National Policy Roadmap

National Policy Roadmap Report on Residential Refrigerators in Eswatini

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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
CTCN	UN Climate Technology Centre and Network
DoE	Department of Energy
EEC	Eswatini Electricity Company
ERS	Eswatini Revenue Services
ESERA	Eswatini Energy Regulatory Authority
EU	European Union
GCF	Green Climate Fund
GWP	Global Warming Potential
HEPS	Higher Energy Performance Standard
IMF	International Monetary Fund
IPP	Independent Power Producer
LED	Light emitting diode
MDG	Millennium Development Goals
MEPS	Minimum Energy Performance Standard
MNRE	Ministry of Natural Resources and Energy
MV&E	Monitoring, Verification and Enforcement
NPR	National Policy Roadmap
ODS	Ozone Depleting Substances
PRS	Product Registration System
PWG	Policy Working Group
SADC	Southern African Development Community
SWASA	Eswatini Standards Authority
SZL	Eswatini Lilangeni
TBD	To Be Determined
UA	Units of Account
U4E	United for Efficiency

1 INTRODUCTION

The 'Leapfrogging to Energy Efficient Appliances and Equipment in Eswatini (Refrigerators and Distribution Transformers)' project is delivered by the UN Climate Technology Centre and Network (CTCN) with funding from the Green Climate Fund (GCF) and being implemented under the guidance of the government of the Kingdom of Eswatini (Eswatini). The project is also being implemented simultaneously within 7 other countries of the Southern African Development Community (SADC) region, namely Botswana, Zimbabwe, Namibia, Malawi, Lesotho, Zambia and Tanzania. Eswatini has no independent access to the coast/sea. Therefore, it is heavily reliant on use of South African ports for the import of essential commodities, including electricity, which is purchased from Eskom, the state-owned utility in South Africa. The electrification rate in Eswatini is currently around 84% with universal access to electricity projected by the end of 2022 [1]. The government of Eswatini has embarked on a drive to improve its electricity generation capacity to diminish its dependence on imported power from South Africa and to provide greater security of supply. A National Energy Policy was developed in 2018 to facilitate this process. An Independent Power Producer (IPP) Policy was established under the Ministry of Natural Resources and Energy (MNRE) to increase the utilisation of solar and biomass generation plants. The Lavumisa 10 MW solar plant project is nearing completion while there are 40 MW solar and 40 MW biomass generation plants planned for construction in 2021 [1]. The expansion of the grid will result in an increase of transformers on the network. Any improvement in the technical losses present on distribution transformers will have an immediate impact on energy efficiency improvements for the entire network and has direct cost savings for the country. Refrigeration appliances, in particular household refrigerators are also a major contributor to technical electrical losses. Refrigeration appliances are always operating and therefore consume electrical energy constantly. Therefore, energy efficiency improvements in these appliances have a continuous impact on energy efficiency improvements for the country.

The electrification campaign listed above and the drive towards energy efficiency align with the Eswatini National Energy Policy of 2018. The main objectives of the Eswatini National Energy Policy are to enhance energy security and self-sufficiency. The focus of the energy policy is to meet the country's demands for electricity in a sustainable manner. Therefore, one can reach these objectives through the two processes listed below:

1. To minimise losses in energy processes

2. To reduce energy imports in meeting demand

Through the development and the subsequent implementation of this project some of the objectives of the energy policy can thus be met. The aim of the project was 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), Higher Energy Performance Standards (HEPS) 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 Eswatini for future development of related standards and legislation. Furthermore, the project investigated possible financing mechanisms available to assist implementation. The following were the key components of the project:

1. Development of the Eswatini National Standard on energy efficiency in refrigerators (including MEPS and HEPS)
2. Development of the Eswatini Energy Label
3. Development of the consumer awareness campaign
4. Development of the recommendations related to the financial supporting mechanisms
5. Development of the MV&E plan
6. Development of the National Policy Roadmap (NPR) – this report

This report outlines the National Policy Roadmap for the project in Eswatini related to refrigerators. The remaining sections thus outline the background to the project and the impact it can have on Eswatini. There are explanations of the national standard and the energy label and how it related to the regional standard. Furthermore, the implementational aspects are covered in more detail. These include the MV&E implementation and monitoring parts of the project, where recommendations of implementation in particular are detailed. The supporting aspects of the implementation in the form of the consumer awareness and financial mechanisms are explained in more detail. It is important to note that there are separate, more detailed reports on individual aspects of the project, including the energy label, consumer awareness campaign, financial mechanisms and the MV&E plan. However, this report outlines the most important part of each of these aspects and groups them in order to create a policy roadmap for implementation of the entire project. Importantly, the outline of the overall project actions and related budget is also presented, with timelines and responsibilities.

2 Background

The electrical energy layout of Eswatini is one in which, at the moment, relies on imports of power from South Africa. The legal, regulatory and standardisation frameworks are generally inexperienced and untried with regard to energy efficiency matters. As a result, the appliances that are installed in Eswatini are not monitored and do not have minimum energy efficiency thresholds. However, there is enthusiasm within the ministries that will be directly involved with the project of the development of the MEPS and the corresponding regulators and primary stakeholders. The cooperation between key governmental departments in Eswatini appears to be smooth and SWASA has experience in standards development and a well-established process for the operation of technical committees. The ERS appears capable of implementing the MEPS at border levels with adequate controls. Additionally, the regulatory framework and the close alignment between the regulators and key ministries in Eswatini could make the policy transition efficient. 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 Eswatini Revenue Services (ERS) 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.)
- Establishment of a framework that requires minimum energy performance and outlines higher energy performance of refrigerators, which will enable the local manufacturer Palfridge to compete against imports in an even, structured market
- Development of energy efficient appliances could lead to a green building revolution in Eswatini 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.

In order to be able to implement the newly developed Eswatini National Standard on energy efficiency in refrigeration most efficiently a number of areas require understanding so that the impact can be quantified and

some of the awareness campaign aspects targeted. Firstly, he market size of refrigerators in Eswatini needs to be established. As mentioned, Eswatini has one local manufacturer, Palfridge. The remaining units are imported. The import numbers are shown in Figure 1 below.

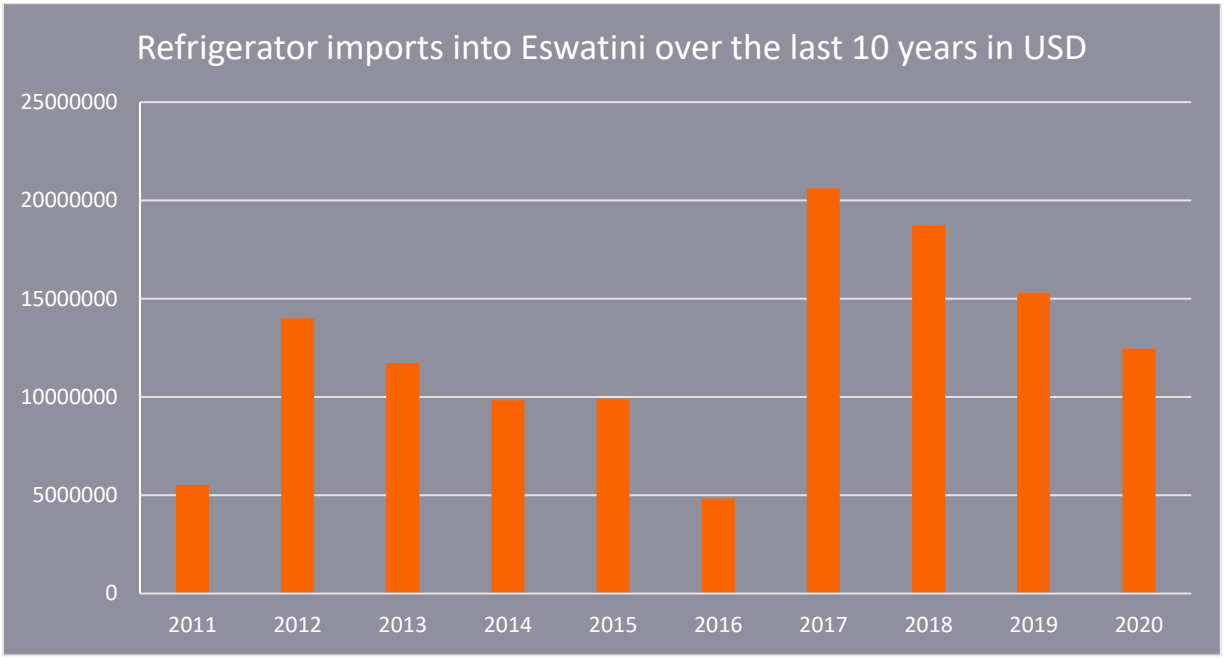

Figure 1. Refrigerator imports over the past 10 years [2]

- The number of units imported in 2020 was 6 143 [3]
- Palfridge manufactured 38 432 refrigerators in 2020 but only 4% were for the local market and the remainder were exported. This brings the local market in 2020 to 7 680
- The local market is estimated to reach 22 000 units by 2030 [3]
- The average price of the refrigerators purchased by households interviewed in the surveys is EL4 678 = $298 [4].

If one considers the value of the total imports divided by the average price of a refrigerator the total number of imported refrigerators is in the region of 40 000 units. However, this is based on estimates of the value of refrigerators and also there are more refrigerators imported per annum than sold as stock reserves are carried by manufacturers. According to Comtrade data [2] the refrigerator market in Eswatini is approximately at 35 000 units per year (this is taking into account the number of units imported and the units sold by Palfridge). One of the possible reasons for this difference is that not all the varieties of HS codes related to refrigerators are presented in this survey. Another possibility is that some of the Comtrade data is captured as residential refrigerators but is actually for commercial refrigerator imports. However, importantly the trend of an increasing number of refrigerators is present in the country.

The average price of refrigerators must be considered in context of the average income of households in Eswatini. Eswatini falls into the lower-middle income tier of countries in Africa. As such there are large number of households that have very little disposable income. It must be stressed that none of the households were willing to disclose their annual income during the market assessment study. Without this information it is difficult to ascertain their disposable income accurately but from conversations with stakeholders from Eswatini the general consensus is that the disposable income is in the region of 200 – 300 USD per month. This is related to upper middle-class persons and therefore a disposable income of 100 USD or less is probable for lower income and middle to lower income households This is presented in Figure 2 below.

Additionally, the current expenditure on electricity in the country per household is shown in Figure 2 below.

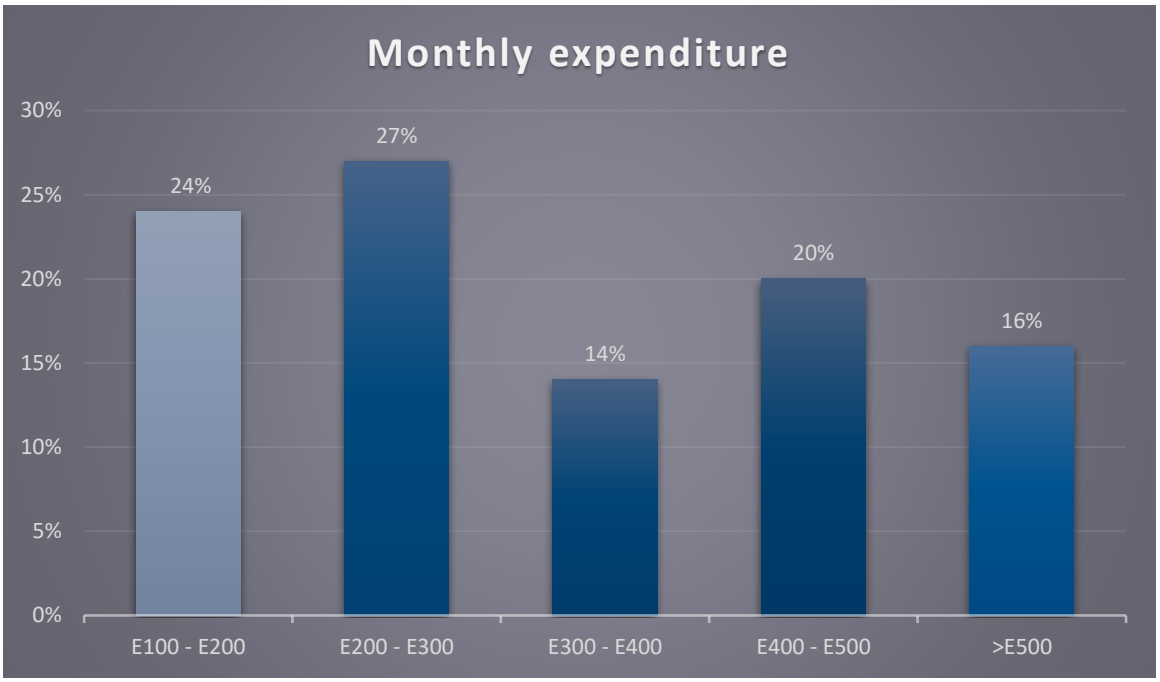

Figure 2. Breakdown of electricity monthly payments per household [4]

Therefore, one can see that a significant portion of the household budget is spent on electricity. Typically the disposable income per household is in the region of SZL 3500 per month [4]. Therefore, the spending is approximately 8% - 10% of disposable income.

Furthermore, it is important to note the age of the existing refrigerators in Eswatini. This is shown in Figure 3 below.

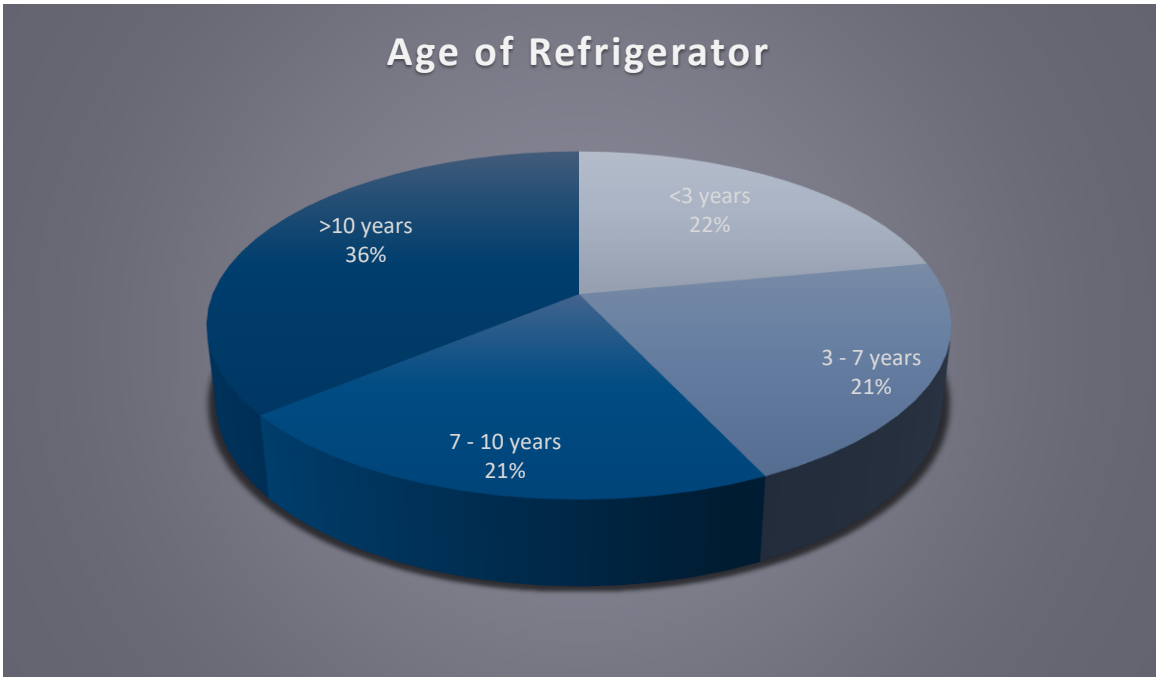

Figure 3. Age of refrigerators gathered from the market assessment surveys [4]

It is common for refrigerators to be replaced within 10 - 12 years of usage [5]. When replacing refrigerators the Eswatini consumers have the following behaviour of purchase as shown in the Figure 4 below.

