Refrigerator and DT Training

Refrigerator and DT Training Report - Lesotho

25 September 2022

UN environment programme

U4E United for Efficiency

GREEN CLIMATE FUND

CTCN UN Climate Technology Centre & Network UNFCCC Technology Mechanism

PEGASYS CHANGING LIVES CHANGING WORLDS

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ABBREVIATIONS

AfDB	African Development Bank
CAR	Conformity Assessment Report
DoE	Department of Energy
EU	European Union
GCF	Green Climate Fund
GWP	Global Warming Potential
HEPS	Higher Energy Performance Standard
IMF	International Monetary Fund
LEC	Lesotho Electricity Company
LED	Light emitting diode
LEWA	Lesotho Electricity and Water Authority
LNDC	Lesotho National Development Corporation
LSI	Lesotho Standards Institute
LSL	Lesotho Loti
MDG	Millennium Development Goals
MEPS	Minimum Energy Performance Standard
MV&E	Monitoring, Verification and Enforcement
ODS	Ozone Depleting Substances
PRS	Product Registration Scheme
PWG	Policy Working Group
RSL	Revenue Service Lesotho
SADC	Southern African Development Community
TBD	To Be Determined
U4E	United for Efficiency

1 INTRODUCTION

The 'Leapfrogging to Energy Efficient Appliances and Equipment in Lesotho (Refrigerators and Distribution Transformers)' project is funded by the Green Climate Fund (GCF) and being implemented under the guidance of the government of the Kingdom of Lesotho (Lesotho). The project is also being implemented simultaneously within 7 other countries of the Southern African Development Community (SADC) region, namely Botswana, Zimbabwe, Namibia, Malawi, Eswatini, Zambia and Tanzania. Lesotho is one of the few countries in the world that is completely encircled by another country. Lesotho is completely contained within the borders of South Africa. Thus, Lesotho has no access to the coast/sea. Therefore, it is heavily reliant on trade with South Africa be it for equipment or for commodities such as oil, petrol and even electricity. The electrification rate in Lesotho is currently under 45% [1] but it is on the increase. The government of Lesotho has embarked on an electrification campaign, which also targets rural areas. The electrification is also expected to drive economic growth in the country. Currently however, Lesotho imports over 60% of its electricity from South Africa [2]. For this reason, the average price of electricity (generation + import) in Lesotho is quite high and any losses are hence expensive. Refrigeration appliances (and distribution transformers), in particular household refrigerators, are appliances that are constantly operating. As such they always consume energy (24 hours per day, 365 days per year). Therefore, energy efficiency improvements in these appliances have a continuous impact on energy efficiency improvements for Lesotho.

The aim of the project was thus to focus on distribution transformers and household refrigeration appliances and attempt to establish a framework in order to improve the energy efficiency of these appliances. This was done through the establishment of national standards for both refrigerators and distribution transformers and development of Minimum Energy Performance Standards (MEPS) as well as an energy labelling scheme for refrigerators. During the project engagements were held with all of the key stakeholders within the country to create a system through which the necessary legislation can be developed related to the implementation of the MEPS and also to create a national implementation plan that will both enable the implementation of the MEPS but also create a framework within Lesotho for future development of related standards and legislation. Furthermore, the project investigated possible financing mechanisms available to assist the implementation of this project and the respective training programmes to enable transition into a self-sustained and managed implementation of the project in the future. Extensive training was performed on the MEPS, HEPS and the label for refrigerators amongst other topics. The training on distribution transformers was focused on the various standards and the losses in those standards as well as the Total Cost of Ownership methodologies and their application during procurement and contracting. Pegasys was contracted by the UNEP through the UN Climate Technology Centre and Network (CTCN) to implement this initiative in Lesotho. The CTCN is overseeing the project together with United for Efficiency (U4E) as a technical partner. As part of the project a number of tasks were completed as per the project plan. These include:

1. Development of the Lesotho National Standards on energy efficiency in refrigerators and distribution transformers (including MEPS and HEPS)

2. Development of the Lesotho Energy Label (draft) for refrigerators and distribution transformers
3. Development of the consumer awareness campaigns
4. Development of the recommendations related to the financial supporting mechanisms
5. Development of the MV&E plans

This report outlines the training that was performed by Pegasys related to refrigerators and distribution transformers. The refrigerator training was focused on the Revenue Services Lesotho (RSL) personnel that would be present and performing inspections at the borders. However, the training was also aimed at the other institutions that are key in the implementation of the MEPS, HEPS, national standard and the energy label. These include institutions such as LEWA and the DoE. The training was also performed on a train the trainer basis. The training on distribution transformers was primarily provided to the large purchasers of transformers such as the Lesotho Electricity Company (LEC) and some of the other users of distribution transformers such as the LNDC. The reminder of this document outlines the main parts of the project related to refrigerators and distribution transformers that require training and the actual training that was performed.

2 Background

The electrical energy layout of Lesotho is one in which, at the moment, there is a reliance on imports of power from South Africa and a general lack of energy efficiency within household appliances. The legal, regulatory and standardisation frameworks are generally inexperienced and untried with regard to energy efficiency matters. Additionally, the general population is largely unaware of the benefits of energy efficiency and much work will need to be undertaken on the public awareness campaigns related to this issue.

However, there are also a number of opportunities for a successful implementation of MEPS in the refrigeration and distribution transformer environment. These are:

- Successful implementation of MEPS in the refrigeration and distribution transformer sectors could open up a pathway to implement similar projects in other sectors and with other appliances (e.g., washing machines and dishwashers, stoves and ovens, air conditioners, etc.)
- Successful training of the customs officials of the Revenue Services Lesotho (RSL – previously known as the Lesotho Revenue Authority - LRA) in relation to energy efficiency compliance will make them more capable of enforcing other governmental initiatives related to energy efficiency and quality on a variety of products (e.g., air conditioners, power cables, etc.)
- Successful training of the LEC and other large buyers' procurement officers in relation to TCO and the benefit this has for their organisation and the country, from an environmental, cost and security of supply perspectives.
- Development of energy efficient appliances could lead to a green building revolution in Lesotho and align with the national energy policies.
- Increasing public awareness related to energy efficiency would be beneficial to the general behaviour of the population towards energy use and could provide general energy saving benefits and an energy conscious behaviour beyond the confines of this project.

As part of the project the national standard for refrigerators was developed. This standard also includes the MEPS, HEPS and the energy label for refrigerators. The PWG, led by the DoE also decided to ensure that the implementation of the standard is mandatory through the development of the related regulation. The regulation will be developed through the leadership of the DoE and will make compliance to the national standard and the energy label mandatory in Lesotho. Once that occurs it will be critical for the enforcement of the regulation to be implemented by various entities. Some of these include the RSL, which will be enforcing the regulation through the checking of compliance at the border posts and the other the LEWA and RSL inspectors that will be performing market surveillance at retailers. There are in fact a number of entities that are important in the implementation of the standard, the MEPS and the label. Similarly, a national standard for energy efficiency of

distribution transformers was developed. Tis sets the minimum losses allowed (MEPS). The TCO tool was also developed so that it can be used by the respective buyers of distribution transformers. The responsibility of the various entities was discussed during the project and is shown in Table 1 below.

