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, 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 5.2 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	10 125 000	10 741 613	-5%	11 829 850	-7%	12 754 056
Business as Usual	Class B - Class A	7 875 000	8 354 588	-2%	9 533 060	-3%	10 768 006
Business as Usual	Class A+ & Above	4 500 000	4 774 050	14%	6 309 253	17%	8 557 560
DNV GL Projected MEPS	Lower than Class B	10 125 000	10 741 613	-52%	5 977 187	-61%	2 702 387
DNV GL Projected MEPS	Class B - Class A	7 875 000	8 354 588	41%	13 670 049	4%	16 538 970
DNV GL Projected MEPS	Class A+ & Above	4 500 000	4 774 050	45%	8 024 927	38%	12 838 264
DNV GL Projected BAT	Lower than Class B	10 125 000	10 741 613	-69%	3 860 267	-80%	895 021
DNV GL Projected BAT	Class B - Class A	7 875 000	8 354 588	46%	14 126 640	-35%	10 637 603
DNV GL Projected BAT	Class A+ & Above	4 500 000	4 774 050	75%	9 685 257	83%	20 546 997

Data & Assumptions:

- *Exchange Rate: 1 ZAR = 13.5 USD.*

- *Average Electricity Price to consumer: 0.053 USD/kWh.*
- *Electricity Cost Increase: 8% per annum.*
- *QTY and adoption of new technologies based on information from stakeholder interviews.*

If these adoption rates are accurate, the following savings are projected (Table 5.3) to be achieved under the MEPS and BAT scenarios. The U4E targets are also shown as benchmarks.

Table 5.3 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	882	1 591	100	291	795	1 433
DNV GL Projected BAT	1 260	2 273	143	416	1 136	2 048
U4E Targets	823	1 596	44	85	816	1 584

5.2.2 Job creation

The adoption of energy efficiency drives job creation in the local manufacturing industry, especially due to the labelling initiative which highlights the energy efficiency of units in the market.

5.3 Status of Policies and Initiatives

5.3.1 Standards and regulations

Refrigerators are required to adhere to SANS/IEC 62552 (MEPS) and SANS 62301 (Noise).

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 i.e. 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.

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.

5.3.5 Environmentally Sound Management

South Africa 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 redundant replaced energy units is addressed in the Environmental Management Act 7 of 2007 and related regulations. An Industry Waste Management Plan for Lamps is under consideration for development.

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, 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 [15]. 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 [16].

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 for when to repair or when to replace is given in this image below (provided by ABB).

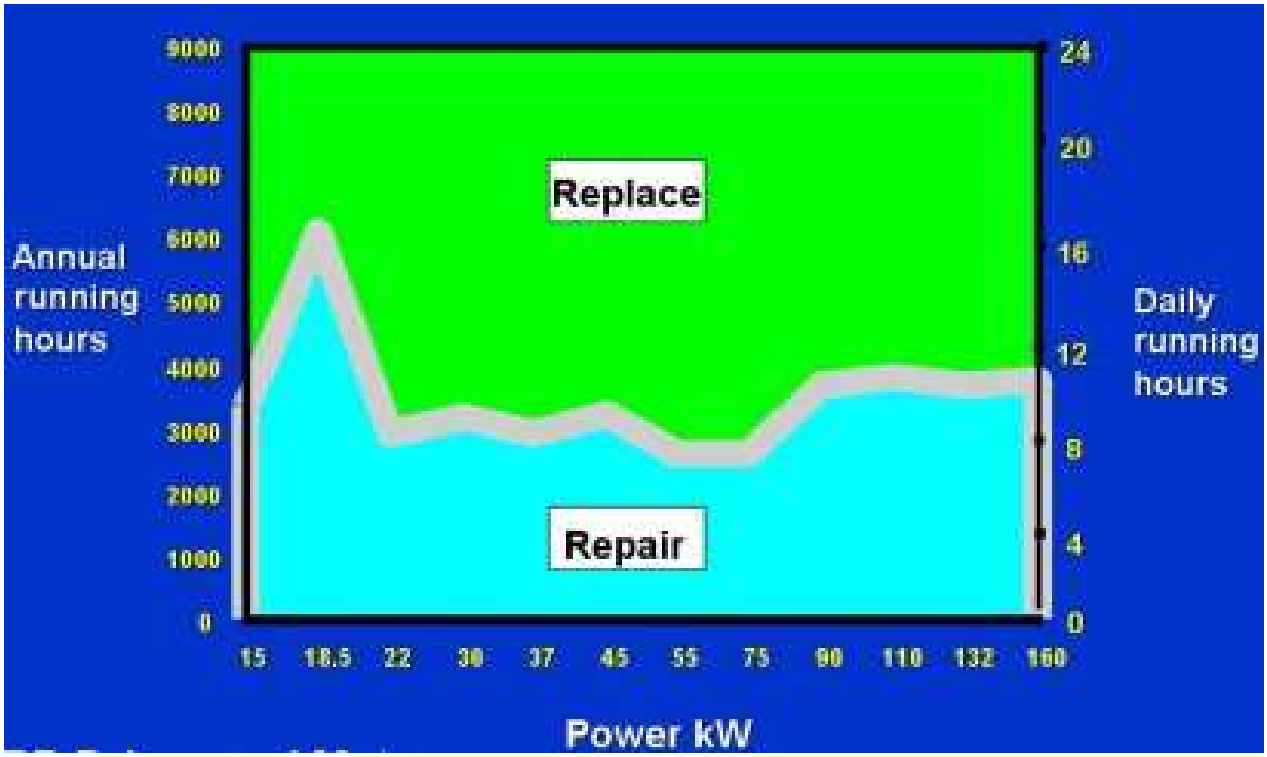

Figure 6.1 Repair/Replace power-time chart [17].

