TECHNICAL MARKET REVIEW

Country Profile: Lesotho

Climate Technology Centre & Network

Revised Report
Date: 23rd April 2018

IMPORTANT NOTICE AND DISCLAIMER

1. *This document is intended for the sole use of the Customer as detailed on the front page of this document to whom the document is addressed and who has entered into a written agreement with the DNV GL entity issuing this document ("DNV GL"). To the extent permitted by law, neither DNV GL nor any group company (the "Group") assumes any responsibility whether in contract, tort including without limitation negligence, or otherwise howsoever, to third parties (being persons other than the Customer), and no company in the Group other than DNV GL shall be liable for any loss or damage whatsoever suffered by virtue of any act, omission or default (whether arising by negligence or otherwise) by DNV GL, the Group or any of its or their servants, subcontractors or agents. This document must be read in its entirety and is subject to any assumptions and qualifications expressed therein as well as in any other relevant communications in connection with it. This document may contain detailed technical data which is intended for use only by persons possessing requisite expertise in its subject matter.*

2. *This document is protected by copyright and may only be reproduced and circulated in accordance with the Document Classification and associated conditions stipulated or referred to in this document and/or in DNV GL's written agreement with the Customer. No part of this document may be disclosed in any public offering memorandum, prospectus or stock exchange listing, circular or announcement without the express and prior written consent of DNV GL. A Document Classification permitting the Customer to redistribute this document shall not thereby imply that DNV GL has any liability to any recipient other than the Customer.*

3. *This document has been produced from information relating to dates and periods referred to in this document. This document does not imply that any information is not subject to change. Except and to the extent that checking or verification of information or data is expressly agreed within the written scope of its services, DNV GL shall not be responsible in any way in connection with erroneous information or data provided to it by the Customer or any third party, or for the effects of any such erroneous information or data whether or not contained or referred to in this document.*

4. *Any forecasts estimates or predictions are subject to factors not all of which are within the scope of the probability and uncertainties contained or referred to in this document and nothing in this document guarantees any particular output.*

KEY TO DOCUMENT CLASSIFICATION

Strictly Confidential	:	*For disclosure only to named individuals within the Customer's organisation.*
Private and Confidential	:	*For disclosure only to individuals directly concerned with the subject matter of the document within the Customer's organisation.*
Commercial in Confidence	:	*Not to be disclosed outside the Customer's organisation.*
DNV GL only	:	*Not to be disclosed to non-DNV GL staff*
Customer's Discretion	:	*Distribution for information only at the discretion of the Customer (subject to the above Important Notice and Disclaimer and the terms of DNV GL's written agreement with the Customer).*
Published	:	*Available for information only to the general public (subject to the above Important Notice and Disclaimer).*

Project name:	Technical Market Review
Report title:	Country Profile: Lesotho
Customer:	Climate Technology & Centre Network
Date of issue:	23-04-2018
Report No.	Revised Report

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

Prepared by:	**Verified & Approved by:**
Annanda How, Gabriel Kroes DNV GL	Luisa Freeman, Joseph Lopes, Matthew Jones DNV GL

☐ Strictly Confidential
☐ Private and Confidential
☐ Commercial in Confidence
☐ DNV GL only
☒ Customer's Discretion
☐ Published

Keywords:
Lesotho, Market Review, Energy Efficiency

Table of Contents

1 EXECUTIVE SUMMARY

This report looks at the potential for increasing the energy efficiency of products in Lesotho by providing a technical market assessment of current conditions and policies. Five specific product categories have been examined: 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 Lesotho in achieving its sustainability goals.

Situation analysis

Just over one fifth of households in Lesotho have access electricity, where it is used primarily for lighting, biomass being readily available for other uses. The adoption of energy efficient technologies beyond lighting has consequently been low in Lesotho to date, where the focus in the residential sector is on first expanding access to electricity. Opportunities for adoption of efficient products has been limited due to a range of reasons that include high levels of poverty and cultural factors, particularly in rural areas. The design and construction of efficient buildings has been impacted by the limited existence and enforcement of regulations and an informal property market.

Underlying process

DNV GL conducted an initial desktop analysis before sending out data requests and scheduling meetings with key local entities involved in the energy sector within Lesotho. These included the Ministry of Science and Technology, Ministry of Natural Resources, Energy and Environment, Lesotho Electricity Company (LEC) and other local stakeholders such as contractors, suppliers and installers of technologies. Meetings and interviews were conducted by DNV GL during visits to Lesotho and with follow-up communications conducted via email and phone. Key findings are highlighted below.

National Designated Entity (NDE) prioritisation

According to the interviews conducted, power sector challenges, such as electrification and the urgent need of system maintenance means that energy efficiency is a lower priority for the National Designated Entities (NDEs) in Lesotho. More pressing are such basic issues as expanding access to electricity and improving food, water and housing conditions. Considering these priorities, little attention has been paid to the collection and maintenance of the detailed kinds of data of interest to this study. Those with the authority to respond to the study team's requests for information were cooperative in seeking support and feedback from other government entities (e.g., revenue authorities, trade organizations, utilities, statistics bureau, etc.), with varying success in terms of timeliness, comprehensiveness and data quality. None the less, the information obtained by the study team has been employed to the fullest extent in presenting a picture of the status of and opportunity for energy efficiency technologies in Lesotho.

Market Context

Due to high levels of poverty in Lesotho and the Southern African region in general, the equipment markets are extremely price sensitive, with few being able to afford the initial cost of equipment at all, let alone the incrementally higher cost of most energy efficient product options. Energy efficient products typically come at a higher first cost and any additional costs have large impacts on short term cashflows. The concept of lower operating and maintenance costs which can result in fairly attractive payback rates is not widely promoted nor relevant due to limited capital for investment.

Africa constitutes less than 5% of all global electricity consumption. While there is significant growth potential, the expansion of the regional power sector, electrification and appliance and equipment markets are hampered by the number of independent countries with their own policies, regulations and economies, and by persistently high levels of poverty across much of the region. Research shows that appliance and equipment manufacturers are therefore understandably cautious in spending time and resources to invest in producing and shipping high-efficiency products to the African market, which impacts availability to specific countries. In the absence of regional standards or harmonized policies to encourage energy efficiency, there is the potential for lower efficiency lower cost units to dominate the markets in countries like Lesotho, where first cost is the market driver.

Energy Policies

Lesotho's energy policy articulates efficiency goals at a very high level, whereas regulations designed to realize the goals are lacking, and there is scant evidence – short of the application of South African standards for some equipment plus a limited effort at promoting high efficiency lighting – that promotes the technologies of interest to this study. Government is rather focused on fulfilling the more basic needs of the population and improving the quality and availability of power in the energy sector. Departments responsible for trade, energy and economic indicators do not appear to devote resources to the capture and maintenance of detailed data on electric equipment at more than highly aggregated levels.

Summary of Market Assessment Results

Despite the limitations and context that it faces, Lesotho has much to gain by adopting energy efficiency standards, regulations and technologies to ensure that, as it expands access to electricity, usage can be guided to be as efficient and therefore affordable as possible. Ideally, such regulations and market levers would be harmonized with that of the larger Southern African region so as to have maximum impact on the technology market. 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 Lesotho 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 and Figure 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 are expected to increase from over 100 GWh (65.1t CO_2) per annum in 2025 to almost 200 GWh (123.7t CO_2) per annum in 2030. BAT projected savings for 2025 is expected to be around 180 GWh (115.5t CO_2) per annum while savings yielded in 2030 are projected to be almost 400 GWh (245.6t CO_2).

Table 1.1 Projected MEPS and BAT savings for Lesotho.

	GWh savings (2025)	GWh savings (2030)	MUSD savings (2025)	MUSD savings (2030)	GHG savings (2025)	GHG savings (2030)
DNV GL Projected MEPS						
Lights	65	98	13	31	42	63
Aircon	8	24	0	2	5	16
Refrigeration	9	26	2	8	6	16
Motors	5	15	0	1	3	9
Transformers	13	30	1	2	9	19
Total	**101**	**193**	**16**	**44**	**65**	**124**
DNV GL Projected BAT						
Lights	116	176	23	56	75	113
Aircon	16	58	1	4	10	37

Refrigeration	13	32	3	10	8	21
Motors	8	33	0	2	5	21
Transformers	27	84	1	6	17	54
Total	**180**	**383**	**28**	**79**	**115**	**246**
U4E Targets						
Lights	53	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**

Based on the information obtained for this analysis, DNV GL estimates greater potential for 2025 GWh savings in lighting, but significantly less in all other technology groups than the estimated targets developed by U4E.