Table 1. Entities and roles in development and enforcement of the MEPS and energy label in Lesotho

Organisation	Role
Ministry of Energy and Meteorology	Driver of the MEPS development and implementation. Formation of energy related initiatives. They will drive he development of the regulations related to MEPS and labelling.
Ministry of Communications and Science	The support ministry to the Ministry of Energy in this project. Can facilitate governmental support for legislation and implementation support
Lesotho Electricity and Water Authority	LEWA is a regulator in the electrical environment. LEWA is thus responsible for the implementation of the regulation. This would include the assessment of the PRS applications and the monitoring and surveillance activities.
Revenue Services Lesotho	Performing border controls of refrigerators coming into Lesotho (checking compliance with the regulation – ensuring that the PRS certificate is issued, valid and applicable to the cargo at the border)
Lesotho Standards Institution	The LSI is responsible for the development and the administration of the national standards, including the new national standards on refrigerators and distribution transformers.
Lesotho Electricity Company	The main buyer and user of distribution transformers. Also, the importer and seller of electricity and as such a key to the implementation of the project and one of the project's biggest beneficiaries
Lesotho Electricity Generation company	Newly formed organisation. Responsible for new electricity generation within the country.
Lesotho Central Bank	Responsible for the governance of the financial sector and would be able to support initiatives that finance the implementation of the project from a regulatory perspective

The refrigerator training was thus focused on the entities that have the biggest role to play in the implementation. These were the RSL, LEWA, LSI and the DoE. The distribution transformer training was provided to the LEC and the LNDC as well as other entities with vested interests such as LEWA, the DoE, the LSI, etc. The next section outlines the Lesotho MEPS and the energy label that have been developed as a part of this process for both refrigerators and distribution transformers, as well as the PRS scheme that will be implemented through regulation for refrigerators.

3 MEPS and Testing Standard

3.1 MINIMUM ENERGY PERFORMANCE STANDARD AND ENERGY LABEL FOR REFRIGERATORS

As part of this project and through the efforts of the various national stakeholders involved a Lesotho MEPS and energy label have been developed. The MEPS forms part of the national standard for refrigerators. The national standard is undergoing finalisation of the public commenting process and will be published by the Lesotho Standards Institute thereafter. The energy label has been drafted through a consultative process with the PWG members, and is aligned with the current guidelines of the draft regional label. The MEPS are presented in Table 2 below.

Table 2. Lesotho MEPS for refrigerators

Product Category	R (2023)	R (2026)
Refrigerator	1.00	1.25
Refrigerator/freezer	1.00	1.25
Freezer	1.00	1.25

The draft energy label is presented in Figure 1 below.