6.1.2 Price

A list of comparative motor prices is shown in Figure 6.2 below.

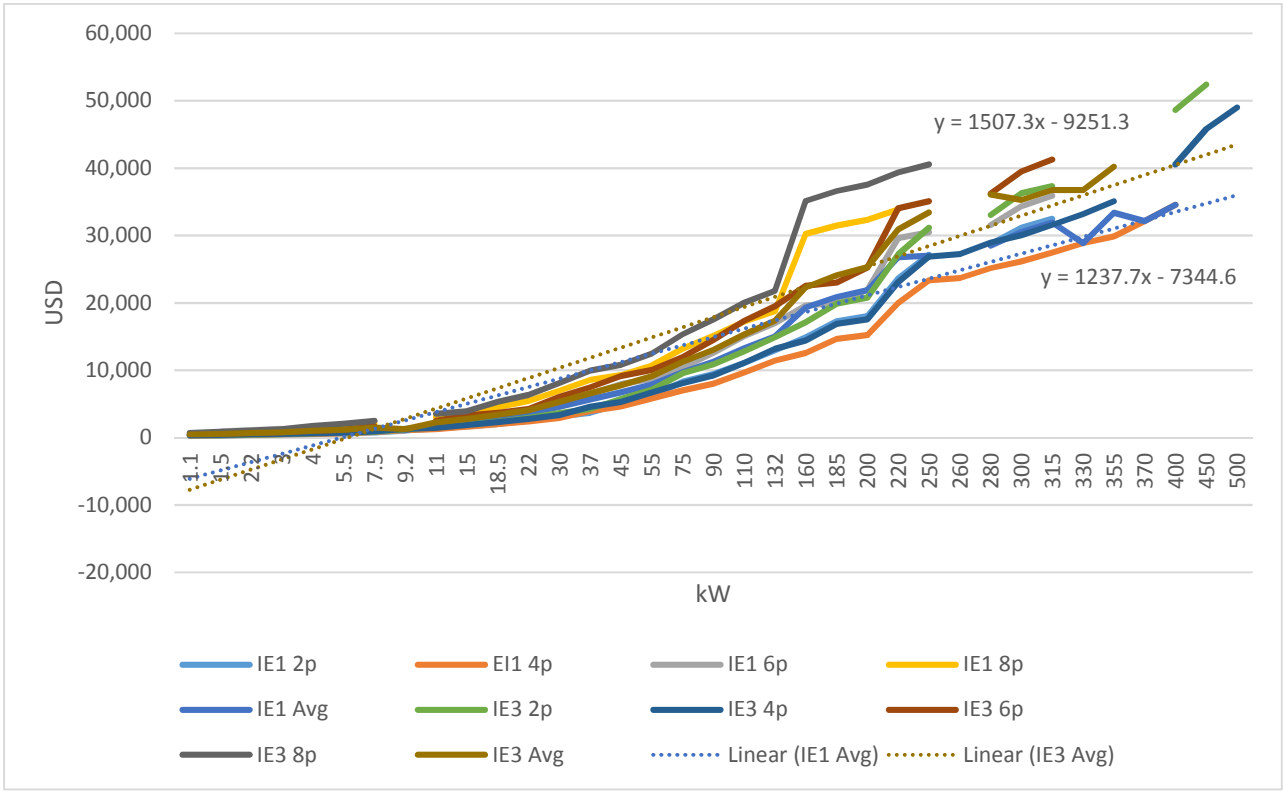

Figure 6.2 Motor pricing versus size.

IE3 motors are typically between 15 – 20% more expensive than their IE1 counterparts. Even though the operating costs of a typically 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 providing 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

Although many local and international companies claim to be motor manufacturers, very little actual manufacturing takes place in South Africa. Some isolated parts of motors are manufactured locally, primarily for very specific types of industries where typical motors do not meet the requirements of the local clients. In some instances, motors are assembled locally according to the needs of the local clients. However, this is a negligible amount and for all practical purposes, one can say that all motors are imported [18].

The three largest motor suppliers in South Africa are:

- WEG (approx. 44%)
- MOTORELLI (approx. 21%)
- ACTOM (approx. 19%)

NOTE market share not available at date of report.

6.1.5 Import/Export

South Africa imports over 80% of its electric motors from China, USA, Germany, Brazil & Italy with sum of other countries making up the remaining 20% [19]. South Africa also acts as primary point of entry into the African market for many manufacturers and distributors and therefore exports a large amount of motors to the neighbouring countries.

Table 6.1 South African Electric Motor Import & Export.