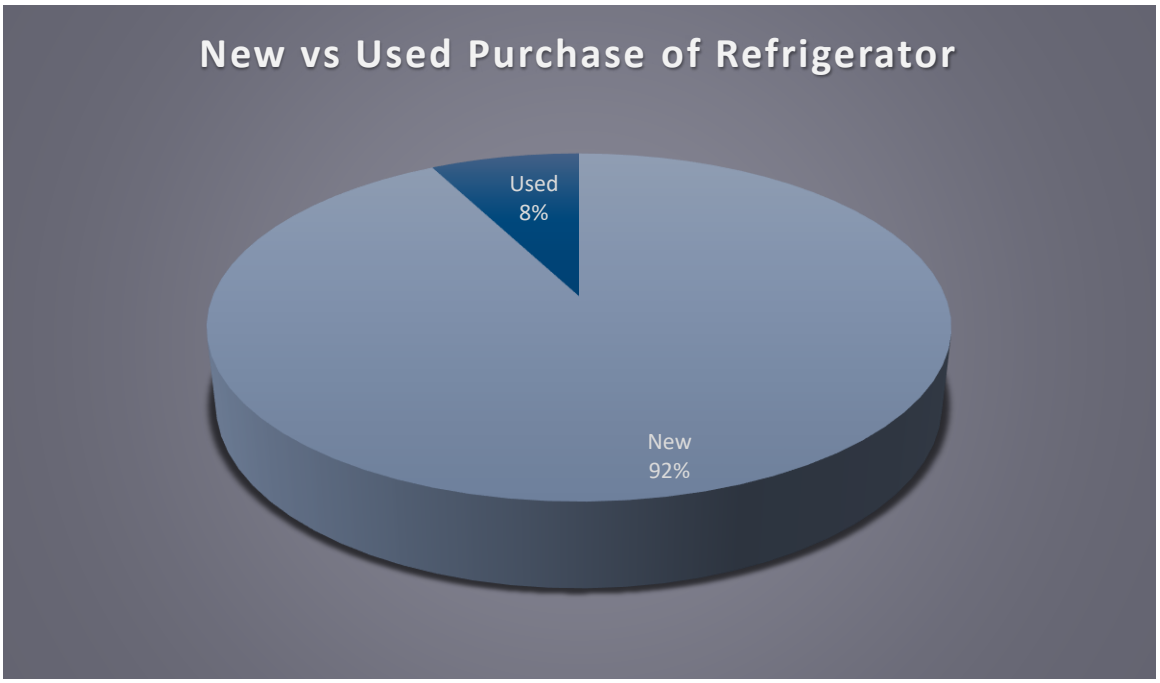

Figure 4. New vs used purchase of refrigerators in Eswatini [4]

Therefore, it can be assumed that approximately 30% of refrigerators within Eswatini may be replaced within the next 2-3 years and that approximately 90% of those will be replaced by new refrigerator purchases. One can also consider that Eswatini has a population of approximately 1.2 million. It has an electrification rate of

84%. The average household has 5.8 persons. Therefore, there are approximately 174 000 households with electricity. If one considers that all households with electricity will have refrigerators and taking into account that 30% of refrigerators will be replaced within the next 2-3 years this equates to approximately 52 000 refrigerators to be replaced. With 90% of these being replaced by new refrigerators, this results in 47 000 new refrigerators being purchased, over the next 3 years. Therefore, dividing by 3 it can be seen that approximately 16 000 refrigerators may be replaced in Eswatini in the next year. This is of course a very coarse estimate and aligns with the estimated market in Eswatini in 2030 [3].. For the purposes of this report and calculations to follow the market size is estimated (based on the calculations above and the data available as well as possible data inaccuracies) at 10 000 units per year. There are thus significant savings possible. In order to affect some of these savings the most critical aspects are:

- Development of the national standard, including MEPS and HEPS
- Development of the energy label
- Development of the regulatory framework
- Development of the implementation plan
- Development of the supporting aspects such as the consumer awareness campaign
- Obtaining financial backing for the implementation of the project

The sections below cover each of these aspects in more detail.

3 MEPS and Testing Standard

3.1 CONTEXT

In parallel with this project and the other 7 national projects in Botswana, Lesotho, Malawi, Namibia, Tanzania, Zambia and Zimbabwe, there is a regional project for SADC currently being implemented. The regional project is aimed at the development of regional MEPS, HEPS and the regional energy efficiency label for the SADC region. It covers cooling appliances such as refrigerators and air conditioners. The participation in the regional project includes all 16 SADC states. Whereas the regional project focuses on the alignment and endorsement of a regional MEPS, HEPS and label, the national project includes the underlying implementation aspects, such as the preparation of the national adoption, the National Policy Roadmap (NPR), the consideration of financing mechanisms to support consumers and consumer awareness campaigns.

The scope of refrigerators in the regional standard and the national standards is related. The scope is as follows [6]. The following types of refrigerators are includes in the scope:

- compression type
- with a rated volume at or above 10 Liters (L) and at or below 1,500 L
- powered by electric mains
- offered for sale or installed in any application

There are also certain exemptions that are listed. These are:

- wine storage appliances
- refrigerating appliances with a direct sales function
- mobile refrigerating appliances
- appliances where the primary function is not the storage of foodstuffs through refrigeration
- other products that do not meet the definition of a Refrigerator, Refrigerator-Freezer, or Freezer, and
- other refrigerating appliances different than vapour compression type

As part of the regional project the regional standard has been developed. It has been commented on and after the final comments MEPS and HEPS have been finalised, together with recommendations for the regional label.

The aim was for the 8 countries of the national project to align as far as possible with the regional project. The MPES of the regional project are presented in Table 1 below:

Table 1. Regional MEPS

Product Category	R (2023)	R (2026)
All categories	1.00	1.25

As is evident the regional MEPS R level is 1 from 2023 until 2026 and from 2026 the R level is 1.25 [6].

The regional standard is based on the model regulation guideline as presented by the U4E. This guideline, and the regional standard are largely aligned with international best practices.

Additionally, the regional manufacturing capabilities were taken into account. Furthermore, South Africa is a major role player in the region as the largest economy and with the largest number of manufacturers. This is particularly important to Eswatini as South Africa is its major trading partner and the majority of refrigerators come to Eswatini from South Africa or come from South African manufacturers. Therefore, the decision was made to align the level for tier 1 with South Africa and as a result R was increased from 0.75 to 1 and for tier 2. This is critical as it shows intent and a commitment to move towards higher energy efficiency in the future both regionally and through the adoption of the various countries, including Eswatini.

The testing of the regional standard is based on the IEC 62552:2015 version. The energy consumption is therefore measured according to IEC 62552-3:2015 - Household refrigerating appliances: Characteristics and test methods Part 3: Energy consumption and volume [7]. As per this standard energy consumption is determined from measurements taken when tested as specified at 16° C and at 32° C. This is an extremely important point as this means that the refrigerator only needs to undergo one set of tests (2 tests, one at each temperature). After that calculations can be made to evaluate its consumption and R value for any ambient temperature within the range.

The previous version of the standard is IEC 62552:2007 [8]. In this version the testing is only performed at one ambient temperature. Therefore, if a specific country or region utilises an ambient temperature of, for example, 25° C then the testing would be performed at that ambient temperature. If the same refrigerator model is then to be sold in another country or region with an ambient temperature requirement of 22° C the testing would have to be repeated at that specific ambient temperature. In the new version of the standard one would simply recalculate using weighting factors.

In the regional standard therefore, in order to calculate the R value the following process is utilised:

Firstly, the annual energy consumption of the refrigerator is calculated from the testing performed. The annual energy consumption is calculated using the formula:

$AEC = EC_T \times (365/1000)$ *in kWh per year … (1)*

- where EC_T is energy consumption in Wh per 24 hours based on ambient temperature T

In order to calculate EC_T the following equation is used:

$$EC_T = a \times E_{daily16} + b \times E_{daily32} \text{ in Wh per day } \ldots (2)$$

- where $E_{daily16}$ is energy consumption measured at ambient temperature 16° C
- and $E_{daily32}$ is energy consumption measured at ambient temperature 32° C

in accordance with IEC 62552-3:2015. In the regional standard the reference ambient temperature for determining maximum energy use requirements is 24 °C. Hence, coefficients a = b = 0.5

Therefore, the refrigerator is tested at 16° C for 24 hours and the daily energy consumption is measured. This is multiplied by 365 to get an annual energy consumption at 16° C. Similarly, the refrigerator is tested at 32° C for 24 hours and the daily energy consumption is measured. This is multiplied by 365 to get an annual energy consumption at 32° C. Since the regional standard requires the energy consumption to be indicated at 24° C and this is exactly half way between 16° C and 32° C, the weighting factors a and b are equal and are 0.5. Effectively the two energy consumptions are added and divided by 2 to get the average.

Now that the annual energy consumption of a refrigerator in question has been measured and calculated it has to be compared to a value in order to ascertain whether the energy consumption is good/acceptable or not. This reference value is known as Maximum Annual Energy Consumption (AEC_{Max}). In order to obtain AEC_{Max} there are several processes to take and understand. AEC_{Max} corresponds to the yearly energy consumption of a reference appliance in the standard conditions. It is defined for 3 categories of appliances and this definition depends on the Adjusted Volume (AV), as can be seen in Table 2 below.

Table 2. Adjusted volume conversions [7]

Reference Ambient Temperature	**Product Category**	**AEC_{Max}(kWh/year)**
24°C	Refrigerators	0.163 ×AV + 102
	Refrigerator-Freezers	0.222 ×AV + 161
	Freezers	0.206 ×AV + 190

There are therefore conversion factors for the type of appliance as defined in the standard. These are factors based on reference refrigerators that were calculated over years of testing. The aim of the above calculation is to be able to compare the energy calculated in the actual, tested refrigerator against a reference value but the reference value needs to be adjusted/normalised so that the comparison is of the same values/types of refrigerators (effectively comparing like for like).

Therefore, for refrigerating appliances, the main energy service is expressed in terms of the storage volume, but only after it has been normalised to take into account the storage temperature differences in different compartments using a metric called the adjusted volume. Therefore:

This metric takes into account the different compartments, their volume and their temperature

The Adjusted Volume(AV) =∑(Vi×Ki×Fi) …(3)

Where:

I = index of the compartment

Ki is the **volume adjustment factor**: **K=(T1-Tc)/(T1-T2) …** (4)

The conversion factors with the reference temperature of 24° C are shown in Table 3 below:

Table 3.

Table 3. Conversion factors with the reference temperature of 24° C [7]

Reference Temperature	**Fresh food compartment**	**Frozen food compartment**	
T_1=24°C	K=1 (T_2=4°C)	Tc = -6°C	K = 1.50
		Tc = -12°C	K = 1.80
		Tc = -18°C	K = 2.10

Additionally, F_i is the frost adjustment factor:

- F=1.1 for frost-free (automatic defrost) is applied only to frozen food compartments
- F=1.0 is applied to all other compartments and manual defrost frozen food compartments

Therefore, now that the AEC_{Max} has been calculated and since we have the AEC we are able to calculate the ration between the measured value and the reference value. This effectively becomes the R value.

Therefore,

R =AEC_{Max}/ AEC

This means that is the energy consumption of the measured (actual unit we are importing or manufacturing) is greater than the reference value for that size and type of refrigerator the R value will be below 1. If the energy consumption of the measured refrigerator is lower than the reference value the R value will be above 1!

Thus the higher the R value the better the energy efficiency of the refrigerator that has been manufactured.

The MEPS and HEPS for refrigerators are therefore determined by this R value. In the regional standard the MEPS have been set to R = 1 unit 2023 and then to R = 1.25 from 2026 as mentioned previously and shown in Table 1. The HEPS have been set as shown in Table 4 below:

Table 4. Regional HEPS

Product Category	Low	Intermediate 1	Intermediate 2	High
All categories	$1.00 \leq R < 1.25$	$1.25 \leq R < 1.50$	$1.50 \leq R < 1.75$	$1.75 \leq R$

These HEPS effectively set the levels for the energy label. Some of the additional requirements of the regional standard, especially related to testing include:

- The temperature inside the fresh food compartment of the refrigerating appliance shall be adjustable to +4°C, as described in IEC 62552-3.
- The temperature inside the freezer compartment of the refrigerating appliance shall be adjustable between -6°C and -18°C, as described IEC 62552-3.
- A four-star compartment must be qualified with the minimum freezing capacity requirements of Clause 8 of IEC 62552-2.
- Refrigerating appliances shall be tested at an AC voltage and frequency, as described in IEC 62552-1.
- Refrigerating appliances shall operate appropriately with the rated voltage with surge protection +/-15%.
- Refrigerating appliances which, according to the manufacturer's instructions, can be used in ambient temperatures below +16°C and have a winter switch, shall have this winter switch automatically activated or de-activated according to the need to maintain the frozen compartment at the correct temperature.

The majority of these requirements are taken directly from IEC 6225:2015. Importantly, the IEC 62252:2015 standard also has other requirements, specifically ones related to refrigerants and these have also been adopted into the regional standard and the Eswatini National standard.

These requirements for Refrigerant and Foam Blowing Agent Characteristics are shown in Table 5 below (the numbers are upper limits):

Table 5. Upper limits of refrigerant in the regional standard [7]

Product Class	GWP	ODP
All types	20	0

This is a very important point. The previous version of the IEC standard IEC 62552:2007 makes no mention of the refrigerants. Therefore, with the regional standard aligning with the new version of the IEC standard (IEC 62552:2015) there is also alignment with the prohibition of refrigerants with ozone depleting substances (ODS). Importantly, the Eswatini National Standard is aligned with the Regional Standard on this also and hence prohibits the use of refrigerants with ODS. This is in alignment with the various international best practices and agreements that Eswatini has undertaken as described in the previous sections of this report.

Additionally, products using hydrocarbon (HC) refrigerants shall comply with IEC 60335-2-24:2020, or a subsequent revision, or a nationally modified edition of IEC 60335-2-24

The Regional Standard also provides guidelines as to the labelling of the refrigerator, or the use of the Energy Label. The following is stated:

The original equipment manufacturer (OEM) shall provide a label to the importer, product retailer, or installer before the product enters the market [6].

The label shall indicate:

- Model name / number;
- Type of unit;
- Country where the product was manufactured;
- Volume of the different compartments and an indication of whether they are frost-free;
- Rated performance grade;
- Yearly energy consumption in kWh at ambient temperature in °C or °F;
- Reference ambient temperature[s] used in performance rating;
- Refrigerant and foam-blowing designation in accordance with ISO 817 or ASHRAE 34, including ODP and GWP.
- All representations of energy performance shall indicate that the performance rating is an indicative value, and not representative of actual annual energy consumption in all situations.
- The label shall be affixed on the product in a location that is readily visible for the consumer.

- Products that meet the higher performance grade requirements per Clause 3 of this document are eligible for [TBD by country].

As one can see, there are certain elements of the label that are required by the Regional Standard. Furthermore, the label indicates that the specific countries can specify the higher energy performance levels as per the in-country standard. Eswatini has decided to mostly align with the Regional Standard but to include an additional category in the HEPS as shown in Table 9. This is reflected in the Eswatini energy label design. The Regional Standard also has additional indications related to proof of compliance/conformity. These are:

Compliance with the requirements of Clause 3 and any additional optional claims shall be demonstrated in the Conformity Assessment Report (CAR), which:

- demonstrates that the product model fulfils the requirements of this standard;
- provides any other information required to be present in the technical documentation file; and
- specifies the reference setting and conditions in which the product complies with this standard.
- The measured storage temperatures of fresh food compartment, frozen food compartment, freezer compartment, other compartments, where applicable, shall comply with the requirements of Table 2 of IEC 62552-2.
- The measured storage volume for each of the compartments shall not be less than the rated storage volume by more than 3% or 1 litre, whichever is the greater value. Where the volumes of fresh food compartment and cellar compartment are adjustable relative to one another by the user, this requirement applies when the cellar compartment is adjusted to its minimum volume.
- The measured energy consumption (kWh/24h) in the energy consumption test shall not be greater than the rated energy consumption by more than 10%.

Furthermore, the Regional Standard has additional comments related to market surveillance, which are:

- The designated authority implementing this standard shall develop a program to check compliance with this standard and survey the market for noncompliance. The program should include details on sample size, lab accreditation requirements (ISO/IEC 17025 certified), and a challenge process that manufacturers can utilise if the initial testing of their product is found to be out of compliance.
- The competent authority will be responsible for enforcement activities that include potential assessment of penalties for non-compliant products in the country. The competent authority shall establish written policies that clearly spell out its authority, procedures, and penalties. All testing done for compliance and market surveillance testing purposes shall be done penalties. All testing done for compliance and market surveillance testing purposes shall be done using the measurement and calculation methods set out in this standard.

In terms of conformity assessment and market surveillance the Eswatini National Standard has largely aligned with the Regional Standard but has also added specifics related to conformity assessment and compliance as well as market assessment. These are further explained in the next sections. The Eswatini national standard has also amended the HEPS of the regional standard by adding a column of R values above 2. This is also explained in more detail in the next section. The Regional Standard also indicates/prescribes the revision period as follows:

“This harmonized standard shall undergo a systematic review once every five years after approval in accordance with the SADC harmonization procedures. In further revisions, if R values higher than 1 are chosen to determine a stringent requirement in maximum annual energy consumption, the equations in Table 4 do not need to be revised. If R=1 indicates the requirement of maximum annual energy consumption, the equations in Table 4 need to be updated by adjusting the coefficients”.

With regard to the Eswatini National Standard it will be revised after 3 years. This also aligns with the adjustment of the MEPS value after 3 years as indicated in both the Regional Standard and the Eswatini National Standard (from R=1 to R=1.25 as the MEPS).It is however also important to note what the South African energy efficiency standard and regulation look like. This is because the vast majority of refrigerators in Eswatini and in SADC are purchased from South Africa (either from imports or from South African manufacturers). South Africa uses a standard called SANS/IEC 62552:2008. Importantly, it is based on the previous version of the IEC standard, namely, the IEC 62552:2007. The standard has been adopted by South Africa with in country modification. Primarily, the modifications related to the addition of Annex A, where the energy efficiency metrics are defined as well as the energy efficiency classes.

South Africa also has a regulator dealing with what it terms compulsory specifications. These are typically specification that relate to equipment that is either critical to people’s safety or in certain cases (such as energy efficiency) performance that is critical to the country as decided by the government. This regulator is called the National Regulator for Compulsory Specifications (NRCS) and it is established under the Department of Trade, Industry and Competition. The NRCS then publishes compulsory specifications, which set out rules for compliance and often refer to the relevant SANS for specific products. For example, the compulsory specification for energy efficiency refers to SANS 941. SANS 941 deals with all types of appliances (e.g. washing machines, refrigerators, ovens, etc.). From there SANS 941 refers to SANS 62552:2008. This is the standard based on the previous (2007) version of the IEC. This means that the compliance in South Africa is based on testing and calculations as listed in the previous version of the IEC 62552 standard [9].