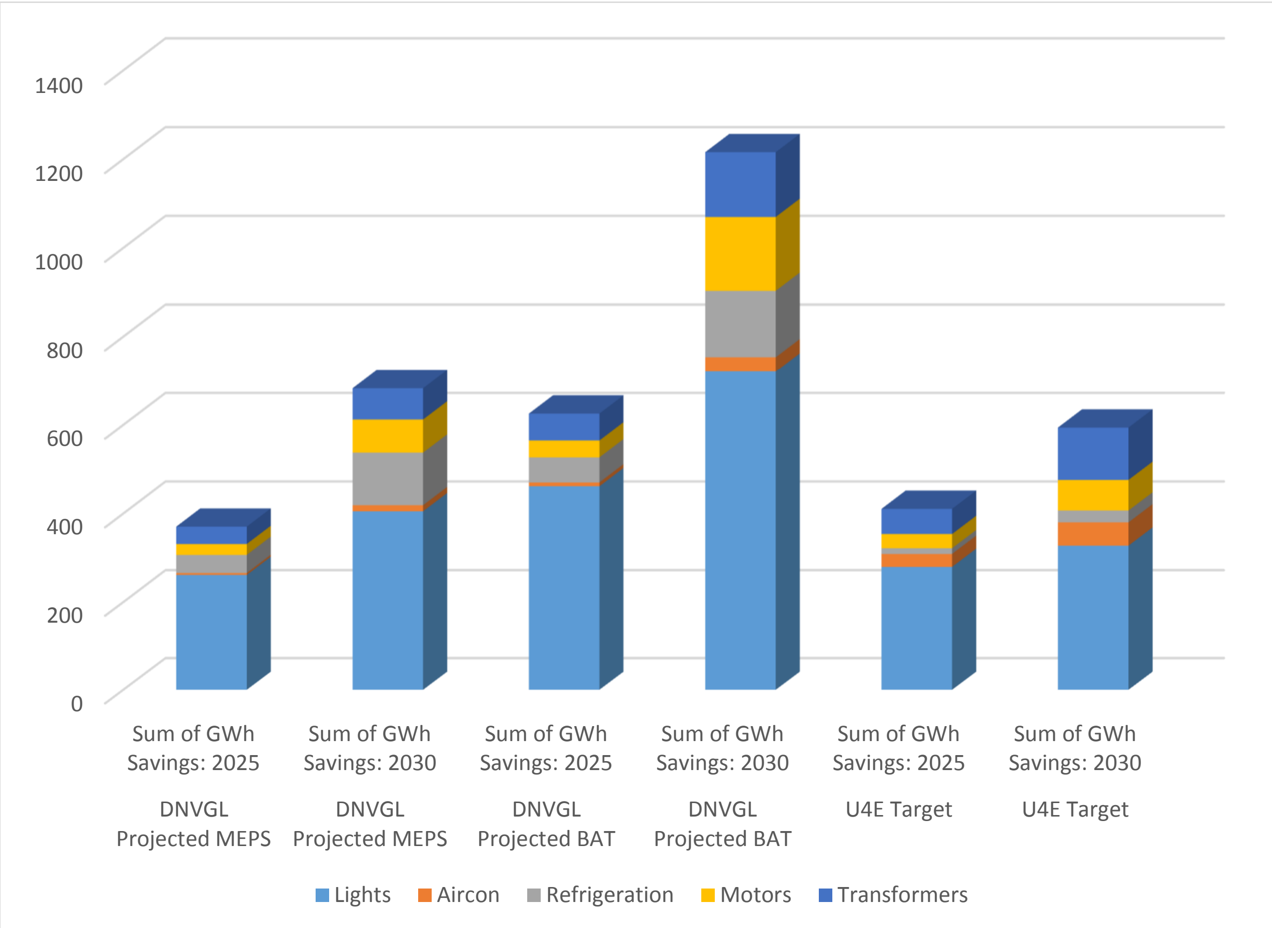


Figure 1.1 Projected annual energy savings for Lesotho.

Figure 1.1 shows that lighting represents the largest portion of potential across both DNV GL estimates and those developed by U4E. Beyond this area of consistency, the opportunities estimated for other technology groupings vary considerably between analyses.

Recommendations

Achieving the penetrations of energy efficiency equipment presented in the section above will require interventions of both a market nature and regulatory nature. Market stimuli would need to address the extra costs that are associated with some energy conservation measures, i.e., the incrementally higher cost of high efficiency equipment, and potential lack of financing. Government and NDEs can impact these goals through the lever of regulation, tariffs and other mechanisms. To be truly effective however, this research suggests that a regional strategy combining harmonized standards and labels, and encouragement aimed at product manufacturers might provide the critical mass of production needed to reduce the higher first costs of efficiency measures and increase their availability. Implementing such strategies in Lesotho will be increasingly important to enable a more stable energy sector that will support economic growth and as the population’s access to electricity expands.

2 INTRODUCTION

2.1 General Information about Lesotho

The Kingdom of Lesotho is situated in the south-eastern region of Southern Africa and is surrounded by South Africa. Maseru, situated on the Western border, is the largest city and capital, with other major population centres being Mafeteng and Roma [2] [3].

Lesotho is a member of the United Nations [4], the Commonwealth of Nations [5] and the Southern African Development Community (SADC) [6].

Based on 2010 statistics 59.65% of the population lives on less than US$1.90 a day (the international poverty line), In 2016, the World Bank classified Lesotho as a "lower middle income" country because the annual gross national income (GNI) per capita levels is USD 1,046 to USD 4,125 [7].

Size (km²)	30,335
Population (Est. 2017) [1]	2,203,821

2.2 Climate and Topography

80% of the Lesotho lies above 1800m and due to this altitude, Lesotho is often cooler throughout the year than other Southern African counties. Temperatures in the lowlands of Maseru may reach a high of 30 °C in summer but can drop to −7 °C in the winter. The highlands are even colder and may reach a low of −18 °C, with snow being common between May and September and higher peaks can experience snowfalls year-round [8].

Annual precipitation varies from around 600 mm in the lowland valleys to around 1,200 mm in areas of the northern and eastern escarpment bordering South Africa. Most of the rain falls as summer thunderstorms: 85% of the annual precipitation falls between the months of October and April. The winters - are usually very dry. Annual variance in rainfall is quite erratic, which leads to periodic droughts in the dry season (May to September) and flooding, which can be severe in the rainy season (October–April).

Lesotho is the only independent state in the world that lies entirely above 1,400m in elevation. Lesotho can be roughly divided into three geographic regions: the lowlands, following the southern banks of the Caledon River, and in the Senqu river valley; the highlands formed by the Drakensberg and Maloti mountain ranges in the east and central parts of the country; and the foothills that divide the lowlands and the highlands. The lowest elevation in the country is at the junction of the Makhaleng and Orange (Senqu) rivers (at the South African border). The highest point is the peak of the Thabana Ntlenyana mountain, which reaches an elevation of 3,482 m.

2.3 Electricity Sector

According to the Lesotho Electricity Company (LEC), around 54% energy consumed was imported from South Africa (ESKOM). Their projected new-builds will result in increased capacity and it is anticipated that this may drop the energy imports to around 46% by 2030. According to the SE4All report "all the electricity generated locally is hydro-based and the country requires energy imports from neighbouring countries to meet its demand.

The electricity deficit is offset by electricity imports from Electricidade de Mocambique (EDM) in Mozambique and ESKOM in South Africa. Muela the main operating plant has an installed capacity of

72MW, and a planned capacity of 200MW. There are also four mini-hydro plants with a combined installed capacity of 3.25MW" according to SE4All's Rapid Assessment and Gap Analysis for Lesotho. In 2014 local generation was 520.1 GWh [10].

In 2009, planned power generation projects included: a 600 MW Lesotho Highlands Power Project by 2025 by a private developer, a 10MW Concentrated Solar Power Plant in Ha-Ramarothole, Mafeteng (2012), a 120 MW Kobong Pumped Storage (2017); 100 MW Monontsa Pumped Storage Scheme pre-feasibility study (2015), 35 MW wind farm (2014) and 47 MW waste-to-power plant (2014) and a solar generation with capacity of 280 kW at the airport (2014). All these target dates were not achieved, however, there has been a marked increase in renewable energy projects. In August 2017 Lesotho secured a grant from the African Development Bank (AfDB) to launch 20 MW grid-connected PV solar plant in the Mafeteng Province [11].