	QTY			Value (USD)		
Year	**Import to SA**	**Export from SA**	**Net Import**	**Import to SA**	**Export from SA**	**Net Import**
2000	341 919	696	341 223	29 326 060	1 511 987	27 814 073
2001	332 792	857	331 935	36 124 098	1 901 391	34 222 707
2002	466 874	2 455	464 419	39 392 927	5 244 550	34 148 377
2003	614 961	2 831	612 130	50 417 428	7 029 500	43 387 928
2004	805 233	12 971	792 263	69 207 904	11 036 185	58 171 719
2005	1 218 522	11 053	1 207 470	88 284 853	12 867 809	75 417 045
2006	1 775 620	17 037	1 758 584	108 996 733	17 127 803	91 868 930
2007	2 449 196	7 406	2 441 789	150 904 180	22 631 165	128 273 014
2008	2 608 226	87 813	2 520 413	183 883 798	27 212 784	156 671 015
2009	2 327 295	11 923	2 315 372	117 177 059	18 945 253	98 231 806
2010	2 441 171	5 027	2 436 144	154 015 211	9 937 276	144 077 934
2011	2 753 006	6 330	2 746 676	225 326 915	9 722 972	215 603 944
2012	2 357 657	2 737	2 354 920	230 325 283	9 394 687	220 930 597
2013	2 591 793	5 846	2 585 947	202 066 397	7 482 821	194 583 576
2014	3 159 193	1 730	3 157 462	206 317 870	4 710 319	201 607 551
2015	3 735 583	9 660	3 725 923	245 072 465	4 609 670	240 462 795
2016	3 511 658	5 331	3 506 328	196 092 997	3 033 346	193 059 651

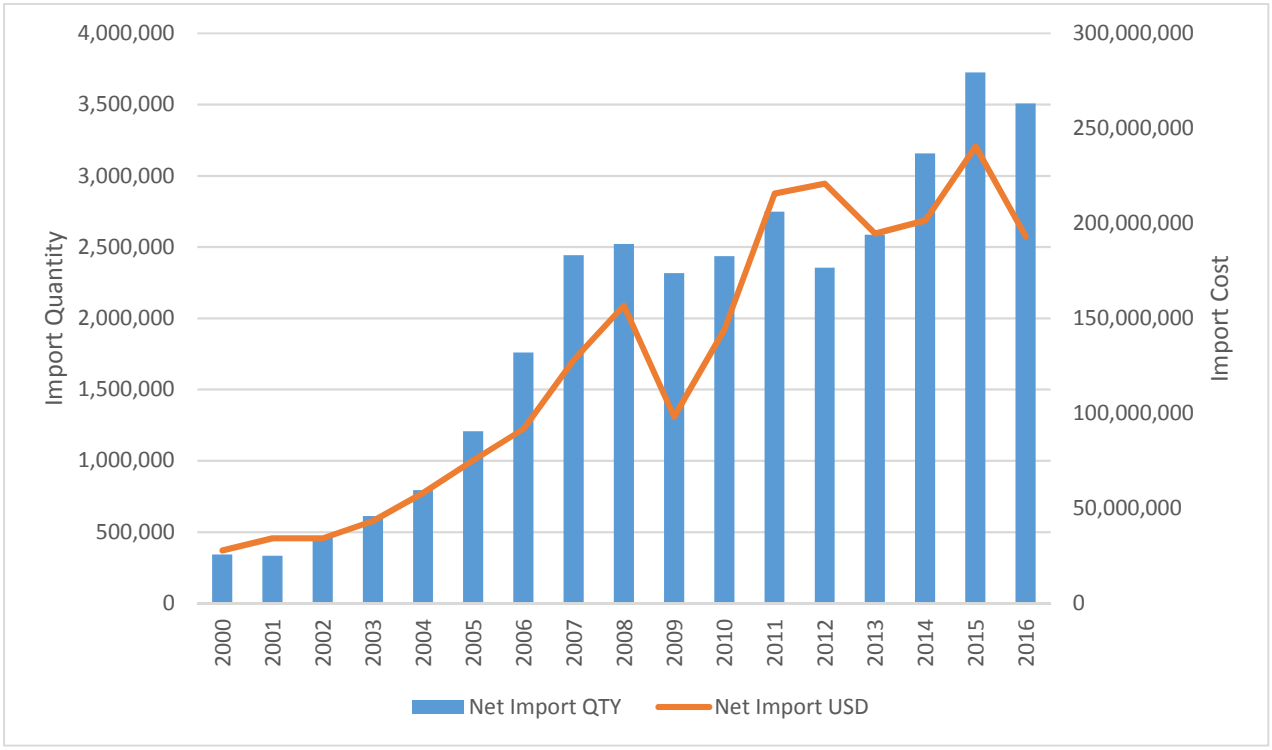

Figure 6.3 Import QTY versus cost.

A general increase in net motor imports is clearly visible in the first half of the trend above (2000 – 2008) until the energy crisis (2008). The result of the crisis is that investment dropped and fewer expansions took place.

6.1.6 Barriers to overcome

Overall Inefficient Systems

Due to the low historical price of electricity in South Africa, 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.

Negligible Savings

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

Rewinding Perception

Further to the above, the fact that motors can be rewound to perform at the same efficiency [20]reduces the drive to buy new equipment. However, it is unclear exactly how efficient rewound motors generally are, as the measurements are not recorded or reported on.

6.1.7 New vs. Used

Motors are typically used at their point of installation until catastrophic 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 end of life. Therefore, the second hand electrical motor industry is negligible.