Hence some of the main differences between the standard in South Africa and the Regional standard are:

The South African standard has the following product categories:

- Refrigerators: Cat. 1-6
- Refrigerator-Freezers: Cat. 7

- Freezers: Cat. 8-9
- As well as Multi-use and other refrigerating appliances: Cat. 10

Additionally, energy consumption*:*

- Measured accorded to the old IEC 62552:2007 Household refrigerating appliances -Characteristics and test methods
- Reference ambient temperature : 25°C

It is also important to understand that the testing methodology is different and that the indexes for representing energy efficiency are different. This is critical in understanding that the two standards and the results obtained in each are not interchangeable and cannot be corrected with a factor.

In the previous IEC and the current SANS 62552 the following applies:

Energy Efficiency Index : $I\alpha = AC / SC \times 100$

Where:

- AC: annual energy consumption of the appliance (tested, measured)
- SC: standard annual energy consumption of the appliance (reference, calculated)

In order to calculate SC the following formula is used:

- $SC = M\alpha \times \sum(Vc \times (25 - Tc) / 20 \times FF \times CC \times BI) \times N\alpha + CH$

Where:

- Vc: net volume of the compartment
- Tc: design temperature of the compartment
- Mα and Nα: appliance category specific factors
- correction factors:
- FF: Frost Free
- CC: Climate Class
- BI: Built-in
- CH: Chill Compartment

From these calculations the energy efficiency classes are determined. The South African energy efficiency classes are shown in Table 6 below:

Table 6. Energy efficiency index and corresponding energy efficiency class in South Africa [10]

Energy efficiency index	Energy Efficiency Class
Iα< 22	A+++
22 ≤ Iα< 33	A++
33 ≤ Iα< 42	A+
42 ≤ Iα< 55	A
55 ≤ Iα< 75	B
75 ≤ Iα< 95	C
95 ≤ Iα	D

The current South African MEPS are set on following level:

- Class B for refrigerators and for fridge-freezers
- Class C for freezers

In summary the main differences between the standards are summarised in Table 7 below:

Table 7. Comparison of the SADC and RSA standards

Category	SADC Regional Standard	South African Standard
Test Standard	IEC 62552:2015	IEC 62552:2007
Test ambient temperature	16°Cand 32°C	25°C
Ref. ambient temperature	24°C	25°C
Product categories	3	10
EE Metric	$R=AEC_{Max}/AEC$	Iα= AC/SC x 100
AEC	Different approach for measurement	
AV	Different approach for calculation	
Refrigerant requirements	GWP = 20 (or less) ODP = 0	Not available

Therefore, critically: results with IEC 62552:2015 cannot be easily compared to results according to IEC 62552:2007!

There are a number of reasons for the update of the IEC standard. And significant improvements have been made in the new version. Therefore, it is a positive that the Regional Standard and the Eswatini National Standard are aligned with the new version of the IEC standard. Some of the main differences and advantages are summarised below:

Advantages of IEC 62552:2015 compared to IEC 62552:2007 and main reasons for change:

- Interpolation of any ambient temperature based on tests carried out at 2 ambience temperature (16°C and 32°C)
- Better capture new technical features of modern refrigerators placed on the market
- Factors M and N (see IEC 62552:2007) are derived from a statistical assessment of the linear trends of the commercially available models in 1992 in the 10 categories: outdated
- The correction factors, also unchanged since a long time, were based on a technical assessment of what would be fair compensation for these features. It has been decided:
    - To eliminate the climate correction factor CC completely;
    - To redefine the chill-compensation CH in a fixed part N_{ch} and a variable part (depending on V_{eq}) M_{ch}, which on average equals the current compensation but aims at more correct distribution
    - To redefine the frost free compensation FF to make it no longer dependent on the equivalent volume V_{eq} but to link it directly to the standard annual energy SAE. The value of such a parameter would still need to be established
    - For the Built-in appliances to use different categories and thus also different reference lines (factors M and N or similar).

All parts of the standard have been largely rewritten and updated to cope with new testing requirements, new product configurations, the advent of electronic product controls and computer based test-room data collection and processing equipment:

- For more efficient analysis and to better characterise the key product characteristics under different operating conditions, the test data from many of the energy tests is now split into components (such as steady state operation and defrost and recovery). The approach to determination of energy consumption has been completely revised, with many internal checks now included to ensure that data complying with the requirements of the standard is as accurate as possible and of high quality.
- Now provides a method to quantify each of the relevant energy components and approaches on how these can be combined to estimate energy under different conditions on the expectation that different regions will select components and weightings that are most applicable when setting both their local performance and energy efficiency criteria while using a single set of global test measurements.
- For energy consumption measurements, no thermal mass (test packages) is included in any compartment and compartment temperatures are based on the average of air temperature sensors (compared to the temperature in the warmest test package). There are also significant differences in the position of temperature sensors in unfrozen compartments.
- The energy consumption test now has two specified ambient temperatures (16°C and 32°C).
- A load processing energy efficiency test has been added.

Furthermore, research was conducted on the compatibility of results obtained when testing with the old vs the new versions of the IEC standard and is presented in [11].

The following conclusions are derived from this study with respect to energy consumption:

- For refrigerators (Category 1, 2 and 3) an average increase of 19 % has been found for a large part due to the lower average fresh food compartment temperature in the new global standard.
- For refrigerator-freezers (Category 7) with a single control (type I) a large spread in data has been found. Product adaptations to better match the new global standard are expected but will be limited. By filtering from the analysis those products which will likely be adapted, an average increase in consumption of 19 % has been found.
- For static refrigerator-freezers with multiple controls (type II) an increase of 7 % was found. The new global standard advantages the frozen food compartment which results in this lower increase compared to the refrigerators group.
- For frost-free refrigerator-freezers of type II an increase of 9 % was found. The difference with the previous group is the fact that the energy for defrost is more strongly taken into account in the new global standard.
- For static upright freezers an average reduction of 1 %was found while for frost free upright freezers an increase of 2 % was found. Again the difference can be contributed to different treatment of the energy needed for defrost.
- For the chest freezers an average reduction of 2 % was noted.

Therefore, energy consumption using different measurements is not interchangeable. It is important to note that many countries and regions around the world have been adopting the new version of the standard (IEC 62552:2015). For example, it has been adopted and applied in China, EU, Indonesia, Kenya, Malaysia, and Thailand. This regional standard will also aim to introduce the usage and adoption into the SADC region.

The above would make the new version of the standard is the logical choice. However, one does need to take note of the fact that South Africa has a unique place in the region as the dominant economy and as the housing of the majority of the manufacturers that sell refrigerators in the region. Therefore, it is crucial that South Africa also aligns with the regional drive towards energy efficiency and the move towards the new version of the IEC. Otherwise, there could be significant challenges for both manufacturers based in South Africa and for the importers into the SADC region, exporters from South Africa, wholesalers and chain stores and the general public. There could be a situation where the South African manufacturers would either need to test their product to the South African standard as per the old IEC and then test again as per the new standard for the SADC region or where they lose out on the market due to the excessive costs of this additional testing. This could also lead to shortage of supply for consumers or inflated prices.

Discussions were held with South Africa on a regional level. South Africa has indicated that it is also updating its regulations and aligning with the regional standard in a sense of transition to the new version of the IEC standard and the update of its MEPS. Whether its new MEPS and HEPS will be completely aligned with the regional standard is unknown at this point, however the most important is the alignment with the new version of the IEC. From above one can see that this will mean that the manufacturers will only require one set of testing to be able to supply to the region.

The one challenge is the South African laboratory for energy efficiency testing, housed by the South African Bureau of Standards. It is currently accredited to the SANS 62552:2008 standard, which is based on the IEC 62552:2007 standard. Therefore, it is capable of testing with an ambient temperature of 25° C. Through discussions with the SABS laboratory during this project it was ascertained that the laboratory in its current setup is unable to perform testing at 32° C, as required by the new version of the standard. This has been raised during the meetings with the South African counterparts and investment will be required into the laboratory to

enable it to test to the new version of the standard and get the relevant accreditation. In Eswatini there is the Palfridge laboratory, which is capable of testing at 32° C and as per all of the requirements of IEC 62552:2015, although it does not have the necessary accreditation for that standard due to lack of demand for testing to the new version of the standard as yet. It has however committed to obtaining the required accreditation (by the end of 2022 or early 2023) and as soon as the standards are adopted to allowing external manufacturers to test in its laboratory (under pre-defined conditions of impartiality and confidentiality), which is highly encouraging for the region.

3.2 RECOMMENDATIONS

The Regional Standard has been finalised and it is based on the new version (2015) of the IEC 62552 standard. The Eswatini National Technical Committee for Refrigeration decided to align with the MEPS of the regional standard. The Eswatini MEPS are shown in Table 8 below. They also decided to add one more level in the HEPS. The HEPS for Eswatini is therefore shown in Table 9 below. The reason for this was to encourage manufacturers to pursue higher energy efficiencies. It effectively gives manufacturers a higher target to achieve and to be able to distinguish themselves in a higher sector of energy efficiency. This is particularly important to Eswatini because of its local manufacturer, Palfridge, who will aim to be the first SADC manufacturer to reach the target of R > 2.

Table 8. Eswatini 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

Table 9. Eswatini HEPS for refrigerators

Product Category	Low	Intermediate 1	Intermediate 2	Intermediate 3	High
Refrigerator	1.00 ≤ R < 1.25	1.25 ≤ R < 1.50	1.50 ≤ R < 1.75	1.75 <R ≤ 2.00	2.00 ≤ R
Refrigerator/freezer	1.00 ≤ R < 1.25	1.25 ≤ R < 1.50	1.50 ≤ R < 1.75	1.75 <R ≤ 2.00	2.00 ≤ R
Freezer	1.00 ≤ R < 1.25	1.25 ≤ R < 1.50	1.50 ≤ R < 1.75	1.75 <R ≤ 2.00	2.00 ≤ R

Importantly, the levels of MEPS in particular are attainable by the local and regional manufacturers. Throughout the project and the regional project extensive discussions have been had with the local and regional manufacturers. These are primarily manufacturers based in Eswatini and South Africa. The manufactures in these countries have indicated that they are able to produce refrigerators with an R value of greater than 1 presently. They have also indicated that they are either able to reach the updated R = 1.25 value by 2026 or are even able to reach that value currently. The transition period is important for 2 reasons. The period of 3 years will allow the public to get used to the energy efficiency standard and most importantly the energy label. It will also allow the manufacturers time to prepare both in terms of manufacturing and testing as well as the logistics of compliance with the standard and the label requirements. Furthermore, it is important as it shows that the energy efficiency requirements are going to increase. Therefore, this is not just a once off for the manufacturers but that there is a drive to improved energy efficiency and that this should be embedded in manufacturing methodologies and techniques. This period will also allow the relevant authorities time to perfect their entry point controls and market surveillance methods.

The Eswatini National standard was thus drafted during the Technical Committee Meetings, under the guidance of Eswatini Standards Authority (SWASA). The final version of the standard was decided upon in July 2022. The decision to increase the number of HEPS levels was also due to the readiness of Palfridge to meet currently proposed requirements. By adding another level it encourages Palfridge to attempt to reach an efficiency with R > 2, rather than stopping at R > 1.75. The standard was then sent for public comment. The aim was for this process to take 1-2 months. No technical comments were received. The decision was made by SWASA to await the publishing of the regional standard and then publish the national standard in parallel. This was done in order to awaiti the final version of the regional standard to ensure that there is alignment, in case any changes to the regional standard are made before final publication. The Eswatini National standard itself is voluntary and has no regulatory powers or functions at this stage. The regulation will be drawn up separately to refer to the standard and this is outlined in the next section, dealing with implementation actions.

3.3 ACTIONS

As mentioned above the Eswatini National Standard has been drafted. The standard is currently awaiting the finalisation of the regional standard so that it can be published in parallel. The expectation is that the standard will be published in early 2023. In case any changes are made to the current version of the regional standard a Technical Committee meeting will be convened in Eswatini to assess the changes and whether they should be implemented in the Eswatini National Standard. Thereafter the final version of the Eswatini National Standard will be published. The Eswatini National Standard will then be referred to by the relevant Eswatini regulation related to energy efficiency of refrigerators. The regulation will be developed as part of the implementation of this project and the development of the regulation will be driven by the DoE. Therefore, the regulation will be developed such that it outlines the following:

- Scope of the regulation to align with the scope of the Eswatini National Standard
- Definitions – again aligned with the standard
- Compliance requirements (at this stage reference will be made to the Eswatini National Standard and also the process of the application will be outlined)
- Evidence of conformity – in this section the proof of conformity will be explained, related to accredited test reports and certification as well as the market surveillance process
- Non-compliance – in this section actions against offenders for non-compliance to the regulation will be outlined

The Ministry of Natural Resources and Energy and specifically the Department of Energy (DoE) has undertaken the responsibility of driving the regulatory process. The list of actions with responsibilities is listed in Table 8 below. SWASA will be the owner and administrator of the national standard. The regulation that will be drafted will refer to the standard. This is a very important separation. The two main entities driving the standard and related regulation are therefore SWASA and the DoE. Through discussions at the final PWG meeting the process of the regulation was discussed. The PSC will be formed at the beginning of 2023 to drive the implementation of the project. The DoE will be responsible for the regulation. The technical component of the regulation will be drafted by the DoE and presented to its regulatory committee. Once reviewed by the DoE's regulatory committee the final draft will be sent to the parliamentary regulatory committee for review. The draft regulation will be sent for public comment and the comments taken into account before the final draft is made. The regulation will then be reviewed and if adopted will be signed into law by the minister of Natural Resources and Energy. There could be several iterations of the process as some of the questions related to the regulation may require explanation to the various committees. The possible time for this process is 12 months. This is also helped by the fact that the regulation is aligned with the national energy policy.

This will mean that the regulation related to the standard that has been developed can be finalised in a relatively short time. SWASA is responsible for the administrative tasks related to the national standard. This means the organizing of technical committees, the review of the standard, the formalisation of working groups, if required, to assess certain aspects of the standard (for example if a specific test method within the standard requires review or another technical aspect) SWASA, through the technical committee, will organise a working group with specific skills related to the problem that will be reviewed and discussed and a decision made, which is taken to the technical committee for voting. It is therefore very important to distinguish between the standard and the regulation. The standard is a technical document. It is a document that is reviewed and maintained by technical experts. Therefore, it relates to technical matters such as testing methodologies, the energy efficiency requirements – such as MEPS and HEPS, etc. The regulation is a legal document and as it is related to energy matters and is the responsibility of the DoE, it will be implemented and maintained by the relevant regulator, ESERA. The regulation refers to the national standard but covers other legal aspects, such as requirements for compliance, penalties for non-compliance, etc. The regulation is thus maintained by the regulator and the standard by the technical committee.

Table 10. Actions and Responsibilities related to the Eswatini National Standard

Action	Responsibility	Timeline
Gather comments from the public consultations	SWASA	January 2023
Organise final TC meeting	SWASA	January 2023
Publish final national standard	SWASA	February 2023
Prepare the regulatory framework for EE regulation	DoE	January 2023
Draft regulation (including internal governmental processes and consultations)	DoE	February – August 2023
Send regulation for public comment	DoE	September - October 2023
Review public comments	DoE	November 2023
Publish final regulation	DoE	December 2023 – January 2024
Maintain standard	LSI	Ongoing
Maintain regulation	DoE	Ongoing

The gathering of comments from the public consultations and any changes to the final regional standard will be completed by SWASA once the process is finalised. As mentioned the public consultations were due to finish in October 2022. No comments have been received and SWASA is awaiting the finalisation of the regional standard.

If any changes to the regional standard occur, SWASA will organise a final TC meeting to discuss the changes and adopt the final standard. The standard will then be published by SWASA. SWASA will then be tasked with maintaining the standard, which includes an annual review of the standard, arranging TC meetings if necessary and addressing any potential changes that may occur in standards that the Eswatini national standard refers to. The DoE will drive the regulatory process. This will be done through the regulatory process aligned with the national energy policy. The draft regulation will be made by the DoE's regulatory committee/panel. This will be presented to the DoE and subsequently to the parliamentary regulatory committee. Once the regulation has been finalised through the parliamentary committee the draft regulation will be sent for public comment. Based on the public comments the regulatory committee will meet and finalise the regulation before publishing it. From there the task of maintaining the regulation will be the responsibility of the regulator, ESERA. ESERA will sit on the TC of the national standard and will also be aligned with industry needs. In parallel ESERA will monitor the country's energy efficiency needs and will align the regulation depending on these needs and the impact of the implementation of the regulation. This will be done through the regulatory processes of Eswatini and in consultation with the DoE and the regulatory parliamentary committee.

4 Energy Label

4.1 CONTEXT

As previously outlined the Eswatini National Standard is mostly aligned with the regional standard. The main difference is the additional HEPS level that has been added to drive further energy efficiency improvements in the future. The MEPS are aligned with the regional standard however. This means that manufacturers are able to perform one set of tests per refrigerator type and then use those results to obtain permission to sell refrigerators within the region, including Eswatini. The most important aspect that the public will encounter is the energy label that will be placed on refrigerators being sold in Eswatini. This will be the Eswatini specific energy label. As mentioned in the previous chapter the regional standard has guidelines as to the content of the energy label. The Eswatini National Label has been drafted according to those guidelines. Many label designs have been undertaken in the world. The details of labelling schemes and the choices for the Regional and Eswatini label are outlined in a report specific to labelling that can be found in Appendix A.

Therefore, various experiences from around the world were considered both during the development of the regional label and the development of the Eswatini national energy efficiency label for refrigerators.