Households typically use a combination of traditional fuels (i.e. fuelwood, agricultural residues and dung), intermediate fuels (i.e. coal and kerosene) and modern fuels (i.e. electricity and LPG). 21% of the population have access to electricity, which is used mostly for lighting rather than for cooking and therefore represents a small share of the domestic energy consumption.

Lesotho 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. Lesotho also joined the International Renewable Energy Agency (IRENA) - a global initiative to promote and reduce barriers to the uptake of renewable energy. [12] [13]

Table **2.1** provides a summary of major energy efficiency and demand-side management (DSM) activities. Of these, the only one implemented in Lesotho has been a CFL exchange.

Table 2.1 Energy efficiency and Demand-Side Management (DSM) activities[1] in Lesotho [14].

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
Lesotho	X													

Adaptation of these technologies has been low due to design and cultural issues and a failure to appreciate the value of saving energy, particularly in rural areas where biomass is freely available. SE4All's Rapid Assessment and Gap Analysis for Lesotho states that "implementation of efficient buildings measures in rural and peri-urban areas has been hampered by the existence of an informal property market where there are no regulations governing building plans and construction, lack of enforcement of building regulations in urban areas, extra costs that are associated with some energy conservation measures, and the absence of established property developers." [15].

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

Table 2.2 Lesotho energy efficiency targeted programs [14].

Type	Lighting retrofit	Reduce electricity distribution losses	Improved cooking devices	Load management	Standards and Labelling	Financing	Revised building codes
Lesotho	X		X				

Error! Reference source not found. below indicates targeted GWh savings per product type proposed by United4Efficiency (U4E) by 2030 as identified by NDE's in response to a questionnaire by U4E used to gather data from country officials. The baseline is 2014 and assumes a successful implementation of the various energy efficiency strategies.

Table 2.3 Targets for energy savings [16].

U4E Pathway to Energy Efficiency	Targeted annual GWh savings by 2030				
	Lighting	Residential refrigerators	Room air conditioners	Industrial electric motors	Transformers
Lesotho	62.1	19.8	5.6	11.5	31.1

(Extracted from the U44E Country Assessment, December 2016[2])

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

2.4 Power Industry Regulation and Policies

The National Strategic Development Plan 2012/13–2016/17 acknowledges the importance of enhancing Lesotho's electricity generation capacity so as to cater for the energy needs of the productive sector, specifically for the mines that are currently not connected to the national grid. The draft energy policy also highlights the important role played by energy in job creation and establishing Lesotho's economic competitiveness.

The Lesotho Energy Policy does not set specific targets for access, capacity, generation and energy security. However, the Lesotho Vision 2020 sets targets for electricity access to 35% by 2015 and 40% by 2020 as well as reducing fuelwood usage in the national energy consumption. The National Policy 2015-2025 is the sector guideline and it envisions the development of the renewable energy sector [17] [13] [18] [19] [20] [21].

The Energy Efficiency (EE) program includes information for dissemination on EE for residential and transport sectors, development of Energy Efficiency guidelines for industry, commercial and residential sectors, power factor correction and dissemination of residential and energy efficiency stoves [14].

An overview of the Power Sector Regulatory environment is set out in the table below.

Table 2.4 Lesotho's power sector regulatory environment.

Organizations responsible for energy policies	• Department of Energy • Petroleum Fund (PF) • Lesotho Electricity Generation Authority (LEGA) • Lesotho Electricity Company (LEC) • Lesotho Electrification Unit (LEU) • Ministry of Forestry and Land Reclamation • Ministry of Natural Resources or Ministry of Energy, Meteorology and Water Affairs
Energy regulator	• Lesotho Electricity Authority (LEA)
Energy policy publications	• Lesotho Electricity Authority Act, 2002 (LEWA Act) • Lesotho Electricity Authority (Amendment) Act, 2011 • Lesotho Energy Policy 2015-2025 • Lesotho – Environment Act 10 of 2008 • Draft National Electrification Master Plan (NEMP) • Draft Generation Master Plan 2010-2011A • MNR Strategic Plan (2009) • National Strategic Development Plan 2012/13–2016/17 • National Vision 2020 (2000) • The National Policy 2015-2025
Main entities in the electricity market	• Lesotho Electricity Corporation (LEC)

The Department of Energy (DOE), DOE is responsible for overall national energy policy, coordination and monitoring of energy programmes and projects. DOE is fully responsible for the planning and implementation of rural electrification in Lesotho.

The National Rural Electrification Fund and the Rural Electrification Unit (REU) have been established to assist and implement electrification in rural areas. These projects include sustainable energy sources such as solar power. As its name suggests, the National Rural Electrification Fund's role is to channel capital subsidy resources into rural electrification. As part of its drive to increase rural access to

[2] The reference document implies that this data is from a 2014 questionnaire that was used to gather data from country officials.

electricity and expand the use of PV in rural electrification, the Government established the Rural Electrification Unit (REU). The goal is to channel capital subsidy resources for rural electrification into viable business opportunities. A current programme, funded by the European Investment Bank, is targeting communities affected by construction of the Metolong Dam Water Supply Programme. This aims to provide electricity to over 70 villages, including some schools and clinics in the Metolong catchment area. The REU is government's main vehicle for increasing access to electricity and use of PV in rural areas. The REU uses subsidies to make rural electrification attractive for investment. The Unit builds, operates and transfers transmission and distribution infrastructure to the stated-owned utility - Lesotho Electricity Authority (LEA).

Table 2.5 and Table **2.6** indicate the extent of current energy efficiency and renewable energy support policies in Lesotho, as reported in 2016.

Table 2.5 Energy efficiency policies initiated in Lesotho, as of 2016 [14].

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
Lesotho			X							

Table 2.6 Renewable energy support policies initiated in Lesotho, as of 2016 [20]. Note R = revised (i.e. one or more policies of this type) and ☐ = existing national (i.e. could also include subnational).

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
Lesotho	R			☐				☐

Table 2.7 Renewable fiscal incentives and public financing initiated by 2016 [20]. *Note ☐ = existing national (i.e. 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
Lesotho	☐	☐		☐	☐

2.5 Key Challenges and Recommendations

According to information gathered in country, key challenges in the energy sector include: very low access to electricity (6% in rural areas, according to the LEC); stagnant generation capacity; no new plants planned to come into operation in the near future; problems in the maintenance of facilities; rising demands; dependency on supply from Mozambique/South Africa and a lack of both knowledge and awareness of potential renewable resources; and siltation and flooding impacts on generation at the mini-hydro plants.

SACREE is the SADC Centre for Renewable Energy and Energy Efficiency and, it works towards addressing SADC country challenges w.r.t. renewable energy and energy efficiency (Appendix A) [22]. Funding available to the SADC countries for energy efficiency is listed in Appendix B.

Table 2.8 Energy efficiency opportunities and recommendations.

	OPPORTUNITIES	RECOMMENDATION
Policies	Processes and procedures supporting national policies to enforce and prioritize energy efficiency requirements should be put in place.	• As in Table 2.1 above, policies for energy efficiency in buildings, energy efficiency audits and 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	Funding is already available regionally for energy efficiency, as in Appendix B. This may need to be supplemented by providing affordable financing for energy efficiency investment and/or by leveraging funding from public	• Clarify if any funding is currently used for EE; references suggest greater priority placed on funding RE as consistent with electrification policy. • Determine what barriers exist preventing use of available funding,

	(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 projects for SMEs and low-income sections of the population.	as summarised in Appendix B. • Harmonize donor support by source affordable financing for energy efficiency investment. • Develop guarantee funds to cover for deflationary risk.
Information	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 Scenarios

The projection of savings estimates was calculated using three scenarios, each of which is entirely feasible.

1. The "Business as Usual (BAU)" scenario 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.

2. If "Minimum Energy Performance Standards (MEPS)" 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.

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

All Scenarios

For all of the scenarios, an average increase in the electrification per year was used. These are based on long-term averages as provided by the electric utilities.

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

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

According to the Lesotho Bureau of Statistic's census in 2011, just over 20% of the roughly 500,000 households in Lesotho use electricity for lighting. This is consistent with the more recent estimate that around 27% of the population has access to electricity[23].