6.2 Potential Savings from Energy-Efficient Motors

Current minimum energy performance standards in Swaziland requires motors to be at least of Class IE1. 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, 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 6.2 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	13 065 000	13 860 659	-5%	15 264 887	-7%	16 457 455
Business as Usual	Class IE3	5 025 000	5 331 023	10%	6 785 768	11%	8 733 893
Business as Usual	Class IE4	2 010 000	2 132 409	8%	2 669 810	12%	3 466 446
DNV GL Projected MEPS	Class IE1 & below	13 065 000	13 860 659	-11%	14 300 789	-13%	14 423 325
DNV GL Projected MEPS	Class IE3	5 025 000	5 331 023	23%	7 626 264	21%	10 737 073
DNV GL Projected MEPS	Class IE4	2 010 000	2 132 409	13%	2 793 413	8%	3 497 398
DNV GL Projected BAT	Class IE1 & below	13 065 000	13 860 659	-13%	13 979 423	-20%	12 964 786
DNV GL Projected BAT	Class IE3	5 025 000	5 331 023	25%	7 725 146	27%	11 392 621
DNV GL Projected BAT	Class IE4	2 010 000	2 132 409	22%	3 015 897	23%	4 300 389

Data & Assumptions:

- *Exchange Rate: 1 ZAR = 13.5 USD*
- *Current Average Electricity Price to consumer: 0.020 USD/kWh*
- *Electricity Cost Increase: 8% per annum*
- *Average Motor Size: 10kW (Source: ESKOM DSM Energy Efficient Motor Program)*
- *Average Operating Hours: 8 hours per day, 5 days per week, 50 weeks per annum.*

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

Table 6.3 Projected savings for motors 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	991	1 987	42	137	893	1 790
DNV GL Projected BAT	1 404	3 766	60	260	1 265	3 394
U4E Targets	3 300	6 878	66	138	3 274	6 823

6.2.2 Job creation / elimination from energy efficient products

Strict implementation of high EE 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

Minimum energy performance standards (MEPS) for industrial electric motors and motor-driven systems have been shown to be effective in many parts of the world. However, the impact of MEPS may be constrained if they are introduced in isolation, so they will be introduced as part of a wider coordinated approach to transforming the market for industrial electric motors. This will also include: awareness-raising and support relating to the importance of overall system optimisation; tighter regulation of the motor rewinding industry; the use of differential import duties to reduce / eliminate the price differential between standard and premium efficiency motors. MEPS may also be extended to include packaged motor driven systems (pumps, compressors, fans etc.).” – Draft National Energy Efficiency Strategy (NEES) 2015. [21]

Even though the NEES references MEPS for electric motors, no minimum energy performance standards are currently defined for South Africa.

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

South Africa 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 redundant replaced energy units is addressed in the Environmental

Management Act 7 of 2007 and related regulations. An Industry Waste Management Plan for Lamps is under consideration for development.

6.3.6 Other on-going projects/initiatives

Eskom launched an Energy Efficient Motors Programme in mid-2007 to subsidise the replacement of old motors with high efficiency motors. Efficient motor suppliers registered with Eskom are directly paid by the subsidy, resulting in an immediate discount for the consumer. The purchaser must trade in their old motor, along with all components, for scrapping.

7 TRANSFORMERS

The South Africa's power networks are mostly distributed at the endpoints by liquid-immersed distribution transformers made from cold rolled grain-oriented silicon steel material. Distribution transformers built with amorphous iron cores have 70 % lower no load losses compared to the best conventional designs, achieving up to 99.7 % efficiency for a 100 kVA unit. High efficiency transformers, not only yield a net economic gain, but are advantageous to the environment, reducing greenhouse emissions [22].

7.1 Status and Trends of Transformers

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

ESKOM provided information indicating that they have roughly 400,000 distribution transformers on their distribution network. Municipalities have another 289,000, bringing the total number of transformers in South Africa to just under 690,000.

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

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

7.1.3 Local manufacturers, suppliers, retailers and other stakeholders

See a list of top local manufacturers in Appendix D.

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

Several local manufacturers provide equipment and services to the historically loyal South African industries. The import & export values are shown in Figure 7.1 below.