The main option for the design was the choice between a dial and a bar type label. Some of the known labels that are either of the bar or dial type are presented below:

Figure 5. Chinese energy efficiency label – bar type

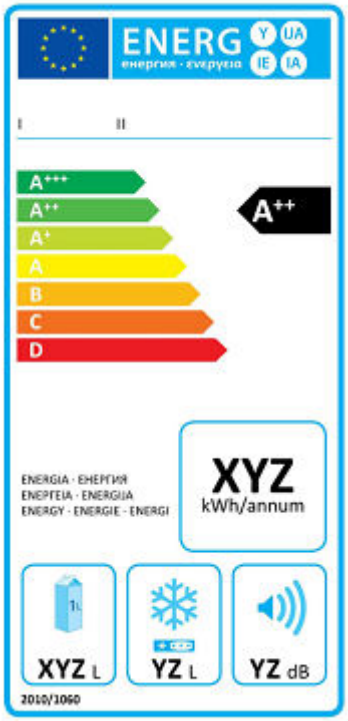

Figure 6. European energy efficiency label – bar type

Some of the dial type labels used in countries around the world are presented below:

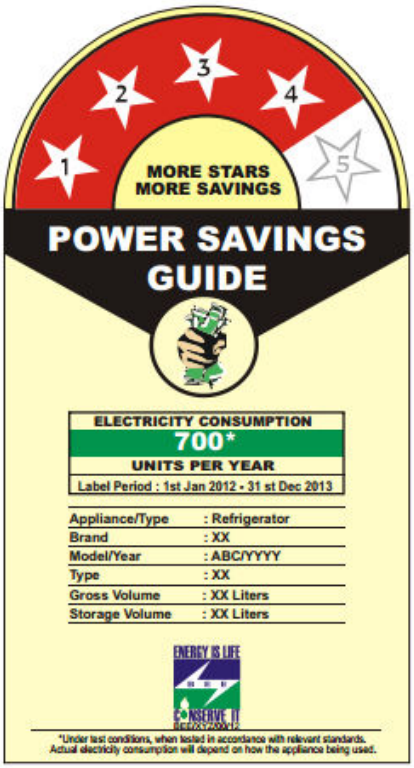

Figure 7. Example of a dial type energy efficiency label

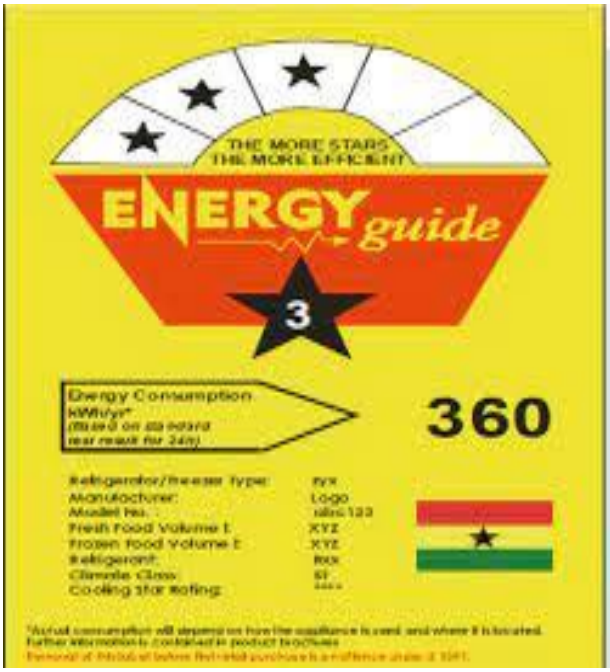

Figure 8. Example of a dial type energy efficiency label used in Ghana

Importantly, in South Africa, during the development of the energy efficiency project the alignment was with the bar label for several reasons. The development of the energy efficiency labels in South Africa was not started with only refrigerators. There were a number of appliances that were included in the project, such as ovens, washing machines, etc. As such research was done on the labels that the South African public had interaction with. There were certain European suppliers that exported appliances to South Africa with the European energy label. Therefore, this was the label type that the South African public had most interaction with. Additionally, the majority of the international consultants that were assisting South Africa with its energy efficiency MEPS, HEPS and labelling programme were from Europe. Thus, they had experience with the European/bar type label and thus the obvious choice for South Africa was to adopt the bar type label.

Since the majority of refrigerators in Eswatini are imported from South Africa and travel through South Africa to Eswatini they also possess the South African Energy Labels. The situation is similar in many of the countries in the region. The South African label has therefore become known in the region and the public has had interaction with it. This was also confirmed in Eswatini during the market assessment study, whereby the public indicated that the only energy label they have seen related to refrigerators is the South African one. Even the local manufacturer, Palfridge, exports the majority of its refrigerators to South Africa and tests to the relevant South African standard and prints the South African energy label for such exports.

The South African energy label for refrigerators is shown in Figure 9 below.

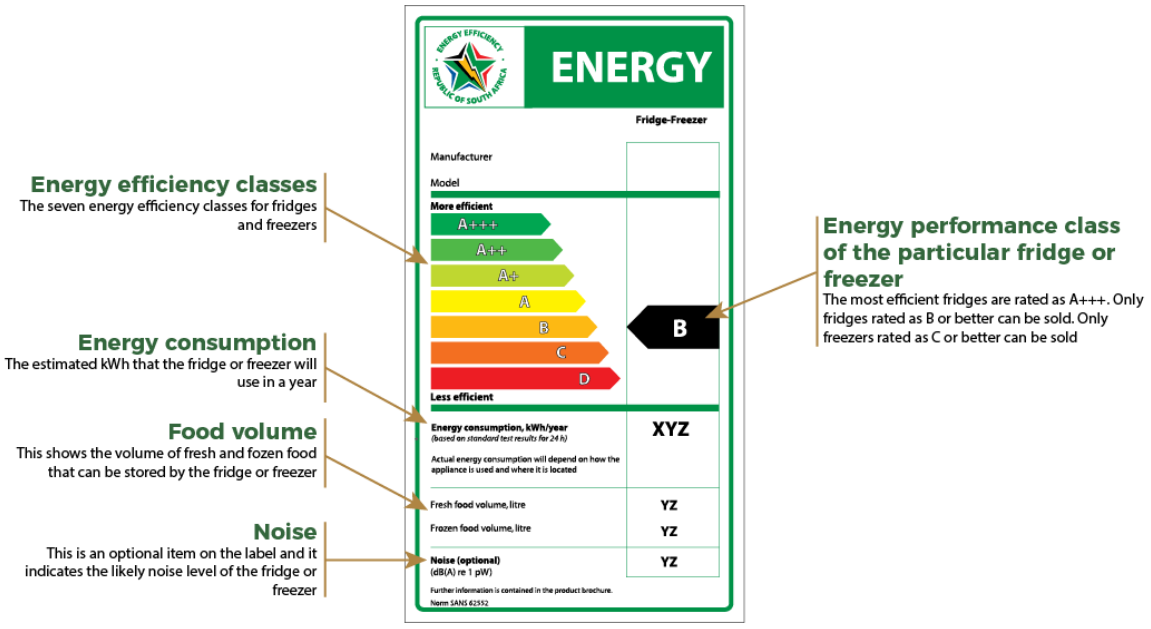

Figure 9. South African energy label for refrigerators – with explanations

4.2 RECOMMENDATIONS

The regional project therefore decided to align with the South African label in terms of design and the majority of the content, and to display the MEPS and HEPS of the regional standard on the label. These were the guidelines provided to the national committees in relation to the label. As mentioned the rationale was to align with the label design that is already known in the region. This would add to the existing knowledge of energy labels on refrigerators and would further assist in the label awareness programmes within the SADC region as there would be uniform in country labels that would be easier to associate with and learn how to use by the public, than if there were several different designs of labels in the region.

In summary therefore, the Eswatini National Label aligns with the guidelines of the regional label as listed previously. It uses the HEPS as adopted in the Eswatini National Standard and it portrays the information required. The Department of Energy in Eswatini will be the custodian of the label as was decided in the Policy Working Group meetings. The draft label has been designed and discussed at the various stakeholder engagements in Eswatini. Based on the feedback the current proposed label is shown in Figure 10 below. As mentioned this label design is currently the final one and will be placed in the regulation. At the time the Department of Energy may make adjustments but has committed to maintaining the regional label guidelines.

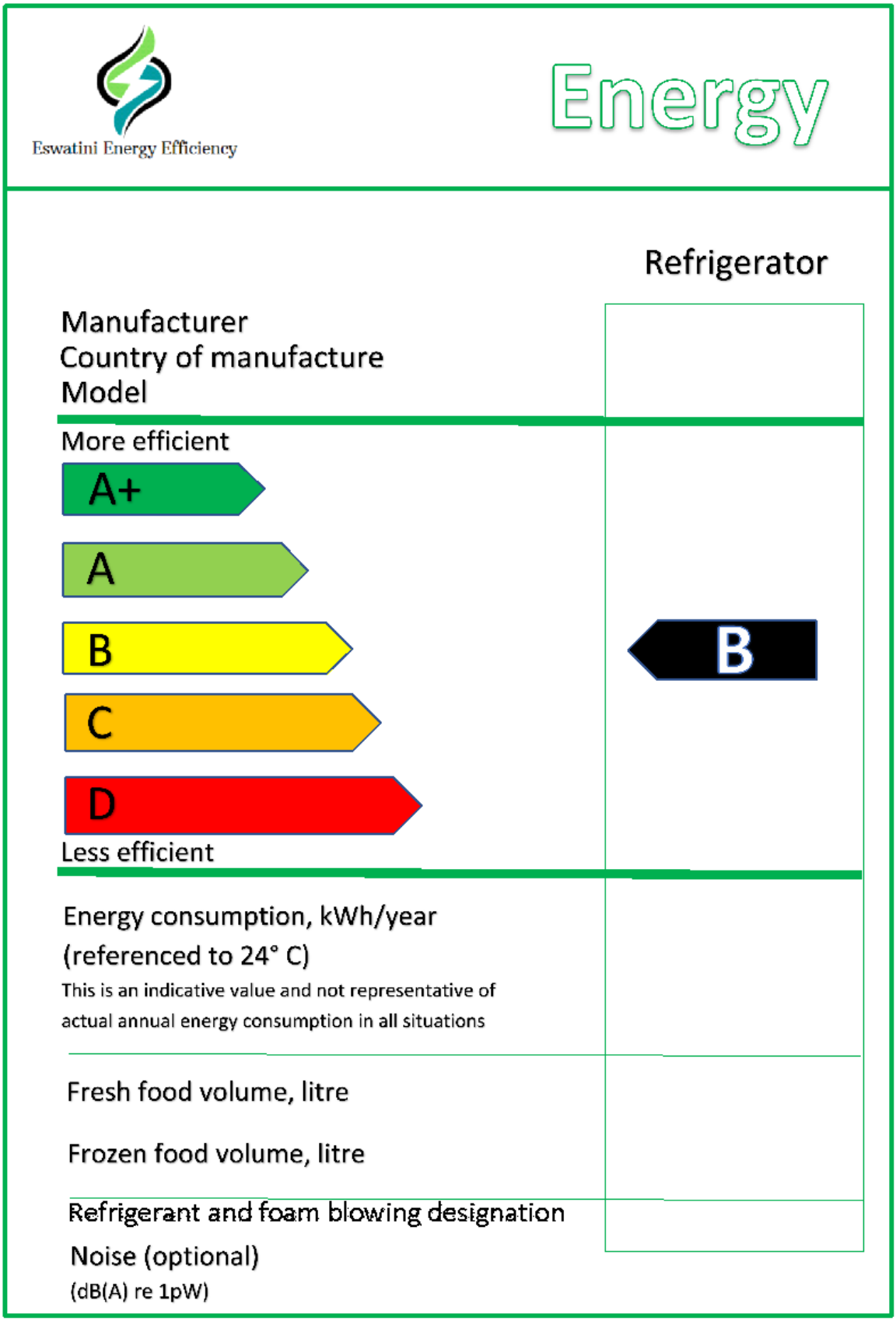

Figure 10. Draft energy label for Eswatini

4.3 ACTIONS

The draft label has been designed and discussed at the various stakeholder engagements in Eswatini. The initial label design was presented at the refrigerator training on the 5th of October. The initial feedback was positive. The DoE agreed to be the custodian of the energy label in Eswatini. The initial energy label contained the Eswatini flag in the top left corner instead of a logo. Through discussions at the meeting it was decided that an energy label logo would be used instead of the flag. The logo was then developed and a revised energy label presented at the follow up meetings. This included the refrigerator training on the 12th of October and 17th of October and finally the PWG meeting on the 20th of October. At this meeting the updated energy label design and logo were discussed and were widely accepted. This label design and in particular the logo design will undergo a final review by the Eswatini PWG that will be formed to implement the project. Once the final label has been discussed and adopted it will be implemented into regulation, or will be referred to in the regulation a described in the previous section. Thereafter, it will also be promoted as part of the consumer awareness campaign.

The decision has already been made that the main parts of the recommended label be adopted and the changes are therefore more cosmetic in nature. The key aspects of the label that are aligned with the regional standard will remain, and Eswatini HEPS values are displayed in the bars on the label. The general label design and dimensions that are aligned with the regional label (and the South African label), the key information such as annual energy consumption and compartment volumes, etc., will remain. As mentioned this will be under the custodianship of the DoE and will be implemented as part of the consumer awareness campaign.

The action plan for the implementation of the energy label is thus as presented in Table 11.

Table 11. Action plan of implementation for the Eswatini Energy Label

Action	Responsibility	Timeline
Review the draft energy label	DoE and PWG	January - February 2023
Finalise label design	DoE	February 2023
Align final label with the regulation	DoE	March 2023
Align final label with the national standard	DoE/SWASA	March 2023
Provide energy label for the consumer awareness campaign	DoE	April 2023
Maintain Energy Label and perform annual reviews	DoE	Ongoing

The draft energy label has already been discussed during the PWG meetings in Eswatini and the national consultations and workshops. The current label design has been accepted thus far. The remaining actions include the final review of the draft label. It has been decided during the PWG meetings that the DoE will be the custodian of the energy label and as such the DoE will perform the final review of the design. Once the final design is accepted the final label will be referred to in the national standard and in the regulation. This final energy label design will also be provided to the respective implementers of the consumer awareness campaign.

The DoE is tasked with the maintenance of the energy label. The energy label will be discussed at the TC of the national standard. If there are any technical changes (e.g. changes in the MEPS or HEPS) these will be communicated to the DoE (the DoE is also a part of the TC). These changes will then be made to the energy label (for example the transition to new MEPS in 2026). Furthermore, any design changes or updates will be the responsibility of the DoE. The DoE is also responsible for the distribution of the energy label for advertising/marketing purposes and other regulatory requirements (e.g. ensuring that the ERS and ESERA have the correct “master copy” of the energy label for use when doing border or market surveillance).

5 MV&E – Key Implementation Points

5.1 CONTEXT

In order for the future Eswatini National Standard and energy label to be done effectively, a well-planned, supported, systematic Monitoring, Verification and Enforcement (MV&E) framework is required. A separate report on the MV&E framework has been developed as part of this project and is available in Appendix A.

The proposed MV&E plan in Eswatini is one that uses regulation for the implementation and enforcement of the MEPS and the energy label. This will create a framework for compliance and ensure that all players in the market are subjected to the same requirements. It will also provide mechanisms for market surveillance and for handling non-compliances. Through having such structures, it is likely that there will be substantial levels of compliance in the market. Having such a system is often beneficial for those market players that are looking to comply and that aim to sell energy efficient products. It is therefore beneficial to such companies and as long as the MV&E structures are implemented it is primarily a negative to the non-compliant companies and those that are looking to bring in inefficient, cheap alternatives. It is also beneficial to the local manufacturer as it provides a structured framework for compliance and for delivering energy efficient refrigerators. For such reasons the market becomes partly self-governing in such a setup as it is suited to compliance. Once such a system is established it also lends itself to continuous improvement. The MEPS in Eswatini are set to increase in 2026, as are those of the regional standard. Furthermore, through public awareness (the implementation of which is part of the MV&E plan) the average consumer will demand higher efficiencies and market forces dictate that these will come as a result of manufacturer's improvements and will eventually lead to increased efficiencies and quality of refrigerator at reduced prices.

There are therefore 3 aspects to the MV&E plan which are equally important with their own role within the framework.

Monitoring –The monitoring that forms part of the MV&E plan relates to the checking energy efficiency of refrigerators. This includes the monitoring of the number of refrigerators that are compliant to the MEPS that have been established and that have the compliant label and of course the number of non-compliant refrigerators and the reasons for non-compliance or rather the type of non-compliance.

Verification – this is the process of checking whether the product in question, a refrigerator int this case, performs as it is required by the standard and the regulation. This includes several processes within the overall procedure. The first is the testing of the refrigerators at the laboratories. Secondly, certain manufacturers may carry product certification for their refrigerator range and this would be another verification process. Finally, the processes of verifying the compliance to the regulations at the border and during market surveillance are also a part of such a process.

Enforcement – this is the process of ensuring that there is compliance with the regulations that will be developed and that there are actions taken against those that are non-compliant. Effectively, it is important to set up the rules of operations and to set up structures for these rules to be implemented but it is equally critical for the rules to be enforced and for the consequences of not complying with those rules to also be enforced.

The next sections outline the final recommendations for the MV&E plan and from the discussions within the PWG and with the Eswatini National Stakeholders an action plan has been developed, with responsibilities for implementation assigned to various entities. Additionally, a preliminary budget for implementation for the next 3 year period has been developed and can be found in the final section of this chapter.