As far as the implementation of energy efficient technologies, efficient lighting has seen the highest adoption rates in Lesotho in comparison to other products in the U4E programme. This is likely due primarily to a CFL exchange program that took place in recent years. Secondarily, 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 Stock, sales, sale price, lifetime, projected growth rates and time of use

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

Figure 3.1 Life Expectancy of Lights [24].

Short life expectancies lead to high replacement frequencies which are opportunities to change to newer, more efficient technologies. 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 use lighting on for approximately 3000 hours per annum. In South Africa, for example, 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, amounting to 2190 hours per annum.

Current prices found during the shop visits in Lesotho show that halogen lamps are still the cheapest and a 60W lamp costs between 19 – 34 ZAR (1 – 2 USD). A CFL lamp with comparable output (typically 15W) is in the range of 24 – 44 ZAR (2 – 3 USD), while the LED (6W) would cost just under 5 USD.

Light bulbs, lamps or just "lights" are generally available in supermarkets and retail stores throughout Lesotho. The bulk of stock is split between CFLs and LEDs, with limited quantities of halogen and other types of lighting available. Table 3.2 shows the percentage of stock found in visits to shops by DNV GL. See also images in Appendix D.

Table 3.1 Lighting technology stock distribution.

Technology	Percentage stocked
LED	32%
CFL & FL	50%

Other	17%

3.1.2 Local manufacturers, suppliers, retailers and other stakeholders

Philips has established a presence in Lesotho by erecting a CFL plant in 2009 [25]. As in South Africa, other readily available brands include OSRAM, Pick & Pay, Eurolux and Ellies with remaining brands (mostly of Chinese manufacture) taking up a comparatively small portion of shelf space in stores.

3.1.3 Import/Export

Prior to the establishment of the Philips CFL plant, all lights sold in Lesotho were imported mostly from South Africa, with small quantities coming in from ASIA. Currently, all lights other than the CFLs produced by Philips are imported [26].

3.1.4 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.

Education

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

Import duty & tax

There is no reduction or waivering of import duty or taxes on energy efficient lights (CFL or LED). This is likely to protect the local manufacturing market. 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:

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

3.2.1 Benefits of Energy Efficiency – 3 Scenarios

For the Business-As-Usual (BAU), Minimum Energy Performance Standards (MEPS) and Best Available Technologies (BAT), the starting quantities are the same and indicates the current estimate quantities installed. The percentages indicate the increase or decrease rates of the technologies during BAU, if MEPS are enforced or if BAT is pursued.

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.	682 500	871 484	-10%	1 445 088	-20%	2 129 985
Business as Usual	QTY CFL & FL	875 000	1 117 288	6%	2 173 808	2%	4 078 679
Business as Usual	QTY LED	192 500	245 803	10%	498 164	50%	1 376 752
DNV GL Projected MEPS	QTY Halo, Inc etc.	682 500	871 484	-50%	802 826	-20%	1 183 324
DNV GL Projected MEPS	QTY CFL & FL	875 000	1 117 288	35%	2 770 782	-4%	4 900 180
DNV GL Projected MEPS	QTY LED	192 500	245 803	20%	543 451	50%	1 501 910
DNV GL Projected BAT	QTY Halo, Inc etc.	682 500	871 484	-80%	321 131	-20%	473 330
DNV GL Projected BAT	QTY CFL & FL	875 000	1 117 288	51%	3 116 616	-9%	5 234 698
DNV GL Projected BAT	QTY LED	192 500	245 803	50%	679 314	50%	1 877 388

Data & Assumptions:

- *Exchange Rate: 1 MAL = 1 ZAR = 13.5 USD.*
- *Average Residential Electricity Tariff: 0.093 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 are projected under the MEPS and BAT scenarios, see Table 3.4. 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	65	98	13	31	42	63
DNV GL Projected BAT	116	176	23	56	75	113
U4E Targets	53	62	5	5	37	44

3.2.2 Job creation / elimination from Energy Efficiency 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 neighbouring South Africa. A similar scenario can have similar potentially positive results should the Lesotho Electricity Company (LEC) implement similar schemes. 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

Due to the fact that Lesotho typically adopts South African standards, the compulsory specification for incandescent lamps (VC 8043), dated 7 February 2014 is likely to be seen adhered to even though it may not explicitly be listed as a requirement by the Lesotho government. 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 Waste Act 10 of 2008. 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

No financial mechanisms are in place to incentivise energy efficient lighting.

3.3.4 Monitoring, Verification and Enforcement

Lighting standards in current buildings are seen as voluntary, with very little enforcement of the limited building regulations that do exist. OSHACT standards require certain minimum light levels but do not specify any technologies. Other than that, new buildings are constructed and fitted according to building regulations which prescribe a certain level of lighting but does not list energy efficiency. These are supposed to be verified by building inspectors, but due to the rural nature of Lesotho, construction unfortunately often takes place without adherence to design, consent and regulatory considerations.

3.3.5 Environmentally Sound Management

Lesotho 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 clear that these were not properly enforced. According to interviews, 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.

4 AIR-CONDITIONING

Air-condition units referred to in this section is limited to room air-conditioning (split or standalone) but does not include central cooling or heating systems with air handling units. Due to a low electrification rate and low average income in Lesotho, 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 Market Drivers

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 such as Midea are sold for 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 [27] [28] [29].

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 in Lesotho, 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.

Lesotho does not specify MEPS for the import of equipment. As most of its equipment is imported from South Africa, therefore relies primarily on the automatic compliance with SABS standards. Therefore, the bulk of new units available in Lesotho are Class A or better.

4.1.3 Local manufacturers, suppliers, retailers and other stakeholders

According to our research, no small residential or commercial air-conditioning units are manufactured locally. All major international brands are well represented by local distributors in Lesotho. Air-conditioning units require annual services and are often repaired when broken, rather than replaced.

4.1.4 Import/Export

Lesotho is almost exclusively an importer of air-conditioning units and since it is surrounded by South Africa, it is no surprise that more than 99% of the units are imported from that country[30]. The most prominent brands are LG, DAIKIN, SAMSUNG, Carrier, Fujitsu and Mitsubishi.

Table 4.1 Air-conditioning unit import/export QTY by year [25]

Year	QTY
2010	16137
2011	2386
2012	6768
2013	2605
2014	19839
2015	3828
2016	6244

4.1.5 Barriers to overcome

Due to the very poor economy in Lesotho, only the upper income bracket that can afford air-conditioning and makes up a very small percentage of the population. The perception that the cost of services outweighs the benefits, often results in a lack of proper maintenance of air conditioning units which typically leads to significant decreases in efficiency or even early system failure.

4.1.6 New vs. Used Equipment

Not applicable to air-conditioning units, as the units are typically installed in a fixed location and not removed or sold second hand.

4.2 Potential Savings from Energy-Efficient Air-conditioning[3]

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

The following table shows the benefits from energy efficiencies and adopts the three scenarios described earlier.

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	46 688	59 616	-6%	103 248	-7%	176 912
Business as Usual	Class B - Class A	36 313	46 368	4%	88 603	2%	165 975
Business as Usual	Class A+ & Above	20 750	26 496	7%	52 234	11%	106 824
DNV GL Projected MEPS	Lower than Class B	46 688	59 616	-28%	79 084	-19%	118 023
DNV GL Projected MEPS	Class B - Class A	36 313	46 368	24%	105 933	1%	196 740
DNV GL Projected MEPS	Class A+ & Above	20 750	26 496	21%	59 069	24%	134 950
DNV GL Projected BAT	Lower than Class B	46 688	59 616	-35%	71 395	-33%	88 132
DNV GL Projected BAT	Class B - Class A	36 313	46 368	14%	97 512	-14%	155 198
DNV GL Projected	Class A+ & Above	20 750	26 496	54%	75 178	49%	206 381

[3] Average size of 3.5kW cooling capacity as identified by U4E in their country assessments

BAT							

Data & Assumptions:

- *Exchange Rate: 1 SZL = 1 ZAR = 13.5 USD.*
- *Average Residential Electricity Tariff: 0.073 USD/kWh.*
- *Average Industrial Electricity Tariff: 0.101 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.*

The quantity and adoption rates of technologies are based on information from stakeholder interviews.

Assuming the adoption rates are accurate, the following savings are projected (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	8	24	0	2	5	16
DNV GL Projected BAT	16	58	1	4	10	37
U4E Targets	3	6	0	1	2	4

4.2.2 Job creation / elimination from energy efficient products.

No direct impact on the Lesotho 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 South African 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', 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." [26]

Since all air-conditioning units are imported from South Africa, these regulations have a direct impact on Lesotho.