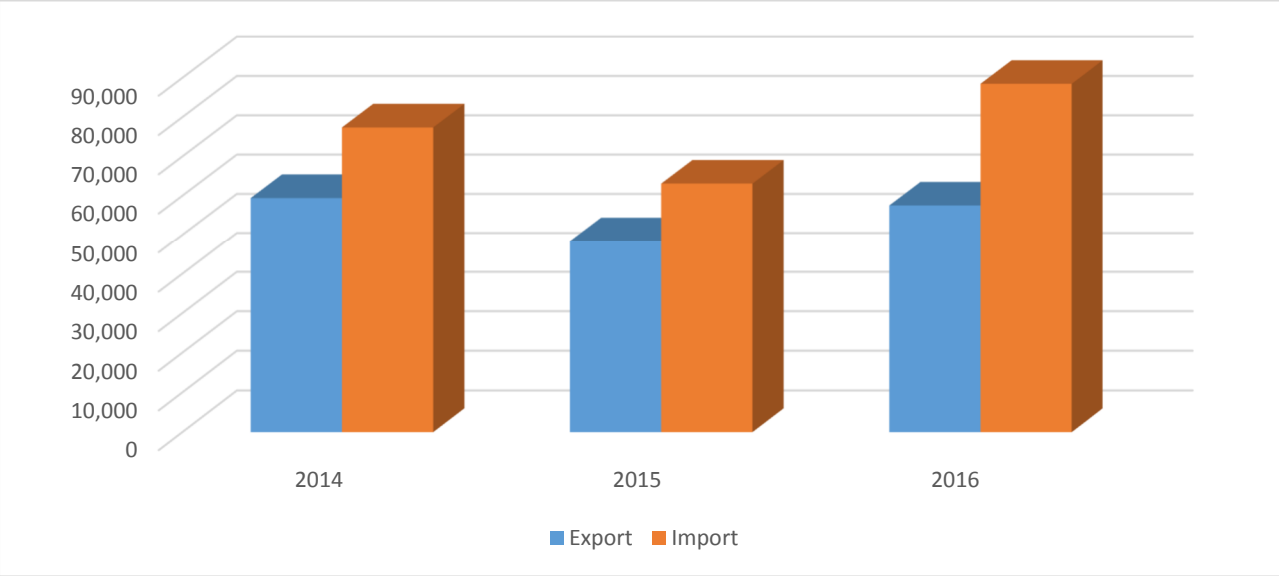

Figure 7.1 Transformer import/export QTY.

The primary source of import is from China and the ever-reducing prices of the Chinese markets are proving hard to beat, resulting in an average increase in imports over the past few years. However, due

to financial constraints on ESKOM (primary buyer) and an overall reduction in the industrial sector, the total sales of transformers have decreased slightly.

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 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

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

7.2 Potential Savings from Energy-Efficient Transformers

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 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	310 345	329 245	-8%	351 150	-20%	325 663
Business as Usual	SEAD Tier 3 or similar	241 379	256 079	4%	308 740	7%	382 575
Business as Usual	SEAD Tier 5 or similar	137 931	146 331	11%	188 298	26%	275 044
DNV GL Projected MEPS	Not Rated	310 345	329 245	-46%	206 110	-25%	179 203
DNV GL Projected MEPS	SEAD Tier 3 or similar	241 379	256 079	45%	430 031	-6%	467 305
DNV GL Projected MEPS	SEAD Tier 5 or similar	137 931	146 331	25%	212 047	37%	336 774
DNV GL Projected BAT	Not Rated	310 345	329 245	-63%	141 224	-66%	55 664

DNV GL Projected BAT	SEAD Tier 3 or similar	241 379	256 079	46%	433 848	-16%	421 032
DNV GL Projected BAT	SEAD Tier 5 or similar	137 931	146 331	61%	273 117	60%	506 588

Data & Assumptions:

- *Exchange Rate: 1 ZAR = 13.5 USD*
- *Current Average Electricity Price to consumer: 0.020 USD/kWh*
- *Electricity Cost Increase: 8% per annum*
- *Average Transformer Size: 315 kVA, 11kV/0.4kV*
- *Average Operating Hours: 24 hours per day, 365 days per annum.*
- *QTY and adoption of new technologies based on information from stakeholder interviews.*

If 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	2 749	3 107	118	215	2 477	2 799
DNV GL Projected BAT	4 421	6 759	190	467	3 983	6 090
U4E Targets	2 692	5 109	143	271	2 426	4 603

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 load side measurements. More details are given in Appendix E.

7.3.2 Supporting Policies – Labelling and consumer awareness campaigns

There is no labelling scheme in South Africa to differentiate between the performances of transformers based on the same rating, like in India (1 - 5 Star scheme), China (Grade 1 – 3 (CRGO), Australia and New Zealand (MEPS and HEPL levels), EU (Harmonised HD428: List A – C).

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 in South Africa.

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).

7.3.5 Environmentally Sound Management

South Africa 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 redundant replaced energy units is addressed in the Environmental Management Act 7 of 2007 and related regulations. An Industry Waste Management Plan for Lamps is under consideration for development.

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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APPENDICES