5.2 GOALS AND OBJECTIVES

During the development of the national standard and the process of developing the project many discussions were held related to the implementation of the standard and the project in its entirety. Decisions were made on the most important aspects related to the successful implementation of the project. The following items were discussed in detail and are key to the successful implementation of the project in Eswatini:

- Regulation related to the MEPS and Label
- Development of an energy efficiency label
- Defining the process of compliance with the regulation in terms of country imports
- Defining the process of market surveillance related to the regulation and non-compliance
- Outlining the budget and the financial support required for successful implementation
- Assigning roles and responsibilities amongst the various entities (primarily state owned entities)
- Ensuring an efficient and effective communication amongst the various implementation entities
- Designing and implementing an effective consumer awareness campaign
- Establishing and implementing an effective MV&E plan

In order for the MV&E system to be effective it requires certain general components that are common and applicable to most situations/projects. They would certainly be applicable to the refrigeration MV&E system required for this particular project and the MEPS and labelling scheme. From the items above the most important ones related to a general MV&E plan are summarised below.

1. The PRS system

The product registration system (PRS) is a very useful tool for the establishment of an effective MV&E system. The PRS allows importers to register their products and for the products to be reviewed by a regulatory authority prior to arrival at the port.

2. Ability to perform/review conformity assessment

The PRS allows for applications to be made as per the requirements of the relevant MEPS/national standards/regulation. It is therefore key for the country to have the ability to review the conformity assessment aspect of the application (test reports and/or certification). For the review aspect, experts are required with

experience in the actual testing standards as well as experience in conformity assessment in order to understand accreditation, types of certification, etc. In terms of self-testing (country testing) the test laboratory is a requirement. This can either be its own laboratory or a relationship with a laboratory within the region that can be used for testing products from the market during surveillance or even at application.

3. Market surveillance

Market surveillance is one of the key aspects of an MV&E scheme. The products that enter the market, especially those that are sold to the public, such as refrigerators, require constant monitoring. The monitoring is most effective at sales points (e.g. wholesalers, appliance resellers, etc.). The personnel performing the market surveillance require training on the permits, the labelling and the standard and relevant regulation.

4. Governmental support

The MV&E scheme often requires various governmental entities to be involved and to cooperate on various aspects of its implementation. This could be the collaboration between the standards institute and the regulatory authority in reviewing applications of the PRS, or the market surveillance that may be conducted by the revenue authority and the regulator. Additionally, the PRS applications and permits are required by the revenue authorities at the ports. Therefore, governmental integration and communication is essential. Furthermore, since regulation is required in order to have an effective MV&E plan to implement, governmental support for the driving of the development of such a regulation is necessary.

5. Financial support

Implementation of the MV&E programme requires certain finances. The financial estimates required for the implementation of this project are presented in the remainder of this document.

6. Alignment with the regional movement

In this particular project there is a regional drive towards energy efficiency and this is underpinned by the regional project, referred to in the first section of the NPR. This aids the implementation of the MV&E system as certain aspects of the system, for example the PRS process and the related software system, can be shared to reduce costs. Furthermore, it allows ease of trade within the region and entices more international suppliers as compliance is only required as a once-off for the entire region.

7. Education of the users of the PRS

The education of the importers, manufacturers and wholesalers of the PRS and the application process in particular is critical. Furthermore, it is important that the wholesalers in particular understand the market surveillance process. The buy in from the importers, manufacturers and wholesalers makes the process much smoother. The majority of the compliant importers and manufactures are usually keen to participate in an MV&E scheme as it helps them in their battle against cheap, non-efficient imports.

8. Feasible/attainable and measurable goals

It is also critical that the goals in the evaluation aspects are measurable. An evaluation and monitoring component requires surveillance of the key components of the project in order to understand whether the MV&E system is successful or whether it requires adaptations. For this to be possible it is critical that the goals that are set are reasonable. They need to be attainable but tough and also need to be measurable. They thus need to be specific enough so that they can be clearly measured through a pre-defined method (e.g. survey of households). The ability to prove that the campaign is successful is a strong marketing tool and has the ability to further drive momentum within the public. Additionally, it shows that the implementation was well planned and executed and that the system works, which can provide further funding for other, similar projects in energy efficiency. If the results are less than satisfactory and goals are not met the accurate evaluation of performance allows for specific targeted improvements to be made, which are most effective.

Non-compliance

Even though the compliance methodology is set up through the various policies and regulation, it is also key to the success of the MEPS and labelling, and hence the overall impact on energy savings, that non-compliance with the processes is dealt with. Non-compliance can occur in different forms. It can be unintentional through the loss of the label for example at the store and hence for it not to be available at the refrigerator, or for the labels to be swapped between refrigerators. It can also be intentional, for example the printing of a new label with a higher efficiency rating by the store in order to try and sell their product as more energy efficient.

The regulation that is related to the MEPS needs to enable implementation of penalties for non-compliance. It also needs to establish non-compliance penalties. These are often risk based approaches and severity of penalties depending on intention of non-compliance, the impact it has and the repeatability. For example unintentional swapping or loss of energy labels at the store can lead to a warning. Intentional forging of the label can lead to monetary penalties and repeat offences of the same nature can lead to suspension of the trading license combined with monetary penalties.

5.3 MEASURES AND ACTIONS

In order for the future Eswatini National Standard and energy label to be effective, a well-planned, supported, systematic MV&E framework is required. Therefore, the next section outlines the final recommendations for the MV&E plan and from the discussions within the PWG and with the ESwatini National Stakeholders an action plan has been developed, with responsibilities for implementation assigned to various entities. Additionally, a preliminary budget for implementation for the next 3-year period has been developed and can be found in the final section of this chapter. The main, general components of the MV&E plan have been outlined in the previous section and the specific details related to implementation in Eswatini are described in more detail below.

5.3.1 COMPLIANCE PROCESS

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 Eswatini. This section outlines the process that was chosen for Eswatini. It must be stressed that this process is not currently implemented in Eswatini 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

The breakdown of each of the processes above is as follows:

5.3.1.1 Application

The application is performed by either the manufacturer or the importer of the refrigerators into Eswatini or the Eswatini based manufacturer. The application is performed on the specific Eswatini governmental internal platform. This is an existing platform in Eswatini (Asequoia World), which allows access to the information to be shared between various departments. Eswatini does have the PRS that is currently used for other commodities, primarily water. The ERS is able to access the required information in this case off the system and use it for port inspections. The ERS therefore has the ability to retrieve the information at the ports and use it to process its border controls. The system however requires modification. For this application purpose the application would be sent to ESERA. The information would also be visible to the Department of Energy (in case there is a need to oversee the process in the future) and to the ERS. The information that the manufacturer/importer needs to supply is the basic information related to their company (name, contact details, address) and information related to the refrigerator (model, type, volumes, etc). In addition, the applicant needs to supply the proof of compliance (test report or certification and a test report) for the refrigerator in question as well as a sample of the label that will be used. All of these documents can be submitted electronically on the platform. The review would be

performed as below and the information for the review will also be available to SWASA for assistance with the proof of compliance.

5.3.1.2 Application Review

The SWASA and ESERA assessors then receive the application and check the following:

- That the test report and/or certification is from an accredited facility (SWASA to perform)
- Checks the energy consumption on the test report and compares it to the energy consumption on the label (ESERA and SWASA to perform)
- Checks the R value as per the outcome of the test report and compares it to the level (bar) of energy efficiency on the label (ESERA and SWASA to perform)
- Checks that all of the information related to the refrigerator is correctly listed on the label (e.g. model, type, volumes, etc.) (ESERA and SWASA to perform)
- Checks that the energy label contains all of the required information (consumption, model, manufacturer, volumes, etc.) (ESERA and SWASA to perform)

The ESERA assessors would be trained in the assessment process. The SWASA and ESERA representatives were involved in the workshops and the training in this project and would be able to further disseminate the training within their organisation.

5.3.1.3 Issue of permit

If all of the information and all of the checks listed above are positive, the ESERA assessor then issues the permit to the applicant. If not a rejection (with reasons) is sent to the applicant. The applicant is then allowed to resolve the issues and re-apply. The successful applicant then has the permit that they would need to submit to the ERS prior to the arrival of the refrigerators at the border or prior to releasing the refrigerators into the market in the case of Palfridge (and any other local manufacturers in the future). The successful permit is also loaded onto the system by the ESERA official and the ERS now also has access to this permit on the system (and can access it remotely/electronically).

5.3.1.4 Submission of permit and label

The applicant (manufacturer or importer) is now in possession of a permit. The importer usually submits documentation to the ERS prior to the shipment arriving at the port. In the case of Palfridge they send the permit to the retailer that will be selling their refrigerators. With these documents they are also required to submit the permit received and the label design. They are also informed that it is good practice for the transporter to also have copies of these documents with them when arriving at the border post. Therefore, the permit and the label will be on the system and the transporter will also have the documentation with them when arriving at the border post for inspection. Similarly, Palfridge would supply the reseller the permit and the label and relevant documentation.

5.3.1.5 Inspection at the border

The ERS officials inspecting the shipment would have a task of verifying the information against the physical evidence. The aim of the process described above was to enable the ERS inspectors to be able to carry out this task with efficiency and simplicity. They therefore do not need to check the test reports or deal with technical matters related to energy efficiency of refrigerators. They would receive the permit from the importer (and can also verify this permit against the one on the system if they decide to). They need to check the following:

- That the physical refrigerator model and manufacturer match the one on the permit and the one on the label
- That the permit is still valid and that it is compliant (that the R value on the permit is above 1.00 – MEPS has been reached)
- That the R value on the permit matched the HEPS level on the label (e.g. if the permit indicates an R value of 1.3 that they confirm that the label indicates a C class refrigerator)
- That the rest of the information on the label matches the permit and is on the actual label (e.g. volumes, energy consumption)

If the above checks are successful the shipment is allowed to proceed. If they are not the shipment is detained until either the error is rectified (if it is a small error – e.g. small error on the label, which can be resolved quickly) or the shipment is returned to the sender for rectification. The ERS has its own well-established set of rules of dealing with these situations, including quarantine areas at border posts, etc. Therefore, these actions related to post inspection are not to be altered and the usual ERS processes will follow.

5.3.1.6 Market Surveillance

The above outlined system is likely to create a situation whereby a significant number of refrigerators within Eswatini are complaint with the regulation. However, there are still areas and methods through which non-compliant refrigerators and labels may find themselves on the shop floors and in people's houses. Some of these could be:

- Passing of certain non-compliant refrigerators through the border. The intention is for the ERS to inspect as many refrigerator shipments as possible. They also have a system whereby certain flagged commodities are highlighted for more stringent and regular inspection. The ERS have indicated that they will flag refrigerators for such inspections, especially in the first 12 months after the passing of the regulation – and that this will be assessed thereafter. However, even with all such systems and with the efforts of the border post personnel certain refrigerators will make it through the border that are non-compliant, as no system is 100% effective.

- The replacement of energy labels at the points of sales or warehouses. The refrigerators may pass through all of the checks with the correct labels and these labels may match the requirements and the refrigerator. However, the labels may be replaced by more efficient ones in order to increase the probability of sale. For example, a refrigerator may have an R value of 1.1. It would thus have a D level of energy efficiency on the energy label. Once in the shop the label may be replaced by a B level one, with all other parameters on the label being kept the same, in order to increase the possibility of sale and to enable the retailer to increase the sale price of the product.

- The mistaken or erroneous loss of label or misplacement of the label. In this instance the label on the shop floor or in the warehouse may be placed on the incorrect refrigerator (for example the labels of two refrigerators may be swapped by mistake). Additionally, the label may get lost during transport or during the moving and positioning within the store or warehouse.

These are the main possibilities of non-compliance at a store or warehouse, although some other mechanisms could exist. Importantly, there will be instances where there is non-compliance at the stores. For this reason it is imperative that there is market surveillance performed to reduce this risk and mitigate for its impact on the consumer and the consumer trust in the process. If there is no market surveillance the system gets abused in a very short time. As mentioned, once the process of bringing the refrigerators into Eswatini has been completed they would either be stored in warehouses or shop floors awaiting purchase. During this time market surveillance would be performed. Market surveillance would also be performed on Palfridge refrigerators that are stored at the factory prior to release to the market. The market surveillance would be performed by ESERA inspectors. However, the ERS would also be available to assist with this task. Between them (and through coordination of information and resources) market surveillance would be conducted. The assigned inspector would go to the specific warehouse or store and randomly inspect the refrigerators. The inspection would not consist of all of the refrigerators in that particular location but rather a random sample size (typically 2 to 3 refrigerators per site).

The inspector may choose to extend their sample size, especially if anomalies or non-compliances are discovered. The inspectors would perform checks that are very similar to those performed at the border posts by the ERS personnel. Therefore, the inspectors would check that the refrigerator on the shop floor or in the warehouse has the correct permit and energy label, and that it aligns with the permit and energy label. Hence, the inspector would check:

- That the physical refrigerator model and manufacturer match the one on the permit and the one on the label
- That the permit is still valid and that it is compliant (that the R value on the permit is above 1.00 – MEPS has been reached)
- That the R value on the permit matched the HEPS level on the label
- That the rest of the information on the label matches the permit and is on the actual label (e.g. volumes, energy consumption)

As long as these market surveillance exercises are performed regularly the probability of non-compliance decreases drastically. This is because the possible offenders are aware that inspection is possible and probable and are less likely to attempt to manipulate the system, especially if there are repercussions. This infers that the manner in which non-compliance is dealt with is also critical.

5.3.1.7 Dealing with non-compliances

In order to have a successful implementation of the project there is a need for the Eswatini governmental entities to be able to deal with non-compliances and with offenders. Having all of the systems in place to check compliance at points of entry and at the market is completely necessary and an excellent practice. However, it is not very useful if the regulation does not allow for punitive measures to be taken against offenders. Many measures were discussed during the project, at PWG meetings and NPR workshops on the 12th, 13th, 14th, 17th, 19th and 20th of October. The decision for implementation in Eswatini was that of a phased approach of measures to be taken against offenders. These measures would depend on the severity of the offence and the number of offences caused by the specific entity. Therefore, repeat offenders would be punished more severely. The approach is to have the following system of measures in place:

- Warnings: These would be given as a first step in the punitive process. The warnings would typically be given to first-time offenders and to less severe offences (e.g. lost label as opposed to a counterfeit label)
- Fines: Fines would be imposed in stages on repeat offenders. Fines would vary per criteria such as frequency of offences and severity of offences. The exact fines have not been decided on as yet and will be decided on during the finalisation of the regulation.

- Quarantine of product: This option would be used as one that would occur in very severe circumstances. It would only be used for repeat offenders and for extremely serious offences. Under this measure the section of the shop or warehouse that houses and sells refrigerators would be sectioned off and would be prevented from operating. The remaining shop or warehouse would be able to continue operating as usual. The quarantine would last until the problem is resolved.
- Suspension of operation: this would be used as a final resort only. It would mean that the particular operator would be suspended from operating its business until the problem is rectified or for a specific period of time as punishment for extreme repeat offenses.

In order for the above-mentioned recommendations to be put into practice a clear plan with set areas of responsibilities is required. The following is the current outline of responsibilities within the Eswatini state owed entities:

- ERS – Inspection of refrigerators at ports, assistance to ESERA in terms of inspection of manufacturer/resellers/dealers/wholesalers as well as confiscation of non-compliant products
- DoE – Drive the development of the regulation and ensure alignment with the National Energy Policy
- ESERA – Drive the development of mechanisms to enforce the regulation that will be developed. Regulatory aspect of compliance –therefore the application process handling, issuing of permits and verification of compliance. Additionally, the market surveillance process would be the responsibility of ESERA with support from the ERS
- SWASA – Development and maintenance of the national standard and assistance with the verification of conformance of the application/product

These are the roles and responsibilities related to the main processes that are required to be implemented as listed above. Therefore, in order for the full MV&E process to be successfully implemented there are 2 main phases of implementation and action. The first is the development of the system of implementation and the second is related to the responsibilities of ongoing implementation and monitoring.

The implementation actions have been discussed in the previous sub-section. The monitoring process is also critical to the long-term successful implementation of the project. The monitoring process methodology is as follows:

- Define what needs to be monitored
- Define goals
- Define timelines
- Define monitoring processes for each main section with responsibilities

Therefore, following from the outline above, the following process is to be followed as part of the monitoring aspect of the MV&E plan.

Aspects that require monitoring:

1. Implementation of the application IT System
2. Training of relevant personnel
3. Purchases of refrigerators above the MEPS value of energy efficiency (C and above)
4. Energy consumption savings in households

Goals

1. Implement the IT system for the application process by May 2023
2. Finalise employment of additional resources if necessary within ESERA and the ERS by June 2023
3. Train at least 5 resources at ESERA in application reviews and market surveillance by May 2023
4. Increase in purchases of energy efficient refrigerators by 30% in year 2
5. Increase in energy efficiency savings in households by 5% in year 2

From the outline above, he actions, with responsibilities, timelines and verification methods are listed in Table 12 below.

Table 12. Actions, responsibilities and timelines of an MV&E Plan

Action	Responsibility	Timeline	Method of verification
Development of the application system – linking it with Eswatini national IT system and enabling it for usage for market surveillance	ESERA	March 2023	Check of IT system by another party (ERS)
Assessing whether additional resources will be required for the processing of applications and making necessary appointments	ESERA	February 2023	Payroll and organogram
Training of personnel on the processing of applications	ESERA	May 2023	Training certificates, register of attendance
Training of personnel on the border controls	ERS	April 2023	Training certificates, register of attendance
Training of personnel on the market surveillance procedure	ESERA	May 2023	Training certificates, register of attendance
Energy efficient purchases of refrigerators	June 2025	Surveys at shops, consumers	ESERA
Energy savings of 5% for consumers	June 2025	Consumer surveys	ESERA

An overall budget for the implementation of the project has been developed. This budget includes the MV&E plan and its activities and is presented in section 8 of this report.