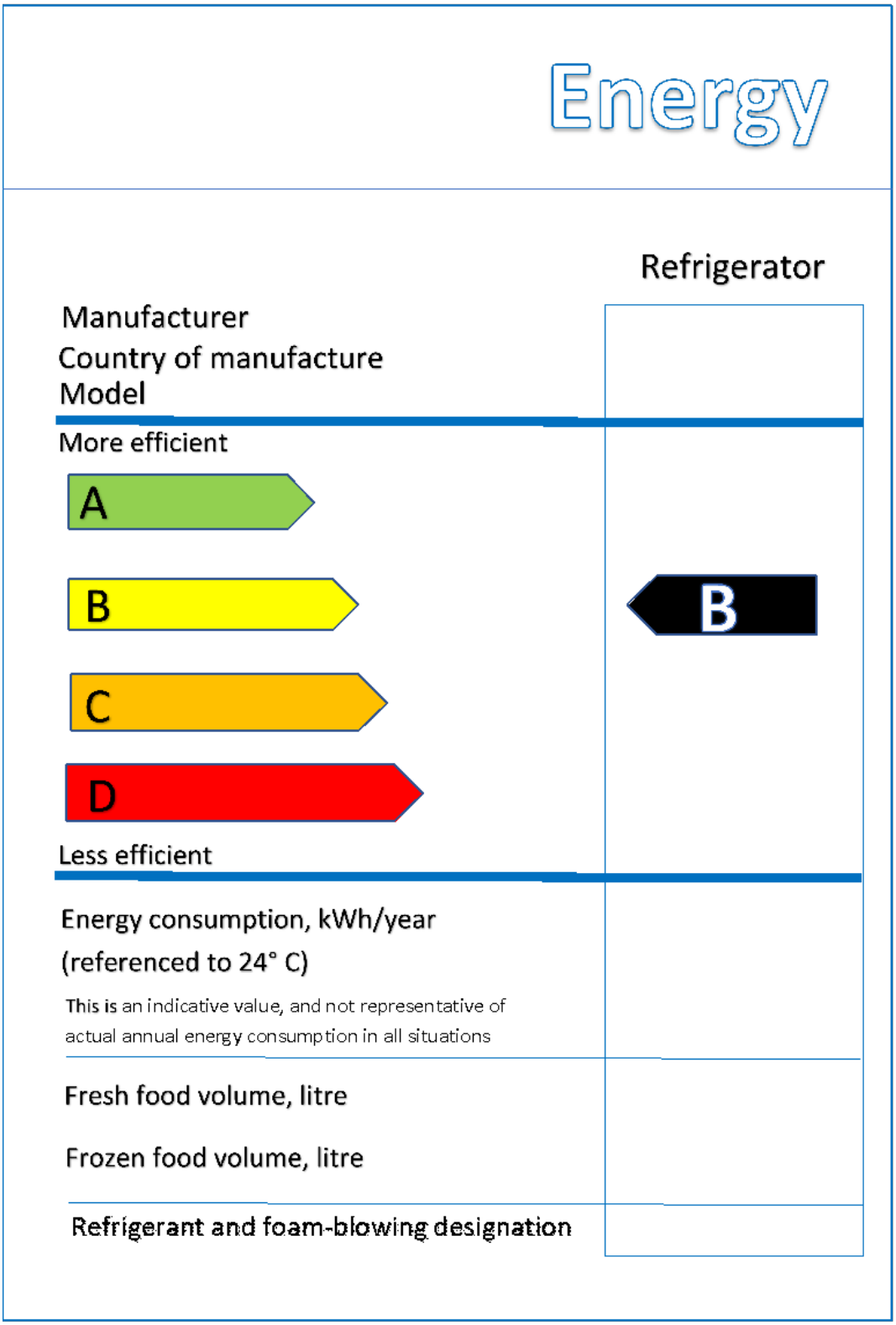

Figure 1. Draft Lesotho Energy Label for Refrigerators

3.2 COMPLIANCE PROCESS FOR REFRIGERATORS

In order for the implementation of the project to be successful there are several steps that are required. Once the regulation is passed the compliance process will need to be adopted by all importers, manufacturers and wholesalers of refrigerators in Lesotho. This section outlines the process that was chosen for Lesotho. It must be stressed that this process is not currently implemented in Lesotho and that this is the proposed process, discussed during the PWG meetings that is going to be implemented in the near future. The breakdown of the steps to be undertaken are as follows:

- Application (effectively the application is part of the PRS)
- Application review (this is the review of compliance)
- Issue of permit (or rejection of application)
- Submission of permit and label by manufacturer at the port
- Checking of permit against the goods at the port
- Market surveillance of goods at the sales points for compliance (label and permit)
- Dealing with non-compliances

Each part of the process listed above is explained in more detail in the NPR report. Importantly, at each of the stages above a local entity is required to perform tasks that require the full understanding of the national standard, the MEPS, HEPS and the energy label, as well as the processes listed above. For that reason, training was performed that focused on these items. The training is described in more detail in the next section.

3.3 NATIONAL STANDARD FOR DISTRIBUTION TRASFORMERS (MEPS)

Transformers in the scope of the National Standard for Efficiency of Distribution Transformers in Lesotho [3] must comply with the maximum allowed load and no-load losses values set out in the following tables. If not otherwise specified, three phase or single-phase power transformers shall be evaluated against the rated power of the individual unit. Maximum allowable losses rated powers that fall in between the given values shall be obtained by linear interpolation.