APPENDIX A: SACREE DETAILS

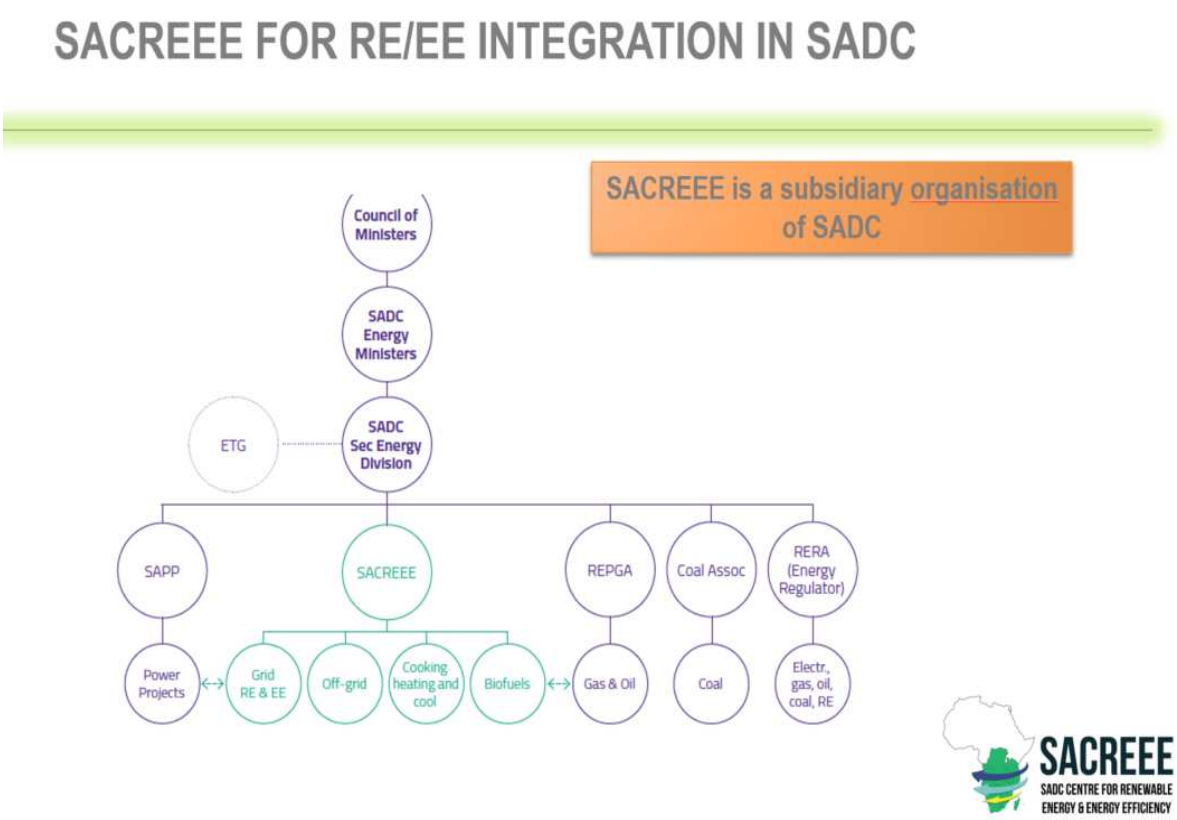
Extracted from the SACREEE_GNSEC_VEF2017.ppt

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.

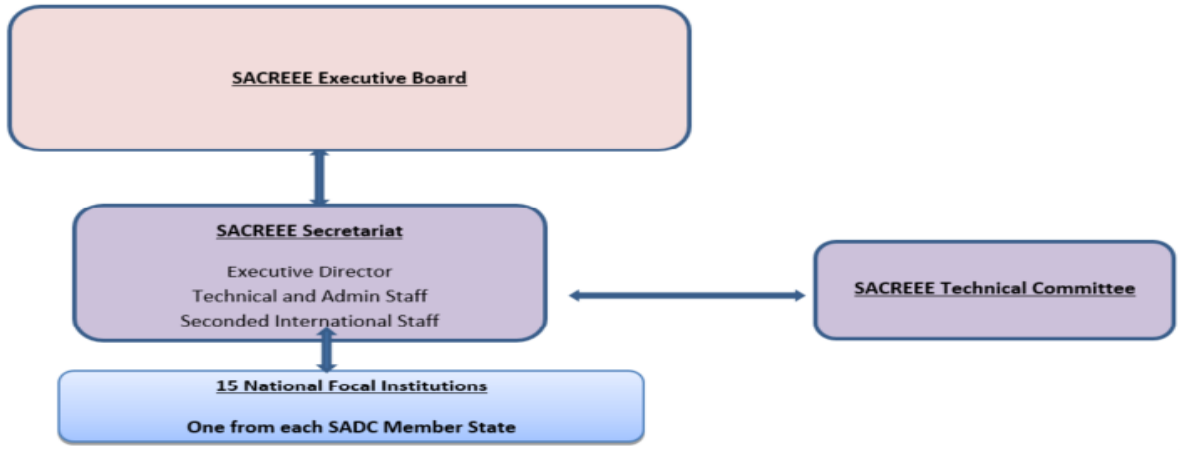
SACREEE's mandate is to implement the Regional Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP) through the promotion of market-based adoption of renewable energy and energy efficient technologies and energy services

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

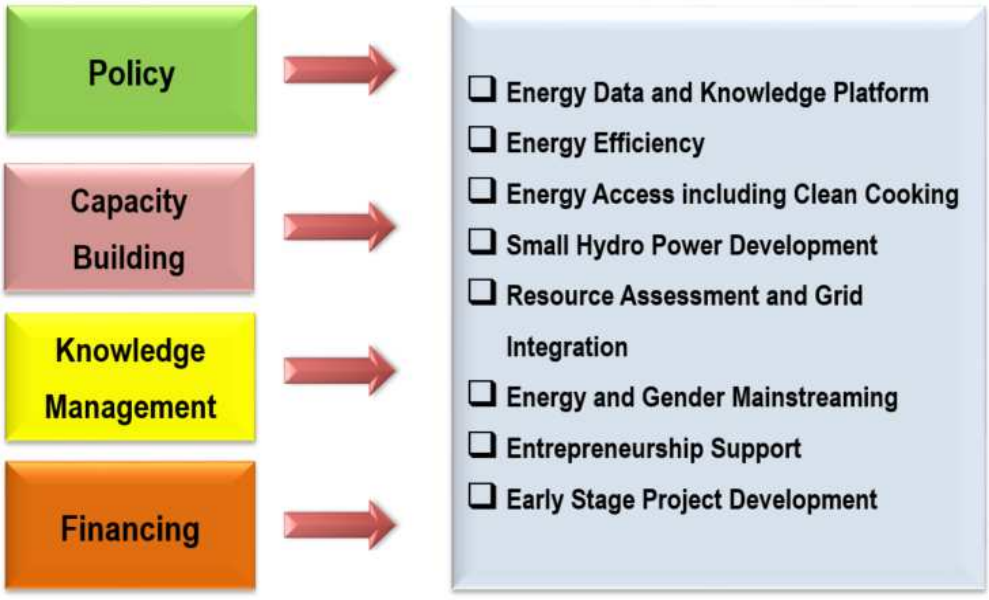
- Member States contributions
- Donor funding
- Cost recovery from services offered to projects.
- SACREEE Secretariat is based in Windhoek, Namibia