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. 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

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, local stakeholder interviews eluded to the fact that verification of compliance is not enforced.

4.3.5 Environmentally Sound Management

Currently not in place in Lesotho.

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 Markets and Drivers

During 2016, refrigerator sales amounted to just over an estimated 36,000 units. The average life expectancy of a refrigerator is determined by the quality of construction and how the item is cared for. Properly maintained refrigerators can last between 14 and 17 years, depending on the model and size. [31]

Market surveys and a census conducted during 2011 indicated that around 17.5% of household in Lesotho have refrigerators. This amounts to just under 90,000 fridges currently in operation at that time [32].

5.1.2 Purchase of refrigeration products, including where and availability of Energy Efficient 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+++).

Figure 5.1 Refrigerators during shop visit in Maseru.

5.1.3 Local manufacturers, suppliers, retailers and other stakeholders

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 in at cheaper prices. Figure 5.1 illustrates the market share for refrigerator manufacturers.

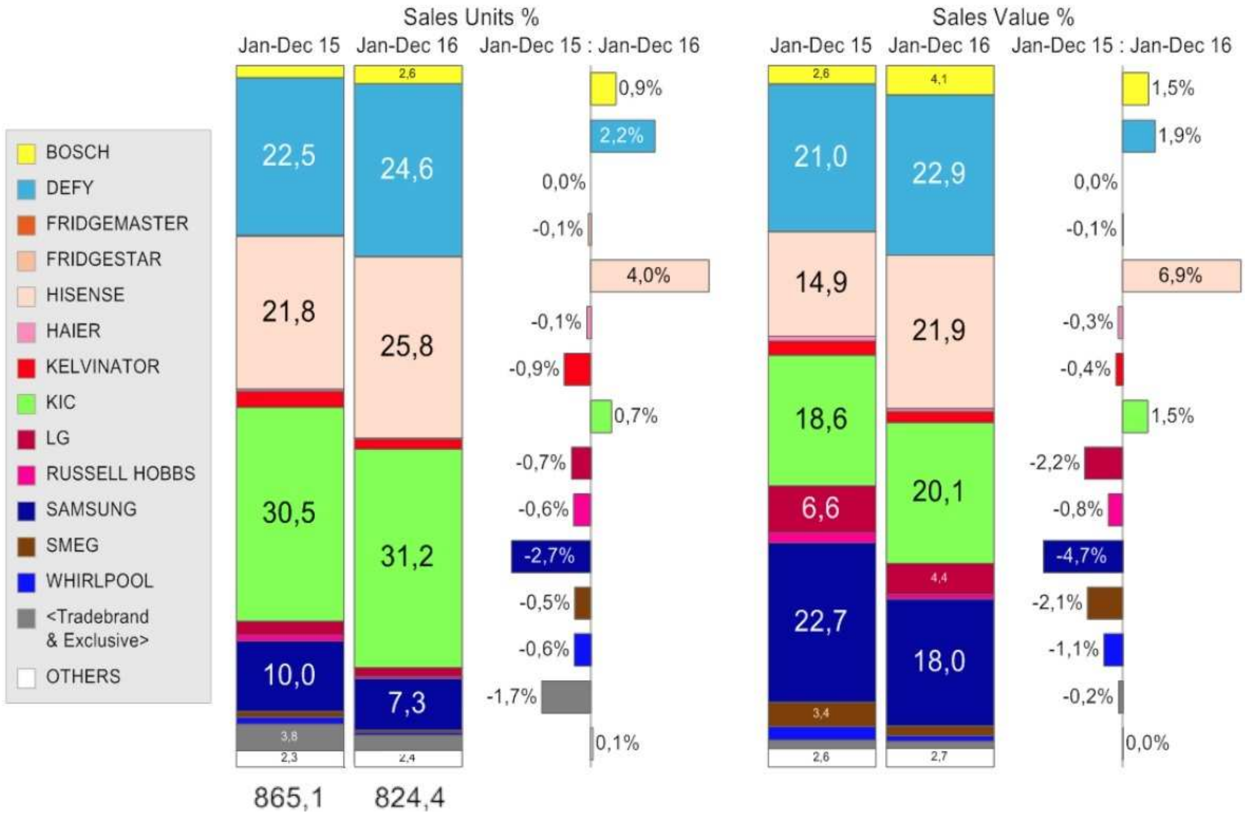


Figure 5.2 Refrigerator Market Share [33].

5.1.4 Import/Export

Comtrade data indicates that Lesotho imports 99% of its refrigerators from South Africa. [34]

Table 5.1 Refrigerator import QTY in Lesotho, 2012-2016.

Year	Import QTY
2012	14 989
2013	14 243
2014	46 181
2015	20 252
2016	39 312
Total (5 years)	134 977

5.1.5 Barriers to overcome

Old refrigerators were built to last. Some very old units are still in operation throughout Lesotho 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 basement or attic. 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 Lesotho. Very small refrigerator repair suppliers can be found in low income areas, but accurate data is not available.

5.1.7 Potential Savings from Energy-Efficient Refrigeration Products

The current minimum energy performance standards in Lesotho require fridges to be at least at 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 [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.

5.1.8 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	60 084	76 722	-5%	134 288	-7%	230 098
Business as Usual	Class B - Class A	21 523	27 482	9%	55 043	10%	111 952
Business as Usual	Class A+ & Above	8 071	10 306	14%	21 646	17%	46 661
DNV GL Projected MEPS	Lower than Class B	60 084	76 722	-52%	67 851	-61%	48 754
DNV GL Projected MEPS	Class B - Class A	21 523	27 482	128%	115 593	27%	269 952
DNV GL Projected MEPS	Class A+ & Above	8 071	10 306	45%	27 533	38%	70 004
DNV GL Projected BAT	Lower than Class B	60 084	76 722	-69%	43 820	-80%	16 147
DNV GL Projected BAT	Class B - Class A	21 523	27 482	165%	133 926	6%	260 524
DNV GL Projected BAT	Class A+ & Above	8 071	10 306	75%	33 229	83%	112 037

Data & Assumptions:

- *Exchange Rate: 1 MAL = 1 ZAR = 13.5 USD.*
- *Average Electricity Price to consumer: 0.073 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 (s are also shown as benchmarks.

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	9	26	2	8	6	16
DNV GL Projected BAT	13	32	3	10	8	21
U4E Targets	9	20	1	2	7	14

5.1.9 Job creation

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

5.2 Status of Policies and Initiatives

5.2.1 Standards and regulations

Seeing as Lesotho has adopted SABS standards, refrigerators are required to adhere to SANS/IEC 62552 (MEPS) and SANS 62301 (Noise). See also Appendix A.

5.2.2 Supporting Policies – Labelling and consumer awareness campaigns

Based on 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.

5.2.3 Financial Mechanisms

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

5.2.4 Monitoring, Verification and Enforcement

MEPS standards are monitored and enforced on imported and locally manufactured items by ensuring compliance to SANS.

5.2.5 Environmentally Sound Management

No effective environmental management of old refrigerators is being enforced within Lesotho.

5.2.6 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 [36]. 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 undertaken 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 [37].