Table 3. Maximum load loss and maximum no load loss for liquid-immersed single-phase transformers with Um <= 36kV and rated frequency equal to 50 Hz

Rated power (kVA)	Tier 1			Tier 2			Tier 3		
	Maximum load losses (in W)	Maximum no-load losses (in W)	EI_{A50} %	Maximum load losses (in W)	Maximum no-load losses (in W)	EI_{A50} %	Maximum load losses (in W)	Maximum no-load losses (in W)	EI_{A50} %
5	133	37	97.17%	123	28	97.68%	112	18	98.18%
10	243	44	97.90%	224	33	98.23%	205	21	98.56%
15	331	58	98.13%	305	43	98.42%	278	27	98.71%
16	346	60	98.16%	319	44	98.45%	292	28	98.73%
25	486	83	98.36%	448	61	98.61%	410	39	98.87%
32	599	93	98.48%	552	69	98.71%	505	44	98.94%
50	889	119	98.63%	819	88	98.83%	749	56	99.03%
64	1070	145	98.71%	986	106	98.90%	901	68	99.08%
100	1535	211	98.81%	1414	155	98.98%	1293	99	99.16%

Table 4: Maximum load loss and maximum no load loss for liquid-immersed three-phase transformers with Um <= 36kV and rated frequency equal to 50 Hz

Rated power (kVA)	Tier 1			Tier 2			Tier 3		
	Maximum load losses (in W)	Maximum no-load losses (in W)	EI_{A50} %	Maximum load losses (in W)	Maximum no-load losses (in W)	EI_{A50} %	Maximum load losses (in W)	Maximum no-load losses (in W)	EI_{A50} %
25	520	70	98.40%	460	56	98.63%	400	42	98.86%
50	880	110	98.68%	782.5	92	98.85%	685	74	99.02%
100	1500	190	98.87%	1340	156	99.02%	1180	122	99.17%
160	2200	270	98.98%	1930	225	99.12%	1660	180	99.26%
250	3100	380	99.08%	2715	320	99.20%	2330	260	99.33%
315	3600	450	99.14%	3200	387	99.25%	2800	324	99.35%
400	4400	540	99.18%	3825	463.5	99.29%	3250	387	99.40%
500	5200	630	99.23%	4550	544.5	99.33%	3900	459	99.43%
630	6200	750	99.27%	5400	645	99.37%	4600	540	99.46%
800	7500	900	99.31%	6750	742.5	99.39%	6000	585	99.48%
1000	8900	1070	99.34%	8200	855	99.42%	7500	640	99.50%
1250	10500	1260	99.38%	9650	1025	99.45%	8800	790	99.52%
1600	12800	1520	99.41%	11800	1247.5	99.48%	10800	975	99.54%
2000	15100	1790	99.44%	14050	1460	99.50%	13000	1130	99.56%
2500	18000	2120	99.47%	16750	1720	99.53%	15500	1320	99.58%
3150	21500	2520	99.50%	20250	2075	99.55%	19000	1630	99.59%

The standard also caters for distribution transformers having dual voltage and have kVA ratings different from the standard transformer ratings.

The energy performance requirements set out in the standard also stipulates the dates that the different MEPS shall take effect. These are stipulated as follows:

- Tier 1 - one (1) year after adoption of MEPS or 1 July 2023, whichever is sooner.
- Tier 2 - four (4) years after adoption of MEPS or 1 July 2026, whichever is sooner.
- Tier 3 - seven (7) years after adoption of MEPS or 1 July 2029, whichever is sooner.

Lesotho, however, decided in favour of having a dedicated energy efficiency label for transformers as it will be of benefit to non-technical staff such as those at the ports of entry, who may find it difficult to decipher a transformer rating plate.