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

9

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

SACREE CONTACT DETAILS:

- AUSSPANN PLAZA NO. 1, NO. 11 DR. AGOSTINHO NETO STREET, AUSSPANNPLATZ, WINDHOEK, NAMIBIA
- www.sacreee.org
- **MR. KUDAKWASHE (KUDA) NDHLUKULA,** EXECUTIVE DIRECTOR
- EMAIL: kuda.ndhlukula@sacreee.orG, TEL: +264 818407702

APPENDIX B: ENERGY EFFICIENCY FUNDING INITIATIVES IN SADC REGION [8.2.13]

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, with 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)

APPENDIX D: SOUTH AFRICAN TRANSFORMER MANUFACTURERS

Powertech Transformers (PTY) Ltd
Address: 1 Buitenkant St, Gauteng West, Gauteng, 0183, South Africa, Pretoria.
Categories: Transformer Manufacturers & Distributors
www.pttransformers.co.za

Steel Cor
Address: Solomon Rd, Lilianton, Gauteng, 1459, South Africa, Boksburg.
Categories: Transformer Manufacturers & Distributors
www.steelcor.co.za

P D S Technologies (PTY) Ltd
Address: 3 Kreupelhout St, Wadeville, Gauteng, 1428, South Africa, Germiston.
Categories: Transformer Manufacturers & Distributors

Powermite Africa
Address: 5 Eitemal St, Emalahleni Ext 8, Emalahleni, 1039, South Africa, Mpumalanga.
Categories: Transformer Manufacturers & Distributors

C M Transformer Services Cc
Address: 495 Servaas St, Gauteng West, Gauteng, 0183, South Africa, Pretoria.
Categories: Transformer Manufacturers & Distributors

Magtran (PTY) Ltd
Address: 4 Marconi Nook, Hennopspark Ext 7, Gauteng, 0157, South Africa, Centurion.
Categories: Transformer Manufacturers & Distributors

Power Transformers
Address: 4 Dorbyl Street, Sacks Circle, Bellville South, Cape Town.
Categories: Transformer Manufacturers & Distributors

Dimako Industries (PTY) Ltd
Address: Cnr. Maxwell & Hilliard St, Ophirton, Gauteng, 2091, South Africa, Johannesburg.
Categories: Transformer Manufacturers & Distributors

Ronny Transformers Distributors (PVT) Ltd
Address: 2 Jalyd Hse, 87 Chinhoyi St, Harare, Zimbabwe, Zimbabwe.
Categories: Transformer Manufacturers & Distributors

SEMEG
Address: 14 Profab Crescent, Germiston.
Categories: Transformer Manufacturers & Distributors

Fanvier Transformers
Address: 10 Minerva St, Ennerdale, Gauteng, 1830, South Africa, Johannesburg.
Categories: Transformer Manufacturers & Distributors

Hawkins Manufacturing (PTY) Ltd
Address: 3 Spring Hawk, 10 Beechfield Cres, Springfield Park, Kwazulu Natal, 4051, South Africa, Durban.
Categories: Transformer Manufacturers & Distributors
www.hawkins.co.za

Jaemeg Transformers Cc
Address: 7 Moller St, Industries East, Gauteng, 1401, South Africa, Germiston.
Categories: Transformer Manufacturers & Distributors

Reliable Transformers Cc
Address: 17 Lincoln Rd, Gauteng South, Gauteng, 1501, South Africa, Benoni.
Categories: Transformer Manufacturers & Distributors
www.reltrans.co.za

Associated Transformer Manufacturing

Address: 17 Palmiet Rd, Stikland, Western Cape, 7530, South Africa, Bellville.
Categories: Transformer Manufacturers & Distributors

Current Electric (PTY) Ltd
Address: Cnr. Myrna & Staal Rd, Knights, Gauteng, 1401, South Africa, Germiston.
Categories: Transformer Manufacturers & Distributors
www.actom.co.za

Transforman (PTY) Ltd
Address: 29 George Lubbe St, Hamilton, Free State, 9301, South Africa, Bloemfontein.
Categories: Transformer Manufacturers & Distributors
www.freestatetransformers.co.za

Thermascan 2020
Address: 15 Groningen St, Kabega Park, Eastern Cape, 6025, South Africa, Port Elizabeth.
Categories: Transformer Manufacturers & Distributors
www.thermascan2020.co.za

Transformer Manufacturers (PTY) Ltd
Address: 14 Simon Bekker Rd, South Gauteng Ext7, Gauteng, South Africa, Germiston.
Categories: Transformer Manufacturers & Distributors