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

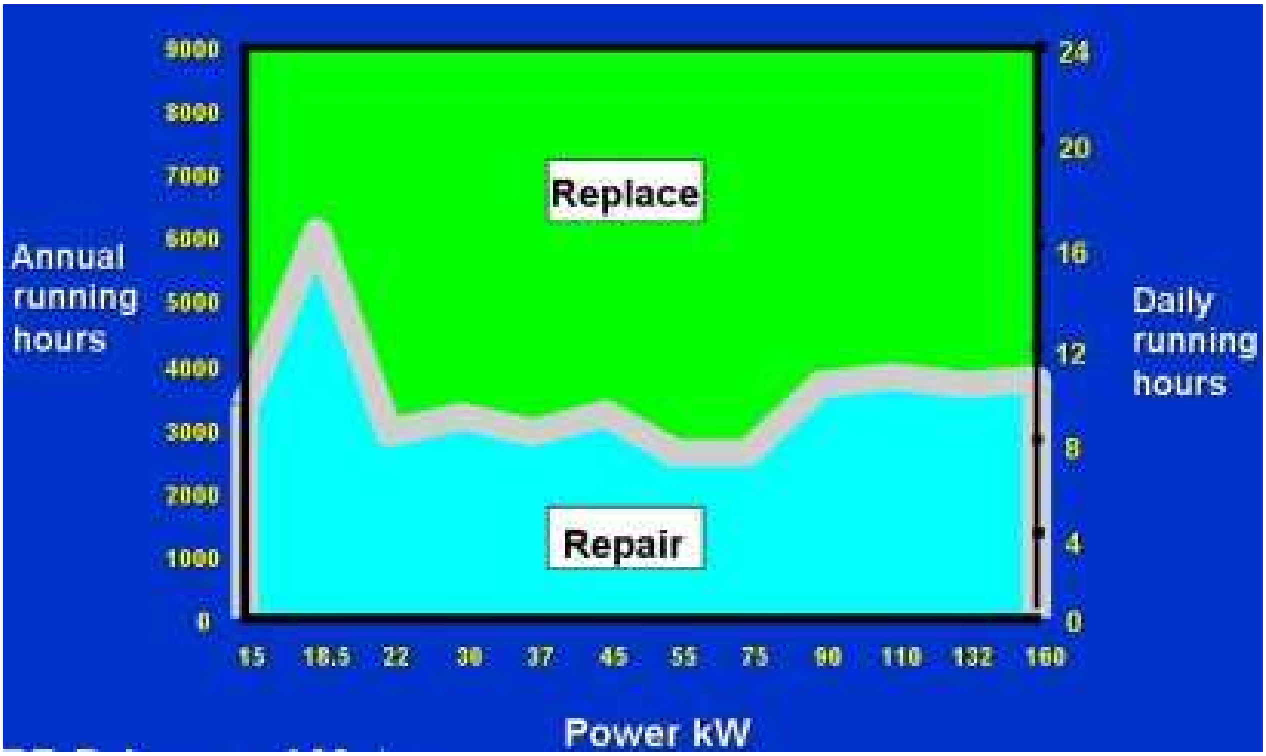


Figure 6.1 Repair/Replace power-time chart [38].

6.1.2 Price

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

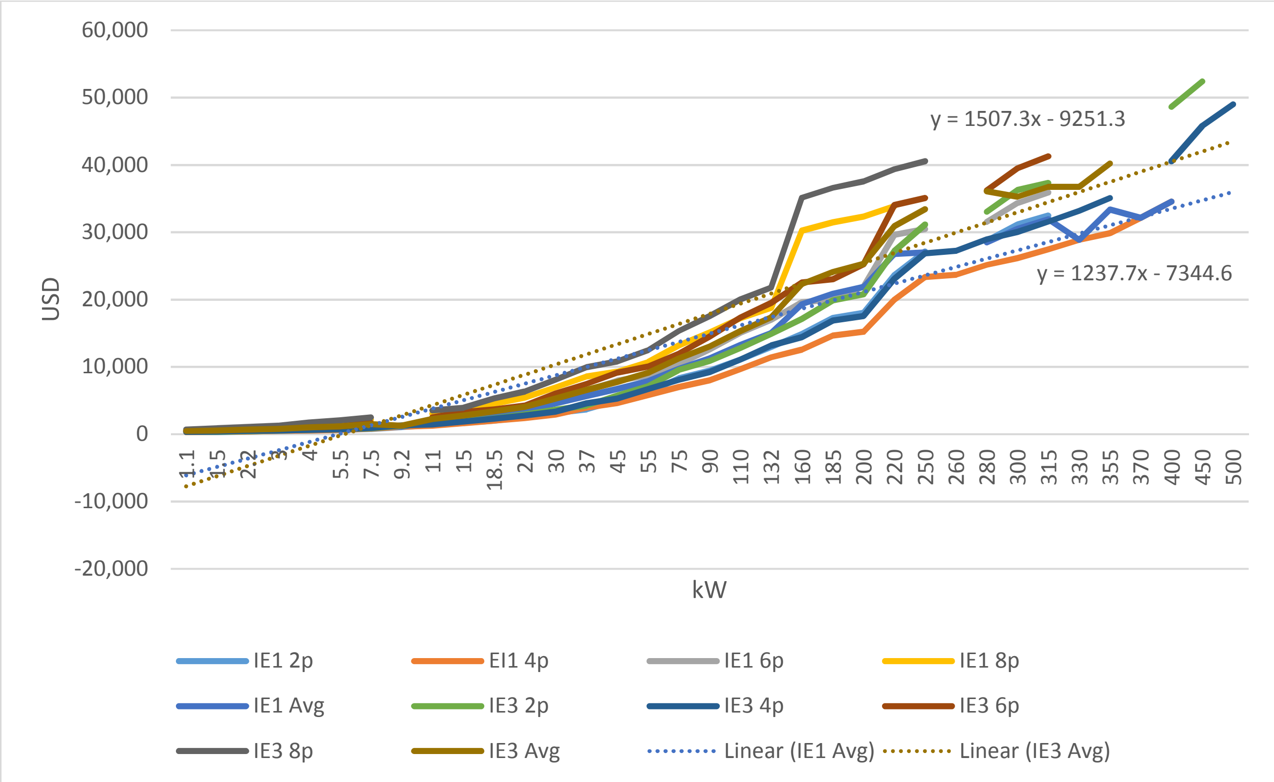


Figure 6.2 Motor Pricing versus size chart.

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 providing 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 administer 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 motor manufacturing takes place in Lesotho due to the small market size and the close proximity to South Africa. Some isolated parts of motors are manufactured locally, primarily for very specific types of industries where standard motors do not meet the requirements of the local clients. In some instances, motors are assembled locally per the needs of the local clients. However, this is a negligible amount.

6.1.5 Import/Export

For all practical purposes, one can say that all motors are imported into Lesotho [39]. Similar market shares are found in Lesotho for the three largest motor suppliers, as in South Africa. These are:

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

South Africa 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 neighboring countries. Lesotho imports over 92% of its electric motors from South Africa.

A general increase in net motor imports occurred in the first half of the decade (2000-2008) until the energy crisis in 2008 caused the collapse of the South African industrial and commercial market. The result is that investments dropped and fewer expansions took place.

6.1.6 Barriers to overcome

Overall Inefficient Systems

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

Rewinding

In addition, the fact that motors can be rewound to perform at the same efficiency reduces the drive to buy new equipment. However, industry reports indicate that very few rewinders actual perform the rewinding to the same standards and optimal efficiencies are hardly ever reached. [40]

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 end of life. A common observation during the country visit was that there is little second hand electrical motor industry to speak off.

6.2 **Potential Savings from Energy-Efficient Motors**

Current minimum energy performance standards in Lesotho require 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 6.1 BAU, MEPS, BAT scenarios for motors.

Scenario	Description	QTY (2017)	QTY (2020)	Tech. Adopt (2025)	QTY (2025)	Tech. Adopt	QTY (2030)

						(2030)	
Business as Usual	Class IE1 & below	31 562	40 301	-5%	70 539	-7%	120 866
Business as Usual	Class IE3	24 548	31 345	2%	58 824	1%	109 597
Business as Usual	Class IE4	14 027	17 912	8%	35 642	12%	73 548
DNV GL Projected MEPS	Class IE1 & below	31 562	40 301	-11%	66 084	-13%	105 927
DNV GL Projected MEPS	Class IE3	24 548	31 345	7%	61 629	9%	123 879
DNV GL Projected MEPS	Class IE4	14 027	17 912	13%	37 292	8%	74 205
DNV GL Projected BAT	Class IE1 & below	31 562	40 301	-13%	64 599	-20%	95 216
DNV GL Projected BAT	Class IE3	24 548	31 345	4%	60 144	6%	117 554
DNV GL Projected BAT	Class IE4	14 027	17 912	22%	40 262	23%	91 242

Data & Assumptions:

- *Exchange Rate: 1 MAL = 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 6.2 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	5	15	0	1	3	9
DNV GL Projected BAT	8	33	0	2	5	21
U4E Targets	5	12	0	0	4	8

6.2.2 Job creation or elimination from energy efficient 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

Although the Lesotho Energy Policy 2015-2025 discusses the development and implementation of energy efficiency strategies and programmes, no mention is made regarding any specific technologies.

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 not enforced by Lesotho, but the South African Bureau of Standards enforces standards through SANS 1804-2:2012 "Low-voltage three-phase standard motors" which is expected to result in compliance of this standard throughout the Lesotho.

6.3.5 Environmentally Sound Management

Environmentally Sound Management is not driven in the Lesotho motor industry.