All distribution transformers manufactured for use in Lesotho should be clearly labelled to indicate the tier of losses that the transformer complies to, in accordance with the requirements of the National Standard for Efficiency of Distribution Transformers in Lesotho [3]. The labels will assist port authorities in preventing non-compliant transformers from entering Lesotho. The Ports Authority will correlate the losses stipulated on the transformer's rating plate and energy label to the tiers of losses stipulated in accordance with the requirements of the National Standard for Efficiency of Distribution Transformers in Lesotho [3]. Non-compliant transformers will not be allowed entry into Lesotho. The label is in line with the MEPS and timelines set out the National Standard for Efficiency of Distribution Transformers in Lesotho [3] and is shown in Figure 2 below.

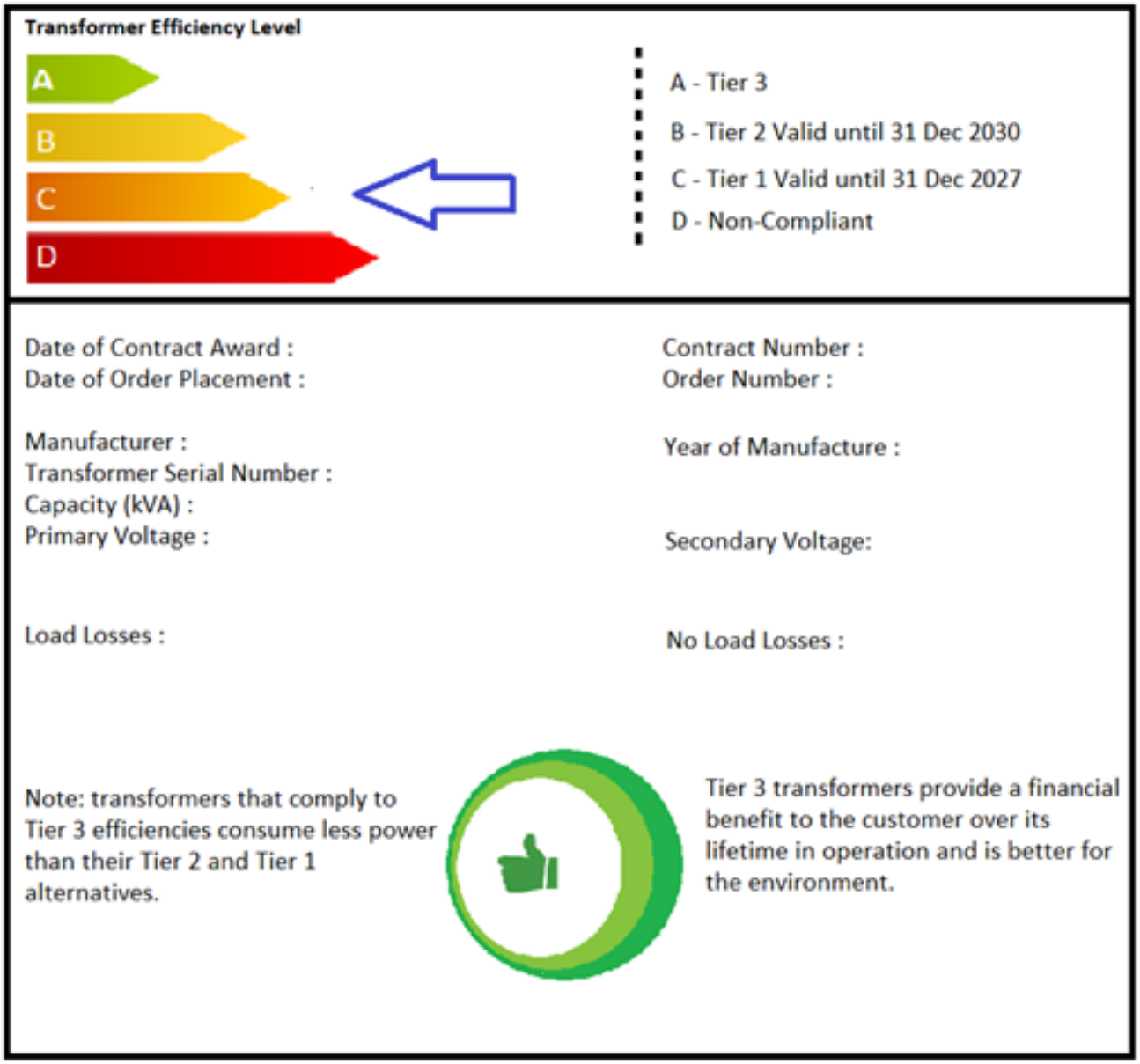

Figure 2. Label for energy efficiency of distribution transformers in Lesotho

3.4 IMPLEMENTATION RECOMMENDATION FOR DISTRIBUTION TRASFORMERS (MEPS)

- It is recommended that purchasers state clearly that the requirements of the National Standard for Efficiency of Distribution Transformers in Lesotho [3] for Transformer Efficiency takes precedence over any document stipulating transformer losses and provision of energy labels on transformers, such as SANS 780 of 2009 and 2019 [4][5].
- It is recommended that purchasers of distribution transformers employ a total cost of ownership strategy in the procurement process, whereby the losses are capitalised over the expected operational lifetime of the transformer. A tool was developed by the U4E to assist with the calculation of the capitalisation values.
- It is recommended that the capitalisation values be provided by the purchaser together with the National Standard for Efficiency of Distribution Transformers in Lesotho [3] in the technical documentation during any Procurement Tenders or individual RFQ's (requests for quotes).

4 Training Performed

4.1 TRAINING PERFORMED FOR REFRIGERATORS

The training that was performed on two separate occasions. The initial training was performed online on the 14th of September 2022. The second round of training was performed in person in Lesotho on the 20th of September 2022. The initial training was performed online by international consultants based in South Africa and Switzerland and for the second round of training the South African based international consultant travelled to Lesotho to hold the training in person and the Switzerland consultant joined via video and assisted the training process. In all of the training the local consultants were also involved.