6 Consumer Awareness

6.1 CONTEXT

Even though MEPS will be regulated, the main driver of the improvement in energy efficiency is the consumer (especially in capitalist economies such as Eswatini). Therefore, the introduction of MEPS into regulation will ensure the minimum level of energy efficiency that has to be met but full buy-in to the concept of energy efficiency from the public through consumer awareness campaigns will ensure that the market forces continuously demand higher energy efficiency. This is the aspect which will drive the improvement of energy efficiency in refrigerators and will increase the HEPS levels of average refrigerators being sold in the shops.

In order for the consumer to be able to drive energy efficiency in the manner described above they first need to completely understand the benefits of energy efficiency. In terms of consumers there are 2 main aspects of energy efficiency of refrigerators that they are concerned with. These are:

- Cost saving
- Improvement of environmental effects

Therefore, if a consumer awareness campaign can highlight how buying energy efficient refrigerators can assist with the 2 points above there is an excellent chance that the consumer behaviour will significantly change towards the purchasing of energy efficient refrigerators.

The detailed consumer awareness campaign outline/plan and report has been compiled separately and is also available in Appendix A of this report. The consumer awareness report is critical to the success of the project.

This is because successful implementations globally require an implementation of both supply-side and demand-side interventions where the latter focus on educating a consumer and changing both purchase and energy usage behaviour. This is why setting of MEPS is advised to be accompanied by, among others, introduction of energy efficiency labels and broader educating campaigns, as is the case in this project (CTCN, n.d.) [12].

The purpose of communication activities is usually to increase consumer awareness on the differences in energy consumption, costs, and benefits between appliances on the market; while educating activities usually aim to educate consumers about the characteristics, costs, and benefits of the energy-efficient product [12]. All of these pursue one purpose – to change the purchase behaviour of the consumer in favour of a more energy efficient appliance.

An example of an effective awareness campaign and the steps required is presented in Figure 11 below.

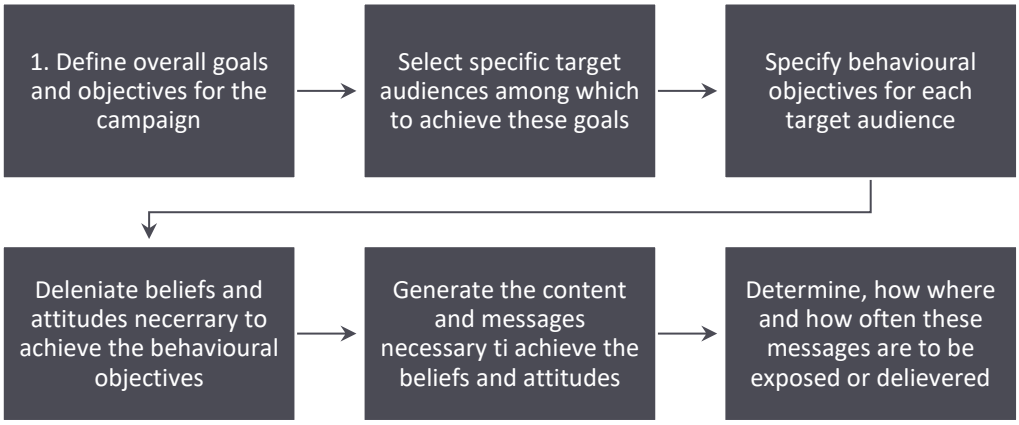

Figure 11. Awareness raising campaign planning process (adapted from [13])

Based on the processes outlined above and the successes of the consumer awareness campaign implemented in South Africa and the lessons learnt, the main process of a consumer awareness campaign development and implementation is proposed as such:

1. Stakeholder analysis
2. Development/identification of targeted audiences
3. Identification of objectives of the consumer awareness campaign
4. Development of messages for the targeted audiences
5. Identification of communication tools to be used for the specific audiences
6. The implementation plan of the consumer awareness campaign
7. The monitoring and evaluation plan of the consumer awareness campaign
8. The overall draft budget for the consumer awareness campaign

Based on the process described above the following recommendations are prepared for Eswatini.

6.2 RECOMMENDATIONS

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Stakeholder analysis

Based on the market assessment the following entities have been identified as the most important stakeholders in Eswatini in relation to refrigeration.

Table 13. Key stakeholders for the consumer awareness campaign for refrigeration in Eswatini

Entity	Role in relation to the MEPS project	Responsibility
Ministry of Natural Resources and Energy	Driver of the MEPS development and implementation Formation of energy related initiatives Lead facilitator in the formulation and or updating of relevant Policies and regulations as required	Campaign champion (provision of vision and action plan, coordination of work of all entities involved)
Ministry of Tourism & Environmental Affairs	The support ministry to the Ministry of Energy in this project Can facilitate governmental support for legislation and implementation support	Develop and maintain printed materials for the campaign Develop radio and TV advertisements and infomercials
Eswatini Environmental Authority	Drive and enforce environmentally related policies (e.g. types of coolants in refrigerators) Assist in training of repairers on coolants and energy efficiency	Develop material for training of repairers and perform training Develop material for training of resellers and perform training
Eswatini Electricity Company	The main buyer and user of distribution transformers. 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	Electricity usage data source
Central Bank of Eswatini	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	Provision of funding for the campaign Provide support for funding mechanisms (e.g. guarantees for loans)
Eswatini Revenue Authority	Inspection/approval of imports of refrigerators and transformers into the country	Targeted audience for knowledge on refrigerator MEPS Targeted audience for knowledge on transformer MEPS
Eswatini Standards Authority	Information on standards of refrigerators and transformers	Provision of information and fact on MEPS for refrigerators and transformers Development of training material Conducting training workshops for sales personnel and repairers
The University of Eswatini (in particular the Center for Sustainable Energy Research)	Perform relevant research that informs national energy policy for sustainable development	Provision of technical support in Monitoring an Evaluation of the campaign Collecting data during and after campaign Analysis of key metrics to inform further changes required to the campaign Development of training material in partnership with Eswatini Standards Authority Conducting training workshops for sales personnel and repairers in partnership with Eswatini Standards Authority

Private sector (Manufacturer – Palfridge)	Technical inputs from experience related to design and costing Input related to testing capabilities and cooperation (as one of only two laboratories for refrigerators in SADC)	Provision of technical support in standard development and maintenance Provision of technical inputs in training material Conducting training workshops related to standard and testing

It is then important to identify the target audiences as related to refrigerators MEPS, HEPS and Energy Label. These are presented in Table 14 below.

Target Audiences

Table 14. Target audiences for the Eswatini refrigeration consumer awareness campaign

Entity	**Role in relation to the MEPS project**	**Responsibility in relation to the awareness raising**
Households	Users of refrigerators	Targeted audience for change in purchase and use behaviour of refrigerators
Businesses operating from residential premises, using residential refrigerators	Users of refrigerators	Targeted audience for change in purchase and use behaviour of refrigerators
Retailers (local and large international)	Resellers of refrigerators	Targeted audience for knowledge about refrigerator MEPS Means of communicating the information/educating end-users
Regional buyers for large international corporations (South Africa-based)	Procurement of refrigerators for international corporations operating in the country	Targeted audience for MEPS requirements for refrigerators
Repair centres and technicians	Repairers and resellers of second-hand refrigerators	Targeted audience for knowledge about refrigerator MEPS Means of communicating the information/educating end-users
Financial Institutions	Lenders supporting the implementing of energy efficient appliances	Targeted audience for knowledge about refrigerator MEPS
Eswatini Revenue Authority	Inspection/approval of imports of refrigerators into the country	Targeted audience for knowledge on refrigerator MEPS and customs approvals

Objectives and Goals

The objectives of the public awareness campaign for refrigerators are to educate the target audiences listed above as to the importance of energy efficiency and its application to refrigerators in Eswatini.

Considering the above general objectives, Table 15 below outlines the targeted audiences and the key objectives of the public awareness campaign that reflect the change desired to be achieved through it.

Table 15. Targeted audiences and objectives of refrigerator awareness campaign

Targeted audience	Key objectives and desired changes
Households	• Change the attitude towards energy saving among all households • Achieve a high level (>66%) of awareness regarding new energy efficient standard for refrigerators among electrified households • Achieve a high level (>66%) of knowledge and understanding of energy label for refrigerators among electrified households • Achieve a high level (>66%) of initiative when purchasing refrigerators in favour of more energy efficient appliances
Small businesses operating from residential premises	• Change the attitude towards energy saving among all households • Achieve a high level (>66%) of awareness regarding new energy efficient standard for refrigerators among electrified households • Achieve a high level (>66%) of knowledge and understanding of energy label for refrigerators among electrified households • Achieve a high level (>66%) of initiative when purchasing refrigerators in favour of more energy efficient appliances
Retailers: sales personnel	• Change the attitude towards energy saving • Impart knowledge regarding new energy efficient standard for refrigerators on consumers • Educate consumers on energy label for refrigerators • Educate consumers on long-term benefits of purchasing more energy efficient refrigerators
Repair services/second-hand shops	• Change the attitude towards energy saving • Impart knowledge regarding new energy efficient standard for refrigerators on consumers • Educate consumers on energy label for refrigerators • Educate consumers on long-term benefits of purchasing more energy efficient refrigerators

Messages for the targeted audiences

Given the different objectives outlined in the previous section, the following table list the messages that should be promoted to achieve the desired change in knowledge and behaviour among various groups of stakeholders:

Table 16. Key objectives and associated messages for refrigerator awareness campaign

Key objectives and desired changes	Messages
Change the attitude towards energy efficiency among all households	• Energy is scarce resource that needs to be conserved • Eswatini consumers are under pressure – lets reduce our energy costs by becoming more energy efficient • Saving energy today will ensure it is available to future generations • Being energy efficient is easy – just make a right choice
Achieve a high level (>66%) of awareness regarding new energy efficient standard for refrigerators among electrified households	• The new energy efficient standard protects against energy waste
Achieve a high level (>66%) of knowledge and understanding of energy label for refrigerators among electrified households	• The energy label makes choosing the more energy efficient refrigerator easy • Look for an energy label on a refrigerator and empower yourself to manage the costs associated with refrigerator usage
Achieve a high level (>66%) of initiative when purchasing refrigerators in favour of more energy efficient appliances	• Save money in short and long-term by buying a more energy efficient refrigerator • Reduce your electricity bill by buying a more energy efficient refrigerator
Impart knowledge regarding new energy efficient standard on consumers	• "Can I help save you more money on a refrigerator today?" • "Can I give you advice on saving energy?"

Key objectives and desired changes	Messages
Educate consumers on energy label	• "Have you seen the new energy labels that refrigerators come with?" • "Do you know the higher the rating means the greater savings on electricity bill?"
Educate consumers on long-term benefits of purchasing more energy efficient refrigerators	• "Do you know how to reduce your monthly electricity bill by buying a more energy efficient refrigerator?"

Communication Tools

Given that we have identified the target audiences for the various messages I enables us to identify specific communication tools to effectively reach those audiences. These tools are shown in Table 17 below.

Table 17. Targeted audiences and communication tools for regurgitator awareness campaign

Targeted audience	Communication tools
Households	• Radio broadcasting (through Eswatini Television Authority) • TV infomercials (through Eswatini Television Authority) • Posters (distributed by Department of Information and at various retailers, Postal Services) • Article and infomercials in the national newspaper (through Department of Information) • Website page • Social media
Small businesses operating from residential premises	• Radio broadcasting (through Eswatini Television Authority) • TV infomercials (through Eswatini Television Authority) • Posters (distributed by Department of Information and at various retailers, Postal Services) • Article and infomercials in the national newspaper (through Department of Information) • Website page • Social media
Retailers: sales personnel	• Training on energy labels and standards for refrigerators • Posters
Repair services/second-hand shops	• Training on energy labels and standards for refrigerators • Posters

In addition to the above general communication channels and means, the efficiency of the public awareness campaign could be enhanced by introducing a competition with an award programme that can encourage and motivate households and small businesses operating from residential premises to accelerate their knowledge uptake and change in purchase behaviour. Some of the ideas for such competitions include:

- Lottery with a monetary reward or a voucher for those who have purchase an energy efficient refrigerator during a specific period;
- Lottery among those who have registered on a mobile app and provided their information on the current usage (has to run for a specific period of time);
- Competition among schools on topics of energy efficiency and costs savings with monetary or voucher reward.

Since the recommendations have been outlined the following section identifies the actions that are to be taken to implement the consumer awareness campaign and outlines the responsibilities for implementation.

6.3 MEASURES AND ACTION

Table 18 outlines the key actions required for the implementation of the campaign and the associated timeframes. The timeframes for implementation and the parties responsible have been outlined in Table 18. The specific actions are further explained below.

1. Securing funding. This is a role of the PWG members that will be assigned to the consumer awareness campaign and any other members that will be co-opted for this task. The funding will be obtained as part of the funding for the overall implementation of the project. Approaches will be made to Eswatini's governmental institutions, including the DoE as well as international bodies such as the GCF. The amount of funding obtained will dictate the number of activities and the extent to which they can be implemented.

2. Establishing a baseline. The majority of this task have been completed during the market assessment study. However, a review of the gathered data will be performed and any additional data gathered if gaps are identified or if a larger sample is required for specific data.

3. The Project Steering Committee (PSC) will be established in order to implement certain tasks and ensure the consumer awareness project plan is followed. The PSC needs to comprise the representatives of the key stakeholders. The TOR needs to define the roles and responsibilities of the PSC in relation to the campaign

4. Research specific to the messages of the consumer awareness campaign will be conducted. In this process the best way of presenting these messages will be discussed. This information should assist with refining the selection of communication material to be developed and communication tools to be used during the campaign, as well as the most effective type of training to be offered to sales personnel at retail stores and repair service providers.

5. The messages that have been developed will then be discussed within the PSC and refined until final agreement. This is important as the messages that go to the public need to be fully agreed upon as changes to the messages during the awareness campaign can cause confusion and distrust.

6. The development of the final material will include all of the final editing, printing, recording, etc. It will also include the translation of the material into the languages decided upon for roll out within the different regions. The type of communication material will need to be decided considering the funding available and the data gathered during information research.

7. Once the material has been developed discussions will be held with the relevant authorities related to the material to get buy in. this will include communications regulators as well as relevant ministries and consumer protection agencies.

8. The sales personnel and repairers will be trained on several aspects. These will include energy efficiency, the Eswatini national standard and the related MEPS and HEPS as well as the Eswatini energy label. They will also be trained on the importance of energy efficiency in terms of environmental impact and the cost savings on electricity that can be accrued by the consumer purchasing more efficient refrigerators.

9. The roll out of communication material will be done. This is an integral part of the consumer awareness campaign and includes the publishing of all of the print material and its distribution. The roll out of TV and radio commercials, the issuing of brochures and the posting of posters and other marketing material.

10. The monitoring of the consumer awareness campaign's success is highly important in order to understand its impact and effectiveness. This will also provide insight into whether modifications to the consumer awareness campaign are required. The details of the monitoring are presented further in this section.

11. Based on the results of the monitoring certain aspects of the consumer awareness campaign may need to be updated. For example a younger segment of the population may not be as aware of the energy efficiency impact and the energy label for refrigerators whereas the over 50's segment may be very well aware. This could point to a successful print media campaign but a less than successful social media campaign, which may require updating.

12. The consumer awareness campaign is a lengthy process with several stages. After the first implementation an evaluation of impact will be performed and then a revised campaign implemented in all likelihood. Since this process is lengthy it requires management and maintenance and this is responsibility of the DoE, working with the PSC.

Table 18. Targeted audiences and communication tools for refrigerator awareness campaign

	Action	Timeframe	Responsible party
1	Secure funding for the public awareness campaign	nuary – February 2023	Ministry of Natural Resources and Energy
2	Establishing a baseline (collect additional data to the one gathered for the study)	ebruary – March 2023	The University of Eswatini (in particular the Center for Sustainable Energy Research)
3	Set up a Project Steering Committee (PSC) comprising of relevant stakeholder groups and develop Terms of Reference for it	January 2023	Ministry of Natural Resources and Energy
4	Undertake informative research to inform the development of awareness and education materials	arch – April 2023	Ministry of Natural Resources and Energy
5	Workshopping messages within the PSC	April – May 2023	Ministry of Natural Resources and Energy
6	Development of communication material, including: • pre-launch testing • translating these into the required languages	May – July 2023	Project PSC
7	Engaging with relevant authorities and entities to obtain their buy-in for the roll out of the communication campaign	ne – August 2023	Project PSC

	Action	Timeframe	Responsible party
8	Training sales personnel and repairers	gust – September 2023	Contracted party
9	Roll out communication material	eptember 2023 – June 2024	Ministry of Natural Resources and Energy
10	Monitor and evaluate the success of the campaign	uly – December 2024	Ministry of Natural Resources and Energy
11	Adapt the messages and communication means based on feedback received from the evaluation	nuary – February 2025	Project PSC
12	Develop a maintenance plan	February 2025	Ministry of Natural Resources and Energy

Monitoring and Evaluation is an integral part of any project, programme or campaign for that matter. It aims to provide an insight into whether the campaign is on course to achieves objectives, which in turn allows one to adapt its execution if any gaps or challenges are identified. Table 19 provides a list of indicators that could be used to monitor the progress of the campaign and to evaluate its success after its completion.