6.3.6 Other on-going projects/initiatives

No ongoing initiatives or projects are in place.

7 TRANSFORMERS

The power network in Lesotho is owned and operated by the "Lesotho Electricity Company", commonly referred to as LEC. The power networks are mostly distributed at the endpoints by pole mounted distribution transformers. Some of them date back to the early sixties. 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 [41].

7.1 Status and Trends of Transformers

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

LEC provided information indicating that they have 3 646 distribution transformers on their distribution network.

Table 7.1 Growth in distribution of transformers 1960-2017

Year	QTY	%
1960 - 1997	623	17%
1998 - 2007	1 790	49%
2008 - 2017	1 232	34%

In 2017, 17% of these transformers will be 20 years or older. A transformer is expected to last roughly 20 years during normal operating conditions. Almost half of the distribution transformers will have passed the midway point towards their end of life and 34% of the transformers are newer than 10 years.

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 a competitive tendering processes, especially when being bought by LEC. 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.

7.1.3 Local manufacturers, suppliers, retailers and other stakeholders

Little information is available related to the sales volumes and market share of the local manufacturers.

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

The bulk of export and import is to and from South Africa.

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 Southern Africa in general, as is the case in Lesotho. 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

Based on discussions with Lesotho Electricity Company (LEC), DNV GL believes that transformers are typically installed in position and operated in that installation until end-of-life, primarily due to the size, nature of use and the fact that these are generally owned and operated by the distribution and transmission utilities. Therefore, there is little to no market for second hand distribution transformers.

7.2 Potential Savings from Energy-Efficient Transformers

Due to the daily variable load on distribution transformers driven by the end users, it is very hard to accurately model a hypothetical simulation to ascertain or predict how many transformers will be operating at certain percentages of full load, at what points of their efficiency curves and for how long. 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 7.2 highlights the potential savings across the three adopted scenarios.

Table 7.2 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	623	796	-8%	1 349	-20%	1 988
Business as Usual	SEAD Tier 3 or similar	1 790	2 286	-5%	4 010	-14%	6 344
Business as Usual	SEAD Tier 5 or similar	1 232	1 573	11%	3 217	26%	7 468
DNV GL Projected MEPS	Not Rated	623	796	-46%	792	-25%	1 094
DNV GL Projected MEPS	SEAD Tier 3 or similar	1 790	2 286	-1%	4 161	-27%	5 561
DNV GL Projected MEPS	SEAD Tier 5 or similar	1 232	1 573	25%	3 623	37%	9 145
DNV GL Projected BAT	Not Rated	623	796	-63%	543	-66%	340
DNV GL Projected BAT	SEAD Tier 3 or similar	1 790	2 286	-20%	3 367	-73%	1 704
DNV GL	SEAD Tier 5	1 232	1 573	61%	4 666	60%	13 755

Projected BAT	or similar						

Data & Assumptions:

- *Exchange Rate: 1 MAL = 1 ZAR = 13.5 USD*
- *Current Average Electricity Price to consumer: 0.101 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 7.3) to be achieved under the MEPS and BAT scenarios. The U4E targets are also shown as benchmarks.

Table 7.3 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	13	30	1	2	9	19
DNV GL Projected BAT	27	84	1	6	17	54
U4E Targets	15	31	1	3	10	20

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, the South African standard applicable in Lesotho, 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.

7.3.2 Supporting Policies – Labelling and consumer awareness campaigns

There is no labelling scheme in Lesotho 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 as compared to EU (Strategies for Development and Diffusion of Energy Efficient Distribution Transformers (SEEDT) project), Australia and New Zealand [Australian and New Zealand Minerals and Energy Council (ANZMEC) Policy (1999); National Appliance and Equipment Energy Efficiency Program (NAEEEP)(2002 - 2004); Regulatory Impact Statement (RIS) (2002)]

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 typically adopted by the Lesotho government through the LEC but is not explicitly listed as a requirement and therefore not listed earlier in Table 2.4.

7.3.5 Environmentally Sound Management

No environmental management initiatives. In relation to transformers.

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.

8 REFERENCES

[1] "Worldbank Database of Countries – Lesotho," [Online]. Available: http://data.worldbank.org/country/lesotho.

[2] "Afripedia and Facts and figures for African Countries," [Online]. Available: https://www.africa.com/countries/ .

[3] "BBC News Africa country profiles," [Online]. Available: http://www.bbc.com/news/world-africa-16833769.

[4] "United Nations member states," [Online]. Available: http://www.un.org/en/member-states/.

[5] "Commonwealth in Africa member states," [Online]. Available: http://www.commonwealthofnations.org/country/.

[6] "Southern African Development Community (SADC)," [Online]. Available: http://www.sadc.int/member-states/.

[7] "World Bank countries and economies," [Online]. Available: http://data.worldbank.org/country/.

[8] "Wikipedia Geography of Countries," [Online]. Available: https://en.wikipedia.org/wiki/Geography of country.

[9] International Energy Agency (IEA) , "World Energy Outlook (WEO)," [Online]. Available: http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/.

[10] "An overview of the Energy Picture for SADC countries, with a focus on renewable energy," [Online]. Available: ht content/uploads/2015/06/SADC-Energy-Report.pdf.

[11] "REEGLE (REN21 and REEEP) country energy profiles," [Online]. Available: http://www.reegle.info/countries/.

[12] "Southern African Power Pool (SAPP) member countries," [Online]. Available: http://www.sapp.co.zw/about-sapp-

[13] "International Renewable Energy Agency (IRENA)," [Online]. Available: https://www.iea.org/policiesandmeasures/

[14] "Mapping of Energy Initiatives and Programs in Africa," [Online]. Available: http://www.euei-pdf.org/sites/default/files/field_publication_file/annex_5_aeep_mapping_of_energy_initiatives_overview_of_initiat

[15] SE4ALL. [Online]. Available: http://www.se4all.org/sites/default/files/Lesotho_RAGA_EN_Released.pdf.

[16] "United for Energy (U4E) Country Assessments," [Online]. Available: http://united4efficiency.org/countries/countr

[17] "IRENA Renewable Energy Statistics 2017," [Online]. Available: http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=3866.

[18] "Energypedia renewable energy and energy access data," [Online]. Available: https://energypedia.info/wiki/.

[19] "SAPP Planning and Prospects for Renewable Energy," [Online]. Available: http://www.irena.org/DocumentDownlo

[20] "KPMG Sub-Saharan Africa Power Outlook 2016," [Online]. Available: https://assets.kpmg.com/content/dam/kpm africa-power-outlook.pdf.

[21] "REN21 Renewables 2016 Global Status Report," [Online]. Available: http://www.ren21.net/wp-content/uploads/2016/06/GSR_2016_Full_Report.pdf.

[22] "UNIDO SADC Renewable Energy and Energy Efficiency Status REPORT 2015," [Online]. Available: https://www.unido.org/fileadmin/user_media_upgrade/What_we_do/Topics/Resource-efficient__low-carbon_prod SADC_RE_and_EE_Status_Report.pdf.

[23] "Lesotho Demographics Statistics," [Online]. Available: http://www.bos.gov.ls/New%20Folder/Copy%20of%20Demography/Population_2006_Dynamics_Indicators.pdf.

[24] "Life Expectancy of Lights," [Online]. Available: https://www.thelightbulb.co.uk/resources/light_bulb_average_rat

[25] "Philips CFL Plant, Lesotho," [Online]. Available: http://www.engineeringnews.co.za/article/cfl-facility-in-lesotho-u

[26] "Philips, confirmed by Comtrade," [Online]. Available: https://comtrade.un.org/data/.

[27] "Interview with Fordham Air," [Online]. Available: http://www.fordhamair.co.za/.

[28] "Air-conditioning price list," [Online]. Available: https://www.ltcairconditioning.co.za/price-list-2016.

[29] "Air-conditioning products," [Online]. Available: http://www.airconexperts.co.za/products_home.html.

[30] "South African Institute of Refrigeration and Air-conditioning," [Online]. Available: www.sairac.co.za/.

[31] "Life Expectancy of Refrigerators," [Online].

[32] "2011 LESOTHO DEMOGRAPHIC SURVEY, ANALYTICAL REPORT, VOL. I, March 2013," [Online]. Available: http://www.bos.gov.ls/New%20Folder/Copy%20of%20Demography/2011_Lesotho_Demographic_Survey_Report

[33] "Provided by DEFY, initial source: GFK," [Online].