The following topics were covered during training [6]:

- Definitions
- Introduction
- Energy efficiency in refrigerators
- Scope of residential refrigerators
- Regional standard and context
- Differences between IEC standards and SA standard
- MEPS
- HEPS/label
- Requirements for success
- Policy and regulatory framework
- Compliance Process (e.g., product registration scheme)
- Conformity assessment
- What to look for at the border
- Market surveillance
- Non-compliance and impact
- Importance of an MV&E scheme
- Requirements for MV&E scheme
- Benefits in Lesotho
- Roles of various institutions
- Conclusion
- Q&A

The training was attended by a number of key persons from various institutions. This included representatives from the RSL, LEWA, DoE, LNDC, LEC, LSI, Ministry of Communications and Science and others. The main

role players involved in the implementation of the project were involved in the training. The training material was also disseminated to the various institutions so that they are able to perform internal training as a part of this process. The two training sessions were very advantageous. It was especially advantageous that the second training session was held in person. This allowed all of the questions to be asked in detail and for those shy to ask in an online forum it allowed for one-on-one questions even during intervals or during personal training sessions. This also aided to overcome any potential language or technology barriers that can be experienced during online training. The internal training has been added as part of the implementation plan in the NPR document and has been budgeted for. The international consultants also indicated that if the trainers (that were trained during these sessions) realise that the material needs to be adjusted or focused in specific areas for their particular training needs (e.g. LSI might want the training to focus on conformity assessment compliance issues), the consultants will adjust the training material for them and focus it as required in the future. It must also be noted that the majority of the personnel from the key departments and institutions that were trained and that will be performing internal training within their organisations were also a part of the PWG and in certain instances the TCs and as such had an excellent knowledge of the standards, the MEPS, HEPS and the energy labels. For this reason it is believed that the internal training will be well executed.