Transforman Cc
Address: 29 George Lubbe St, Hamilton, Free State, 9301, South Africa, Bloemfontein.
Categories: Transformer Manufacturers & Distributors
www.globaltransformers.co.za

Electro Inductive Industries (PTY) Ltd
Address: Eskom Complex, Eskom Rd, Brackenfell, 7560, South Africa, Western Cape.
Categories: Transformer Manufacturers & Distributors

Magnalec (PTY) Ltd
Address: 18 A Chrystal St, Denver, Gauteng, 2094, South Africa, Johannesburg.
Categories: Transformer Manufacturers & Distributors

Kama (PTY) Ltd
Address: 285 Glenville Ave, Crosby, Gauteng, 2092, South Africa, Randburg.
Categories: Transformer Manufacturers & Distributors
www.kama.co.za

Castlet Sa Ltd
Address: 10 Angus Cres, Longmeadow Bus Est, Edenvale, 1609, South Africa, Gauteng.
Categories: Transformer Manufacturers & Distributors

Peter Souris And Co (PTY) Ltd
Address: 62 Eloff St Ext, Village Deep, Gauteng, 2001, South Africa, Johannesburg.
Categories: Transformer Manufacturers & Distributors

APPENDIX E: DISTRIBUTION TRANSFORMERS PER SANS 780

Distribution Transformers as per SANS-780, IEC-76 & IS-2026

Maximum Ambient Temperature=45°C, Oil temperature Rise : 60°C, Winding Rise : 65° C,
Off circuit tap switch : +5% to -5% @ 2.5%, Typeof Winding : Aluminum wound

S.N.	KVA	Voltage Ratio (kv)	Phase	Over all Dimension in mm			No-Load Loss (W)	Load Losses at 75°C(W)	%Z at 75°C	Wt. of Txs. (kg)
				Length (L)	Width (W)	Height (H)				
1	16	11/0.240	1	705	405	1130	80	400	3.0-4.5%	215
2	25	11/0.240	1	760	525	1110	110	530	3.0-4.5%	245
3	25	33/0.240	1	830	580	1380	160	530	3.0-4.5%	335
4	50	11/0.240	1	810	590	1210	180	900	3.0-4.5%	370
5	50	33/0.240	1	920	620	1470	250	900	3.0-4.5%	485
6	16	11/0.415	3	905	530	1035	95	410	3.0-4.5%	280
7	25	11/0.415	3	960	550	1130	120	570	3.0-4.5%	400
8	50	11/0.415	3	1045	580	1200	180	1000	3.0-4.5%	515
9	100	11/0.415	3	1120	660	1290	300	1700	3.0-4.5%	705
10	200	11/0.415	3	1425	815	1370	520	2700	4.0-5.0%	1095
11	315	11/0.415	3	1590	910	1580	720	3800	4.0- 5.0%	1500
12	500	11/0.415	3	1750	970	1690	1100	5400	4.5- 5.5%	2025
13	630	11/0.415	3	1785	1010	1780	1300	6400	4.5- 5.5%	2260
14	800	11/0.415	3	1935	1135	1840	1600	8000	4.5- 5.5%	2670
15	1000	11/0.415	3	2035	1200	1910	1900	9500	4.5- 5.5%	3100
16	1250	11/0.415	3	2380	1440	1950	2250	11000	5.0- 6.5%	3740
17	1600	11/0.415	3	2385	1555	2390	2750	13500	5.0- 6.5%	4785
18	2000	11/0.415	3	2560	1650	2500	3250	16000	5.0- 6.5%	5700
19	25	33/0.415	3	1035	610	1400	170	570	3.0-4.5%	520
20	50	33/0.415	3	1130	680	1345	250	1000	3.0-4.5%	655
21	100	33/0.415	3	1315	605	1515	400	1700	3.0-4.5%	905
22	200	33/0.415	3	1500	730	1680	650	2700	4.0- 5.0%	1350
19	315	33/0.415	3	1645	1020	2135	890	3800	4.0- 5.0%	1850
20	500	33/0.415	3	1765	1140	2220	1230	5400	4.5- 5.5%	2410
21	630	33/0.415	3	1805	1175	2290	1450	6400	4.5- 5.5%	2705
22	800	33/0.415	3	1880	1230	2380	1700	8000	4.5- 5.5%	3160
23	1000	33/0.415	3	2090	1330	2400	2000	9500	4.5- 5.5%	3680
24	1250	33/0.415	3	2205	1390	2510	2350	11000	5.0 - 6.5%	4330
25	1600	33/0.415	3	2385	1585	2615	2820	13500	5.0 - 6.5%	5215
26	2000	33/0.415	3	2545	1680	2755	3300	16000	5.0- 6.5%	5970

Note: 1-All electrical performances are subject to tolerance as per Is-2026, IEC-76, SANS-780
2-Weigthts &dimension are subject to tolerance of ±10%

The Climate Centre and Network (CTCN) fosters technology transfer and deployment at the request of developing countries through three core services: technical assistance, capacity building and scaling up international collaboration. The Centre is the operational arm of the UNFCCC Technology Mechanism, it is hosted and managed by the United Nations Environment and the United Nations Industrial Development Organization (UNIDO), and supported by more than 300 network partners around the world.

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About DNV GL

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