[34] "Comtrade," [Online]. Available: https://comtrade.un.org/data/.

[35] "Information provided by LEC," [Online].

[36] M. Barnes, in *Practical variable speed drives and power electronics.*, Newnes, Elsevier, 2003, p. 52.

[37] H. E. Jordan, in *Energy-efficient electric motors and their applications.* , Springer, 1994, p. 32.

[38] “ABB Replace or Repair,” [Online]. Available: http://www.abb.com/cawp/seitp202/8d1b524a81c82cb9c125715a00
[39] C. A. W. &. Z. WEG, Interviewee, *Manufacturing in Lesotho.* [Interview].
[40] “Motor Rewinding Efficiency,” [Online]. Available: https://www.easa.com/sites/files/resource_library_public/EASA_
0115.pdf.
[41] “Transformer Efficiencies,” [Online]. Available:
http://www.eandcspoton.co.za/resources/docs/Transformers/Reduce_South_Africa_electrical_distribution_transfo

APPENDICES

APPENDIX A: SACREE DETAILS

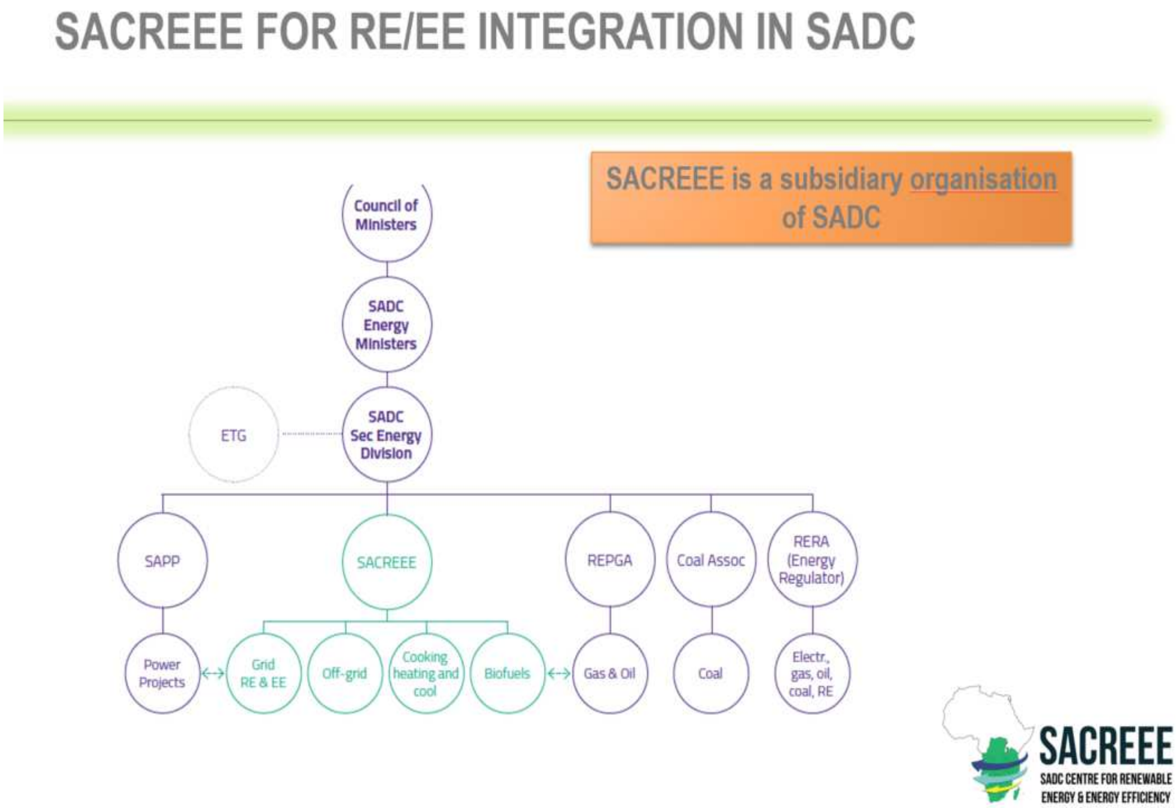
Extracted from the SACREEE_GNSEC_VEF2017.ppt

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.

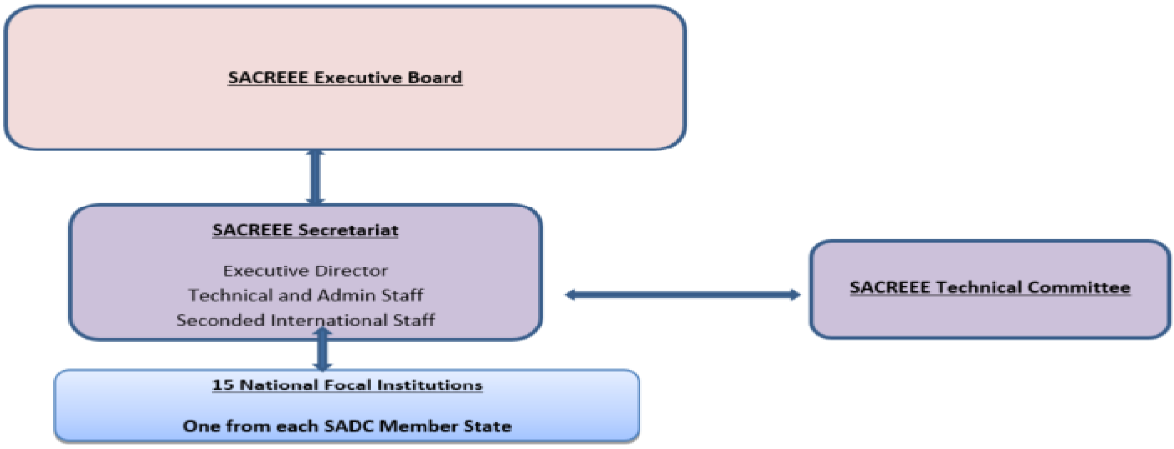
SACREEE's mandate is to implement the Regional Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP) through the promotion of market-based adoption of renewable energy and energy efficient technologies and energy services

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

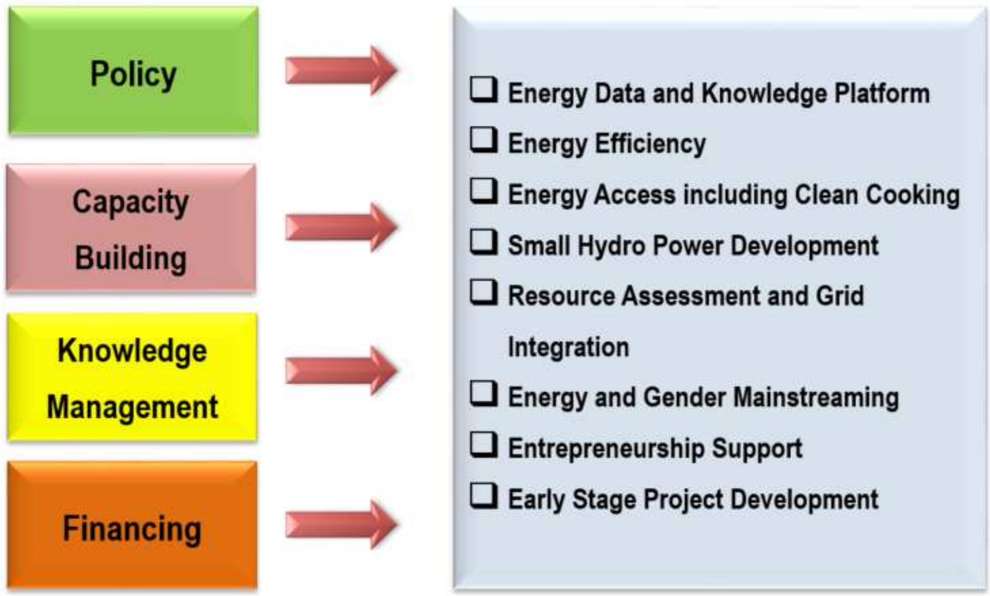
- Member States contributions
- Donor funding
- Cost recovery from services offered to projects.
- SACREEE Secretariat is based in Windhoek, Namibia



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 [14]

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.

PHOTOS

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.

CTCN contact details:

Climate Technology Centre and Network

UN City, Marmorvej 51

DK-2100 Copenhagen, Denmark

+45 4533 5372

www.ctc-n.org

ctcn@unep.org

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.