Table 19. Monitoring and evaluation indicators for refrigerator awareness campaign

Measured output/outcome	Means of gathering data / tools	Frequency of data gathering	Sample
Attitude towards energy saving	Survey at the point of sale	On-going at the point of sale	• Households – different income group and in rural and urban areas • Sales personnel at retail stores • Repairers
	Survey (in person / telephonic)	Quarterly during the campaign, starting from just before the campaign in order to obtain the baseline	
Awareness regarding new energy efficient standard	Survey at the point of sale	On-going at the point of sale	• Households – different income group and in rural and urban areas • Sales personnel at retail stores • Repairers
	Survey (in person / telephonic)	Quarterly during the campaign, starting from just before the campaign in order to obtain the baseline	
Knowledge and understanding of energy label	Survey at the point of sale	On-going at the point of sale	• Households – different income group and in rural and urban areas • Sales personnel at retail stores • Repairers
	Survey (in person / telephonic)	First, before the campaign for baseline and then after the campaign	
Change in purchase behaviour / purchase (sale) of refrigerators by energy efficient label and trend	Survey	Every month of the campaign starting from just before the campaign for baseline	• Households – different income group and in rural and urban areas • Sales personnel at retail stores • Repairers
	Retailers' data	Every month of the campaign starting from just before the campaign for baseline	• Local and international retailers • Local manufacturer - Palfridge
Savings derived by a household from purchasing a more energy efficient refrigerator	Case studies; point of sale mini-survey	Quarterly, starting at the start of the campaign	• 3-5 households at a time
Energy consumption by the residential sector	National statistics / annual reports	One a year	• Ministry of Natural Resources and Energy

7 Financial Mechanisms

7.1 CONTEXT

Based on the market assessment there are several key aspects that need to be considered as related to the financing mechanisms for refrigerators, which will assist in making the implementation possible. The consumers of refrigerators are the general public. In order for them to participate in the drive for higher energy efficient refrigerators the higher initial cost of the products must be acknowledged and considered within the Eswatini environment. For this reason, there are several aspects of the market assessment that provide key insight into the type of financial support required and also the type of consumer patterns that are existing in Eswatini at the moment.

In order to ascertain which financial supporting mechanisms are most important it is key to understand certain aspects of the Eswatini consumer. Some of these are:

- Disposable income
- Cost of electricity and monthly spend on electricity
- Cost of refrigerators most commonly sold in Eswatini
- Cost difference between refrigerators of similar volume and functionality but differing energy efficiencies
- Number of refrigerators sold per year in Eswatini
- Average age of refrigerators currently in usage in Eswatini

From this information one can understand approximately how many refrigerators are expected to be sold in Eswatini each year. Also, one can understand how much households can save per month on electricity by purchasing more efficient refrigerators. Additionally, one can understand the price difference between similar refrigerators with differing efficiency levels. This information will provide the amount of financial support required and the type of support that would be most effective to implement. This information was gathered during the market assessment phase of the project and is presented in the background section of this report, with the estimate of 10 000 new refrigerators being purchased in Eswatini per year being used as the market size figure.

7.1.1 FINANCIAL BARRIERS TO EFFICIENCY

Therefore, in order to enable effective implementation of the project there is a need to overcome some of the main financial barriers to energy efficiency. Some of the main barriers are:

7.1.1.1 High initial cost of purchase or installation

The increase in energy efficiency in most refrigerators comes through the use of better materials and through the use of more insulation. These improvements increase energy efficiency and also in most cases increase the quality of the refrigerator. The increase in quality however comes with an increase in cost and hence an increase in the initial selling price. This ultimately means that a refrigerator that is more energy efficient than another model of the same size/volume and with the same features, will be more expensive. This increase in the initial selling price of the refrigerator is usually offset by the electricity savings that are made during the lifetime of the refrigerator due to its lower energy consumption. However, the extra capital required for the initial purchase can be a restricting factor for families to participate in the increase energy efficiency drive. This can be especially difficult for lower and middle class income families. As mentioned in the Eswatini market assessment report the median income of a Eswatini family falls in the lower to middle class category. Therefore, for such income households, paying a higher initial cost for an energy efficient refrigerator may not be feasible.

7.1.1.2 Lack of access to finance/financial support

As mentioned, the majority of households in Eswatini would be vary of spending more money than necessary on the initial, higher cost of more energy efficient refrigerators. Therefore, this is a critical aspect of the project, as many willing buyers and effective participants in the energy efficiency drive could be turned away due to the lack of access to funds.

7.1.1.3 Energy prices

At times the energy prices in countries are extremely low. This was the case in South Africa in the past, specifically in the 1980s and 1990s. This was due to the strategic decision by the government of the time to drive economic growth through cheap, bulk power to assist in powering electricity heavy industries such as mining and aluminium smelting, etc. It is also the case for example in Kazakhstan, which benefits from the nuclear power installed during the Soviet era, that remained within its control after the breakup of the Soviet Union. Therefore, the initial cost of establishment was shared but the current benefit is for Kazakhstan, enabling low electricity prices (until the maintenance on the ageing plants becomes increasingly expensive).

In situations such as these the low cost of electrical energy can be a detrimental factor as the financial savings are minimised. Therefore, the impact of improved energy efficiency on the consumer spending is also minimised and as such the incentive to purchase more energy efficient refrigerators at a greater initial cost is diminished.

Eswatini also benefited from cheap electricity supply from South Africa. However, this landscape has drastically changed. South Africa has been experiencing a declining electrical utility without the ability to maintain its ageing infrastructure (generation plants and distribution network in particular). This has resulted in increases in electricity prices and a substantial reduction in availability of electrical energy. The impact has been felt by Eswatini. The electricity prices of imports from South Africa have increased and the reliability of supply has decreased. South Africa has experienced what has been termed as load shedding, which means the switching off of electrical supply to customers for a certain period (e.g. 4 hours or 2.5 hours) in a rolling blackout manner. Eswatini has also thus experienced stages where the supply of import electricity is unavailable due to shortages of supply.

7.1.1.4 Lack of awareness of benefits of Energy Efficiency

As there have been no previous campaigns related to energy efficiency of refrigerators aimed at the public in Eswatini, the general consumer is unaware of the benefits (financial or otherwise) of energy efficiency. The limited exposure that there has been to energy efficiency is through the South African label seen on most refrigerators in stores. The public is however unaware of the financial and environmental benefits of improved energy efficiency. As such a targeted and well-presented consumer awareness campaign can be a substantial asset to this project and is in fact one of the key implementation elements. The price differences between old refrigerators and ones with improved energy efficiency have been reducing. Thus if the public can be aware of the financial savings it can make on their monthly electricity bills, far more people will opt for more efficient refrigerators, as the savings over the lifetime of the product are substantial.

7.1.2 POSSIBLE SUPPORTING FINANCIAL MECHANISMS IN ESWATINI

Given the general challenges to the purchasing of energy efficient appliances, ,outlined in the previous section, possible financing mechanisms that are applicable to refrigerator purchasing are outlined below. These financing mechanisms were discussed at numerous meetings of the PWG. The general description of the various financial mechanisms relevant to refrigerators and the advantages and disadvantages of each have been described in more detail below.

7.1.2.1 Bank Loans

These are typically standard bank loans that are available to most persons owning a bank account and qualifying for a loan. The pre-requirements for a loan are typically not high but the loan amount can be limited. These are not loans that are specific to energy efficient technology and are standard bank loans.

Advantages

The biggest advantage of bank loans is that they are easily accessible. In order to qualify people generally just need a bank account and to have certain funds or a certain track record of loan repayment.

Disadvantages

One of the disadvantages of bank loans is that they are not designed for energy efficient projects. They are therefore standard loans and the interest rates are typically high. Also, persons without a bank account are unable to qualify for the loan and the loan amount is generally small – thus limiting the impact of such loans.

7.1.2.2 On-Bill Financing

On-bill financing is a support mechanism whereby an initial amount is provided to the consumers for the purchase of the energy efficient refrigerator by the electrical utility/electricity service provider. The consumer then repays the loan through the pre-defined monthly repayment through the electricity bill. The additional amount is added to the monthly electricity bill effectively. This type of financing mechanism is suited for the purchase of refrigerators as it is geared for the general consumer rather than large organisations, which typically purchase distribution transformers.

Advantages

The main advantage is that this is a very efficient way to reach the refrigerator buying public. The repayment can be controlled through the electricity bill and most importantly consumers can see the benefit of energy efficient appliances directly. For example, if they usually spent SZL300 on electricity and they bought a new refrigerator (that is more efficient than their previous one) for which they took out a loan of SZL500, and for which they need to repay SZL50 per month for 12 months, they would expect to pay SZL300 + SZL50 = SZL350 per month. But with the more efficient refrigerator their monthly saving may be SZL20 and hence the electricity bill may be SZL330, a saving which they can directly see.

Disadvantages

The main disadvantage is that the risk in this type of financing is carried by the consumer. The electricity company can simply switch off the electricity supply if the loan is not repaid and they can impose penalties on the electricity bill thereafter (e.g. for re-connection).

7.1.2.3 On-wage Financing

On-wage financing is similar to on-bill financing, except the loan amount is provided by specific employers of the consumer. Therefore, an employee would go through qualifying criteria within its place of employment. The employer would then approve the employee for a loan related to the purchase of energy efficient appliances. In this case this type of financing is suited to the purchase of refrigerators. The employee would thus receive financial support, perhaps in the form of a voucher, which could be redeemed at the time of purchase of an energy efficient appliance (refrigerator). The value of the loan (voucher) would then need to be repaid by the employee to the employer as per the agreement. This would usually be deducted from the monthly salary of the employee for several months until the loan is repaid. Interest could be charged on the loan by the employer and this would be decided at the loan stage through agreement of terms with the employee.

Advantages

The advantage is that this type of finance is typically relatively easily accessible to most. If the employer has a loan for the financing then the risk is also shared between the employer, consumer and financial loan provider.

Disadvantages

The main disadvantage is that this type of finance is not available to the non-employed. Additionally, some employers are not ready to take on such a risk without added benefits.

7.1.2.4 Tax rebates

Tax rebates and tax benefits are mechanisms whereby the organisation that provides the loans or funding is able to receive certain tax benefits for this. For example, a company may spend money on investing in energy efficient equipment. If this is pre-agreed with the revenue authority that company can get tax offsets for this spend or it can get tax benefits in terms of accelerated depreciation of the equipment purchased and thus a greater reduction in tax spend.

Advantages

One of the main advantages of tax rebates or tax benefits is that it drives similar behaviour within the organisation. For example if a company received accelerated depreciation benefits for purchasing more efficient refrigerators or transformers it can then see the direct benefit of energy efficiency. As such in the next possible

instance it may seek the same benefit (for example changing all of its lighting in its offices into more efficient/LED lighting).

Disadvantages

The main disadvantage, apart from requiring buy in from the tax authority, is that the consumer or the beneficiary requires a large tax base from which to offset such a benefit. It is therefore not really suitable to individual persons but rather to substantially sized organisations.

7.2 RECOMMENDATION

The financial mechanisms below are the ones that are most likely to be implemented within Eswatini, based on the discussions during the financial mechanisms workshop and the PWG meetings. These include:

- On-bill financing
- On-wage financing
- Tax benefits

There is also an option of combining some of the mechanisms listed above. The one option discussed was the combination of on-wage financing and the tax benefits for those companies that choose to participate in the programme.

Before understanding the best mechanisms to implement it is important to understand the amount of funding required for these purchases. As indicted in the background section of this report it is estimated that the size of the market in Eswatini is in the region of 8 000 refrigerators per year. There is other data from Comtrade pointing to a larger market of approximately 35 000 units but this is likely inflated to take into account commercial refrigerators or through incorrect capturing of HS codes. An estimate of 10 000 units can therefore be made for the purposes of this calculation. A correlation with the population size, electrification rate and number of persons per household was also performed in the background and an estimate of 22 000 units was obtained as the annual market size. A number of assumptions were made however, including the replacement of refrigerators after 10-12 years and this figure may be significantly higher in Eswatini at the moment. Therefore, 10 000 is taken as the number of new refrigerators sold in Eswatini per year but it is noted that this figure is expected to rise significantly over the next few years.

If the MEPS are implemented that means that the majority of refrigerators are going to be purchased at a level D (as per the Eswatini National Standard with the R value between 1 and 1.25) from analysis of prices both in Lesotho and in Eswatini and in discussions with the Palfridge the increase in price per increase in energy

efficiency level (as per the South African energy label and although it is not an exact correlation with the different standards) is approximately 8% - 10%. This is a comparison of (as closely as possible) 2 refrigerators that have the same volume are from the same manufacturer and have the same functionality but the one is more efficient that the other model by one energy level (one HEPS level).Therefore, if the aim of the project in year one is to encourage the majority of persons to purchase a refrigerator of level C and above then the difference in price is 10%. The average price of a common fridge/freezer combo in Eswatini is between SZL5000 and SZL7000. Therefore, it is safe to assume that the difference in price is 6%.

Also it is important to note that the people that are going to be buying a refrigerator next year would be buying one if there was the new standard or not as per the calculations above. They therefore have funds to purchase a new refrigerator in most cases. If we assume that the MEPS are implemented and the lowest class available is D and that all of the buyers would want to purchase a level D refrigerator then we need to consider subsidizing the initial difference of purchase to a level C refrigerator. Therefore, the amount of funding required for this transition is:

10 000 (estimate of new refrigerators purchased next year) x 600 (cost difference from D to C energy class) = SZL6 000 000. This equates to approximately $350 000.

Therefore, one then needs to consider the financing mechanisms in this context of approximately $350 000 offending required for the first year of implementation. It must be noted that this would be in the form of loans and not funding that is in the form of a grant. This is the lowest level of financing support required. If consumers wish to purchase refrigerators that are level B or level A they would need additional support. The same principle would apply as the cost of initial purchase would just increase by SZL1 200 or SZL1 800. The consumers would still be able to apply for financing for the greater amount that they require to purchase the more efficient refrigerator. For simplicity of calculation the case of purchase of refrigerators with one level higher energy efficiency is used.

The **on-bill financing** would work as follows:

- A potential purchaser of the refrigerator would apply for a voucher of SZL600 for the purchase of a new refrigerator with the EEC
- The EEC would have a pre-determined set of qualifying shops where the voucher can be used. The voucher can only be used for purchases of refrigerators that are level C and above as per the energy label
- The successful applicant would purchase the new refrigerator and use the voucher.
- The EEC would be notified of that customers name, surname and ID number
- The EEC would then add the amount of SZL600 to the electricity bill (split on a pre-determined number of months, e.g. SZL60 per month for 10 months or 12 months if the EEC decides to charge interest)

In order for the above to be implemented there are several aspects that need to be considered, specifically related to lending risk. In order to mitigate the risk to the utility certain pre-qualifying criteria of lenders need to be applied. These can often be linked to criteria that the general banks in Eswatini apply. The banking sector in

Eswatini is well established and is comprised of large South African based banks and some local banks. The criterial qualifying the public consumers for a loan could then be used in order to qualify for a loan/voucher related to on-bill financing of refrigerators.

From the discussions however, it was indicated that the EEC is unlikely to fund the programme at this stage. The EEC is considering other large investments, including the transformer purchases of the future but would be open to considering the support for the energy efficient refrigeration in the future. This would be discussed during the implementation stages with the PSC. Therefore, on-bill financing is something that should be considered in Eswatini in the future. There is a possibility that the EEC does have funding available in the near future or that another institution is willing to fund such a programme through the use of the EEC's billing mechanisms. The payment of the loan through the electricity bill is very easily set up and is easily implemented/recovered. As such it remains a very attractive mechanism. One possibility is for a loan to be taken by the EEC for the issuing of individual loans to consumers. This overall loan taken by the EEC could originate from international funding mechanism or from one of the national financial institutions. Governmental guarantees can be issued for this loan and hence the EEC would have a smaller interest rate on the bulk loan than it can charge on individual loans to consumers. This is required as the EEC needs to take into account a certain percentage of loan defaults. The loan amount can also be offset by allowing consumers to bring in their old refrigerators. These refrigerators could then be recycled and the consumer could receive the recycling value in terms of a voucher to contribute to the purchase of a new, efficient refrigerator.

However, the on-wage financing was further discussed, given the value of funding required. It was noted that the majority of persons purchasing a refrigerator are employed. Additionally, it may be easier to break the problem into smaller portions (in terms of the organisations issuing the loans) and obtain funding in this manner.