4.2 TRAINING PERFORMED FOR DISTRIBUTION TRANSFORMERS

The training that was performed on two separate occasions. The initial training was performed online on the 14th of September 2022, with the additional online training offered on the 15th of September 2022 for follow up questions and clarifications. The second round of training was performed in person in Lesotho on the 20th of September 2022. The initial training was performed online by international consultants based in South Africa and for the second round of training the South African based international consultant travelled to Lesotho to hold the training in person. In all of the training the local consultants were also involved.

The following topics were covered during training [7]:

- Definitions
- Introduction
- Transformer losses
- Capitalisation of losses
- Case study on the capitalisation of losses
- Use of the TCO tool with examples
- Transformer label

The training was attended by a number of key persons from various institutions. This included representatives from the LEC, LNDC, RSL, LEWA, DoE, LSI, Ministry of Communications and Science and others. The main role players involved in the implementation of the project were involved in the training. The training material was also disseminated to the various institutions so that they are able to perform internal training as a part of this process. The two training sessions were very advantageous. It was especially advantageous that the second training session was held in person. This allowed all of the questions to be asked in detail and for those shy to ask in an online forum it allowed for one-on-one questions even during intervals or during personal training sessions. This also aided to overcome any potential language or technology barriers that can be experienced during online training. The worked examples were very popular, especially amongst the LEC and LNDC personnel as they realised the impact that TCO can have, and how to implement the TCO tools. The internal training has been added as part of the implementation plan in the NPR document and has been budgeted for. The international consultants also indicated that if the trainers (that were trained during these sessions) realise that the material needs to be adjusted or focused in specific areas for their particular training needs, the consultants will adjust the training material for them and focus it as required in the future. It must also be noted that the majority of the personnel from the key departments and institutions that were trained and that will be performing internal training within their organisations were also a part of the PWG and in certain instances the TCs and as such had an excellent knowledge of the standards, the MEPS, HEPS and the label. For this reason it is believed that the internal training will be well executed.

5 Conclusion

As has been shown in this report the Lesotho National Project related to energy efficiency of distribution transformers and refrigerators has resulted in a number of key developments. Amongst these the most important is the development of the Lesotho National Standards on energy efficiency of distribution transformers and refrigerators and the development of the accompanying energy labels. In order to implement the refrigerator national standard, the MEPS and the mandatory use of the energy label for refrigerators, the national stakeholders of Lesotho decided to develop a regulation. The regulation will be developed within the next year. Once the regulation is developed the MEPS and the energy label compliance becomes mandatory. It is critical that the respective port and surveillance authorities are ready for this process. This includes RSL personnel that will be performing border inspections, the LEWA personnel that will be performing compliance verification through the PRS and implementing the PRS with assistance of the LSI and RSL. In order to implement the TCO and MEPS for distribution transformers it is critical that the TCO is implemented into the procurement processes of the LEC, the LNDC and other large buyers of distribution transformers. The MEPS are implemented by referring to the correct standard (the Lesotho national standard) during the same procurement process. In order to enable these entities to smoothly perform these tasks training was organised on these specific subjects. The training was conducted in person and online and was provided by the international consultants on the project. The training was given to the relevant personnel that these entities identified as their representatives and these trained trainers will be performing the training for the rest of the relevant personnel within these organisations.

This report outlines the training that was performed and the overall content of the training. The training was successfully completed and the personnel trained will be able to further train the relevant personnel within their organisations. Additionally, the NPR implementation plan budgets for training within organisations and it is expected that this will be successfully carried out.

6 References

[1] UNDP, Kingdom of Lesotho, “Sustainable Energy for All Investment Prospectus”, June 2016

[2] US AID, Lesotho Power Africa Fact Sheet, https://www.usaid.gov/powerafrica/lesotho, last accessed 24 September 2022.

[3] National Standard for Efficiency of Distribution Transformers in Lesotho.

[4] SANS 780, 2009 South African National Standard, Transformers.

[5] SANS 780, 2019 South African National Standard, Transformers.

[6] Training Material for Refrigerator Training in Lesotho

[7] Training Material for Distribution Transformer Training in Lesotho