As such the process of on-wage financing would be very similar:

- A potential purchaser of the refrigerator would apply for a voucher of SZL600 for the purchase of a new refrigerator with their employer
- The employer would have a pre-determined set of qualifying shops where the voucher can be used. The voucher can only be used for purchases of refrigerators that are level C and above as per the energy label
- The successful applicant would purchase the new refrigerator and use the voucher.
- The employer would be notified of that customers name, surname and ID number
- The employer would then add the amount of SZL600 to the salary deductions (split on a pre-determined number of months, e.g. SZL60 deduction per month for 10 months or 12 months if the employer decides to charge interest). This could also be SZL1 200, SZL1 800, SZL2 400 for the purchase of level B, level A or level A+ refrigerators as discussed previously but one level energy efficiency improvement was used for ease of calculation as a minimum starting point

However, there is another additional possibility of implementing this scheme. In order for the employers to benefit they could have a tax benefit offset for the amount that they have subsidised to their employees. This could therefore be very lucrative for the employers and could offset some of the risk that they would have on employees who would leave their employment prior to the finalisation of the payback of the loan. The specifics are to be decided upon by the ERS through follow up discussions within the PWG. However, a specific example would operate as follows: the employer would provide loans for its employees. In order to qualify for the loan the employees would need to fulfil several criteria. The criteria could be similar to applying for a loan from a commercial bank. Their income and credit record would be taken into account and the income versus the size of the loan would also be considered. Once the loan is issued by the employer the total amount lent would be taken into account by the ERS. For example if a company has 1 000 employees and out of those 900 qualify for the loans and the average loan size is SZL1 000 (the value discussed is SZL600 per level of energy efficiency but some might apply for SZL1 200 orSZL1 800 to buy level B or level A refrigerators), then the total value of the loan is SZL900 000 undertaken by the employer. This employer would then be afforded tax benefits related to this amount. One possibility is the reduction of its tax bill to the ERS by SZL900 000 or a percentage of the amount (or example 50% of it may be tax deductible). The other option is for the assets (refrigerators purchased by the employees) to become assets of the employer until the loans are repaid and for the depreciation of the assets to be accelerated, hence providing tax benefits through accelerated depreciation. These options were discussed with the ERS during the final PWG meetings and NPR workshops. The ERS indicated that it already has tax benefit schemes that it runs and that the mechanism for such support is in place. It would however have to evaluate this specific proposal in more detail internally and that this could be done during the early stages of implementation of the project.

7.3 ACTIONS

In terms of funding in support of the consumer the primary implementation plan is to attempt to enable on-wage financing mechanisms. Therefore, the plan is to engage with various institutions to understand their willingness to participate in such a plan. A task team will be set up to implement this. Prior to that however, the ERS will have internal discussions to ascertain whether there is a possibility of offering tax benefits to participating companies.

Therefore, the implementation plan is shown in Table 20 below.

Table 20. Implementation plan for On-wage financing

Action	Responsible	Timeline
Decide on possible tax benefits for companies participating in on-wage financing	ERS	End February 2023
Set up a task team to approach companies regarding participation	DoE	End March 2023
Engage companies and ascertain which are interested	Task team	End April 2023
Engage retailers to understand which will participate	Task team	End May 2023
Create legal/contractual framework	Task team and RSL	End June 2023
Print vouchers	Task team	Mid-July 2023
Advertise on-wage campaign (can be an addition to the consumer awareness campaign)	DoE and participating companies	June – July 2023
Implement roll-out of the campaign	Participating companies	July 2023 – July 2024
Monitor impact	Task team, DoE and participating companies	July 2024 – September 2024

As shown the impact of the roll out will be monitored. The monitoring will effectively occur throughout the programme as the participation will be verified and correlated with participating companies and participating retailers (in terms of vouchers issued vs vouchers spent). However, after one year of rollout a further monitoring campaign will be carried out to understand how many employees of participating companies knew about the campaign. Additionally, the ease of utilization and experience will be assessed through interviews with certain consumers that participated in the programme. Furthermore, the companies will also be engaged to assess their experience with the programme, the repayment rates will be monitored and, if implemented, the success of the tax benefits scheme.

8 Action Plan and Implementation budget

Throughout this report various aspects of the project have been outlined. This includes the work that has already been completed, the current status and the action plans outlined for future implementation. In this section, a summary is made of all of the actions related to the various aspects of the project. In addition, the action plan in this section also outlines some of the activities required to support project implementation. For example, this includes the financing required to support project implementation. In terms of obtaining the required funding for project implementation there are 2 main possibilities that have been discussed and explored. The one is the grant for implementation from the government. This, however, may be extremely difficult and lengthy to implement. The DoE wanted to have internal discussions and include international consultants with decision makers within its department to ascertain whether there is budget to fund some of the implementation. The government is of course in favour of the energy efficiency project. This is one of the mechanisms that will be explored by the DoE but that is likely to be used as a later stage. If obtained it can be used for implementation in years 2 and 3 of the project.

The second possibility is obtaining funding from direct funding agencies, particularly those dealing with green energy projects. There are a number of organisations that provide such funding, like international organisations such as the World Bank or the GCF or regional organisations such as the IDC located in South Africa. Furthermore, several of the large banks that operate in Eswatini have specific mechanisms to fund “green” projects. One such bank is Nedbank (A South African bank with an Eswatini entity called Nedbank Swaziland).

If such an undertaking is going to be pursued, then the DoE has also indicated that there is a possibility of obtaining financial guarantees on a loan from a commercial bank such as Nedbank. This can lead to significantly lower interest rates and to a better chance of securing the loan due to the reduced risk to the lender.

The action plan for project implementation is presented in Table 21 below. In the action plan the entities responsible for each of the actions have been outlined. Furthermore, an estimated budget has been made for each of the activities in order to enable the implementers to ascertain the level of support and financial budget required for each of the activities. The Eswatini PWG and the national stakeholders have decided to formulate a Project Steering Committee (PSC) in the immediate aftermath of the project. This PSC will oversee the implementation of the project and will delegate certain responsibilities to various institutions. The table below will thus directly assist the PSC with its project implementation plan and budget. Of course this plan set out below can be altered as the implementation progresses and certain experiences are gathered; and is meant to be a starting point of an action plan for project implementation.

Table 21. Overall Project Action Plan

MEPS, Standard and Regulation Activities		
Action	**Responsibility**	**Timeline**
Gather comments from the public consultations	SWASA	January 2023
Organise final TC meeting	SWASA	January 2023
Publish final national standard	SWASA	February 2023
Prepare the regulatory framework for EE regulation	DoE	January 2023
Draft regulation (including internal governmental processes and consultations)	DoE	February – August 2023
Send regulation for public comment	DoE	September - October 2023
Review public comments	DoE	November 2023
Publish final regulation	DoE	December 2023 – January 2024
Maintain standard	LSI	Ongoing
Maintain regulation	DoE	Ongoing
Energy Label Development Activities		
Action	**Responsibility**	**Timeline**
Review the draft energy label	DoE and PWG	January - February 2023
Finalise label design	DoE	February 2023
Align final label with the regulation	DoE	March 2023
Align final label with the national standard	DoE/SWASA	March 2023
Provide energy label for the consumer awareness campaign	DoE	April 2023
Maintain Energy Label and perform annual reviews	DoE	Ongoing
MV&E Implementation Actions		
Action	**Responsibility**	**Timeline**
Development of the application system – linking it with Eswatini national IT system and enabling it for usage for market surveillance	ESERA	March 2023
Assessing whether additional resources will be required for the processing of applications and making necessary appointments	ESERA	February 2023
Training of personnel on the processing of applications	ESERA	May 2023
Training of personnel on the border controls	ERS	April 2023
Training of personnel on the market surveillance procedure	ESERA	May 2023
Energy efficient purchases of refrigerators	ESERA/DoE	June 2025
Energy savings of 5% for consumers	ESERA/DoE	June 2025

Consumer Awareness Campaign Actions		
Action	**Responsibility**	**Timeline**
Secure funding for the public awareness campaign	Ministry of Natural Resources and Energy	January – February 2023
Establishing a baseline (collect additional data to the one gathered for the study)	The University of Eswatini (in particular the Center for Sustainable Energy Research)	February – March 2023
Set up a Project Steering Committee (PSC) comprising of relevant stakeholder groups and develop Terms of Reference for it	Ministry of Natural Resources and Energy	January 2023
Undertake informative research to inform the development of awareness and education materials	Ministry of Natural Resources and Energy	March – April 2023
Workshopping messages within the PSC	Ministry of Natural Resources and Energy	April – May 2023
Development of communication material, including: ● pre-launch testing ● translating these into the required languages	Project PSC	May – July 2023
Engaging with relevant authorities and entities to obtain their buy-in for the roll out of the communication campaign	Project PSC	June – August 2023
Training sales personnel and repairers	Contracted party	August – September 2023
Roll out communication material – TV, radio broadcasts, newspapers, competitions, posters, website page	Ministry of Natural Resources and Energy	September 2023 – June 2024
Monitor and evaluate the success of the campaign – **detailed actions in the consumer awareness campaign report**	Ministry of Natural Resources and Energy	July – December 2024
Adapt the messages and communication means based on feedback received from evaluation	Project PSC	January – February 2025
Develop a maintenance plan	Ministry of Natural Resources and Energy	February 2025

Financing Mechanisms – Supporting purchases of Energy Efficiency Refrigerators		
Action	**Responsible**	**Timeline**

Decide on possible tax benefits for companies participating in on-wage financing	ERS	End February 2023
Set up a task team to approach companies regarding participation	DoE	End March 2023
Engage companies and ascertain which are interested	Task team	End April 2023
Engage retailers to understand which will participate	Task team	End May 2023
Create legal/contractual framework	Task team and RSL	End June 2023
Print vouchers	Task team	Mid-July 2023
Advertise on-wage campaign (can be an addition to the consumer awareness campaign)	DoE and participating companies	June – July 2023
Implement roll-out of the campaign	Participating companies	July 2023 – July 2024
Monitor impact	Task team, DoE and participating companies	July 2024 – September 2024
Financing Actions – Project Implementation		
Action	**Responsible**	**Timeline**
Set up task team to perform functions for obtaining financing	DoE	January 2023
Identify exact entities to approach	Task Team	February 2023
Prepare proposals for each entity that will be approached	Task Team	March 2023
Make initial approaches to each entity identified	Task Team	March - April 2023
Prepare the DoE for the follow up discussions with specific entities	Task Team	May 2023
Engage in follow up discussions with specific entities	DoE/Task Team	June 2023
Further contractual discussions and finalisation of funding	DoE/Task Team	July - August 2023

The budget for the implementation is presented in Table 22 below. Certain activities that will be performed are part of the daily activities of the particular entity and therefore no additional costs are catered for those activities as noted below.

Table 22. Budget Estimate for the implementation of the project in Eswatini

Activity	Cost SZL	Comment/assumptions
Standards, MEPS and Regulation finalisation and distribution costs		
Gather comments from the public consultations	0	Internal process no cost
Organise final TC meeting	30,000	Organisation of a meeting for delegates = 30 000 from experience of PWG meetings
Publish final national standard	0	Internal process no cost
Prepare the regulatory framework for EE regulation	30,000	2 persons 50% of the time for 1 month

Draft regulation (including internal governmental processes and consultations)	210,000	2 persons 50% of the time for 7 month
Send regulation for public comment	30,000	1 person 50% of time for 2 months
Review public comments	30,000	2 persons 50% of the time for 1 month
Publish final regulation	30,000	1 person 50% of time for 2 months
Maintain standard	0	Internal process – no cost
Maintain regulation	0	Internal process – no cost
Standard Distribution	20,000	Administrative costs and legal costs of distribution of standards to key stakeholders
Sub-total – Standard, MEPS and Regulation	380,000	
Energy Label Development costs		
Review the draft energy label	60,000	2 persons 50% of the time for 2 months
Finalise label design	30,000	2 persons 50% of the time for 1 month
Align final label with the regulation	30,000	2 persons 50% of the time for 1 month
Align final label with the national standard	30,000	2 persons 50% of the time for 1 month
Provide energy label for the consumer awareness campaign		Internal activity – no cost
Maintain Energy Label and perform annual reviews		Internal activity - no cost
Sub-total Energy label development	150,000	
Consumer awareness campaign costs		
Secure funding	60,000	Establishment of a team to secure funding - 2 people, working half time for 2 months
Establish a baseline (additional information gathering)	60,000	2 months of work for 2 people, working 50% of the time
Project steering committee (PSC) establishment and meeting	30,000	Organisation of a meeting for delegates = 30 000 from experience of PWG meetings
Prepare messages within PSC - 2 meetings	75,000	2 meetings and half a month work for one person to gather information
Testing of materials - pre launch	90,000	2 people to carry out pre-launch testing, gather feedback for 4 months working 50% of the time
Translation of material into desired languages	60,000	2 months for 1 person
Training of sales personnel and repairers (10 training courses)	300,000	10 meetings effectively similar to PWG and other training meetings held
Social media campaign	300,000	Social media campaign rollout - as per estimates from South African companies
TV adverts	600,000	Development of advert material estimated at LSL400 000 and rollout at LSL200 000 (approximately LSL2 000 per advert slot on TV and radio)
Print media rollout	250,000	Development of material LSL100 000 and print media LSL3000 per advert, so budget for 50 adverts

Monitoring (surveys - in person or online, telephonic, case studies)	270,000	3 people for 6 months working 50% of time on this task
Review of impact and re-design and implementation if needed	60,000	2 people for 2 months working at 50% of time
Sub-total – consumer awareness campaign	2,155,000	
MV&E costs		
Internal training	1,100,000	Cost of training personnel and training facilities. From costs of meetings it is estimated at LSL39 285 per training session with an estimate of 28 sessions.
IT system for application processing	2,000,000	IT personnel costs for system upgrade at scale of similar projects based on experience from South Africa (3 month project – taking into account complexity)
RSL inspectors at borders	3,000,000	Additional personnel and equipment. Taking into account border posts that accept goods, the estimate is for 2 additional persons (roaming between border posts) at LSL 360 000 per person year x 2 x 3 years = LSL2 160 000 and the additional LSL840 000 is budgeted for tablets and scanners (additional IT infrastructure)
Surveillance inspectors	3,000,000	Similarly 2 additional surveillance inspectors budgeted for 3 years, amounting to LSL 2 160 000 and the remaining LSL840 000 for surveillance equipment (tablets, etc.)
Dealing with non-compliance - legal	1,000,000	Cost of a legal person at 30% of time (contract as and when needed) for 3 years
Warehousing	500,000	Cost of additional warehousing at border posts. RSL has the premises available but the costs are for annual maintenance over 3 years
Administrative	458,700	Estimated at 10% of total budget
Miscellaneous	458,700	Estimated at 10% of total budget
Laboratory testing of samples	3,500,000	Cost of testing estimated at LSL70 000. 15 tests budgeted per year, therefore 45 for 3 years. This amounts to LSL2 700 000 and the remaining LSL800 000 budgeted for transport of samples to Eswatini or South Africa
Monitoring	1,200,000	One additional resource budgeted at LSL30 000 per year for 3 years, amounting to LSL1 080 000 and the remaining cost is for the equipment required (tablet, computer, etc.)
Sub-total – MV&E Plan	16,217,400	
Costs of setting up Financing Mechanisms for support of purchases of Energy Efficiency Refrigerators		
Decide on possible tax benefits for companies participating in on-wage financing	0	Internal discussion – no cost
Set up a task team to approach companies regarding participation	0	Internal discussion – no cost
Engage companies and ascertain which are interested	30,000	1 month, 2 people at 50% of time
Engage retailers to understand which will participate	60,000	2 months, 2 people, working at 50% of the time

Create legal/contractual framework	100,000	Legal team costs
Print vouchers	26,000	1 person working 10% plus printing costs = 6 000 + 20 000
Advertise on-wage campaign (can be an addition to the consumer awareness campaign)	320,000	2 people 100% of time for 2 months plus advertising costs = 120 000 + 200 000
Implement roll-out of the campaign	360,000	2 people working 50% of the time for 12 months
Monitor impact	90,000	2 people working 50% of the time for 3 months
Sub-total Financing mechanisms	986,000	
Costs of obtaining financing for project implementation		
Set up task team to perform functions for obtaining financing		Internal action – no cost
Identify exact entities to approach	15,000	1 person 50% of the time
Prepare proposals for each entity that will be approached	30,000	2 persons 50% of the time for 1 month
Make initial approaches to each entity identified	60,000	2 persons 100% of the time for 1 month
Prepare the DoE for the follow up discussions with specific entities	30,000	2 persons 50% of the time for 1 month
Engage in follow up discussions with specific entities	60,000	2 persons 100% of the time for 1 month
Further contractual discussions and finalisation of funding	60,000	2 persons 50% of the time for 2 months
Sub-total financing project implementation	255,000	
Total (SZL)	**20,143,400**	
Total USD (Rate $1 = SZL 18)	**1,119,078**	

The overall implementation budget for refrigerators in Eswatini is under $1.2 million.

9 Conclusion

As has been shown in this report the Eswatini National Project related to energy efficiency of refrigerators has resulted in a number of key developments. Amongst these the most important is the development of the Eswatini National Standard on energy efficiency of refrigerators. This standard is very closely related to the regional standard developed within SADC, with an additional HEPS level implemented in Eswatini. The national standard outlines the MEPS and HEPS values for efficiency in Eswatini. Importantly the energy label has also been developed for Eswatini as part of the project and is aligned with the regional labelling requirements.

With the development of the national standard and the label a number of implementation methodologies were developed. Regulation will be developed that will refer to the MEPS and the label and make both mandatory in Eswatini. This report outlines some of the other key points related to the implementation of the project. These include the consumer awareness campaign that has been developed in order to reach the various consumers and stakeholders of the project. Another important factor for the successful implementation of the project is the financing of energy efficient refrigerators and this report outlines some of the key financial mechanisms that can be exploited in Eswatini that would enable purchasing of more energy efficient refrigerators. Furthermore, the monitoring, verification and enforcement of the energy efficiency of refrigerators has been outlined in detail. All of these aspects are further detailed in the appendix of this document, but the most important aspects to the successful implementation of the project in Eswatini are outlined in this report. Furthermore, the budget for the implementation of the project for the period of the next 3 years has been developed. The detailed action plan will allow the national PSC to implement the project according to a pre-defined process with milestones. The action plan can easily be transferred into a project plan and allows progress tracking. The budget for implementation is estimated at $1.2 million and the budget breakdown also allows the PSC to source funding for specific tasks of the overall implementation in a phased approach, if necessary.

Therefore, this National Policy Roadmap summarises the development of the Eswatini National Standard and the energy label, their alignment with the regional standard and maps out plans for the implementation of the standard and accompanying regulations.

10 References

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