

Overview of the Market on Refrigerating Appliances and Room Air Conditioners in East and Southern Africa



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Acronyms

EAC	East African Community
EACREEE	East African Centre of Excellence for Renewable Energy and Efficiency
EAPP	Eastern African Power Pool
EDCL	Energy Development Corporation Limited
EEl	Energy Efficiency Index
EER	Energy Efficiency Ratio
EPRA	Energy and Petroleum Regulation Authority of Kenya
EREA	Energy Regulators Association of East Africa
EUCL	Energy Utility Corporation Limited
GDP	Gross Domestic Product
GWP	Global Warming Potential
HCFC's	hydrochlorofluorocarbons
HFC	hydrofluorocarbons
LBNL	Lawrence Berkeley National Laboratory
MEPS	Minimum Energy Performance Standards
NEMA	National Environmental Management Authority Kenya/Uganda
NRCS	National Regulator for Compulsory Specifications
ODP	Ozone Depletion Potential
RCOOL FI	Rwanda Cooling Finance Initiative
REEESAP	Southern Africa Renewable Energy and Energy Efficiency Strategy and Action plan
RERA	Regional Electricity Regulators Association of Southern Africa
RSB	Rwanda Standards Board
RSEER	Rwanda Seasonal Energy Efficiency Ratio
RURA	Rwanda Utilities Regulatory Authority
SACREEE	SADC Centre for Renewable Energy and Energy Efficiency
SACU	Southern African Customs Union
SADC	Southern African Development Community
SADCAS	Southern African Development Community Accreditation Services
SANEDI	South African National Energy Development Institute
SAPP	Southern Africa Power Pool
SRI	Star Rating Index
U4E	United for Efficiency
UNBS	Uganda National Bureau of Standards
UNEP	United Nations Environment Programme
USD	US dollars

1. Executive Summary

Growing populations, urbanization and rising living standards in the regions of the East African Community (EAC) and Southern African Development Community (SADC) will drive increased demand for cooling services. If policies are not implemented, it is expected that the electricity consumption used for room air conditioners and residential refrigerators in 2040 will increase by 2.5 times compared to today in the regions. This report provides information about the markets on room air conditioners and residential refrigerators in EAC and SADC to inform the development and adoption of harmonized MEPS and energy labels. United Nations Environment Programme's (UNEP) United for Efficiency (U4E) initiative, in collaboration with the East African Centre of Excellence for Renewable Energy and Efficiency (EACREEE) and SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) have commissioned this market assessment report to accelerate the market transformation to energy-efficient cooling products. The findings, in addition to other market data and analysis, underpin a technical note on these products with detailed recommendations.

The market assessment finds that in most countries, inefficient room air conditioners and residential refrigerators are common. Cooling appliances have a large saving potential, compared to inefficient products the efficiency of room air conditioners and residential refrigerators can be improved by up to 60%. Many cooling products in the regions are imported from China, the European Union, India, Thailand and the United Arab Emirates. Only Eswatini, Rwanda, South Africa, Uganda and Zimbabwe have manufacturing of refrigerating appliances. There are no manufacturers of air conditioners in the regions. In the following key findings are listed.

1.1 Minimum Energy Performance Standards

Minimum Energy Performance Standards (MEPS) are one of the key policy options to accelerate the market transformation to energy efficient and climate friendly appliances. If the policies are developed in a harmonized manner, trade barriers can be reduced between countries, implementation costs are decreased (e.g. through shared testing laboratories) and best practices and lessons learned can be shared among countries on national implementation. At the same time consistent approaches across countries helps yield economies of scale for efficient products that save consumers money on electricity bills, reduce air pollution, mitigate greenhouse gas emissions, and enable greater electrical grid stability.

Currently, out of the 21 countries in SADC and EAC regions, only 7 countries have either refrigerator or air conditioner MEPS in place (see Table 1). In addition, the assessment shows that the standards are at different levels of implementation, as namely only four countries have mandatory MEPS in place for refrigerators and only four countries have mandatory MEPS for air conditioners. Noteworthy, is for example the case of Seychelles and South Africa. Even though the MEPS are at different efficiency levels, the minimum Energy Efficiency Ratio (EER) requirements for wall mounted split air conditioners in Seychelles are equivalent to Class B ($3.2 \geq \text{EER} > 3.0$) of the South African minimum energy efficiency requirements. In addition, also the standards of refrigerators in Mauritius are aligned with South Africa. Chapter 6.2.5 presents more details on the current MEPS of South Africa and the possibility of exploring a regional compliance infrastructure centred in South Africa.

Table 1 Overview of EAC and SADC countries that have MEPS in place including year of adoption

Country/Region	Refrigerating Appliances	Air Conditioners
EAC		
Kenya	Mandatory (2013)	Mandatory (2013)
Uganda	Voluntary (2011)	Voluntary (2011)
Rwanda	Voluntary (2015)	Voluntary (2015)
SADC		
Democratic Republic of Congo	X	Mandatory
Mauritius	Mandatory (2017)	X
Seychelles	Voluntary (2015)	Voluntary (2015)
South Africa	Mandatory (2014)	Mandatory (2014)

Regarding the rating of the performance of the products, many of the countries already adopted the same standard for both products. In the case of room air conditioners, the ISO 163358 standard is adopted by several countries, such as Rwanda, and in the case of refrigerators some of the countries, like Kenya and South Africa, have adopted the IEC 62552 2015 standard.

1.2 Labelling

In parallel to MEPS product labelling facilitates the delivery of key purchase information directly to consumers, in order to help inform the purchasing decision such as using a star or tier system to allow comparison of each appliances electricity consumption.

Many of the appliances that are offered on the market of both regions already have a label as they are primarily imported from countries (outside EAC and SADC) or a nearby market with labelling requirements. This mostly applies to room air conditioners, as there are no air conditioning manufacturers in both regions. Air conditioners in both regions are mainly imported from the European Union, China, the United Arab Emirates and others. In addition, several countries have introduced own labels for room air conditioners, which is the case for two out of the 21 countries for both regions (see table 59). The introduced labels are in one case also in line with the country or region of the appliance's origin: The energy label classes applied in the South African market are mostly similar to those used in the European market.

Also, most of the residential refrigerators carry a label from their country of origin where mandatory labelling is implemented. Though there are also manufacturers of refrigerators in both regions, which is the case for the following countries: Eswatini, Rwanda, South Africa, Uganda and Zimbabwe – amongst which are also countries that do not have a mandatory labelling regulation in place. A mandatory labelling regulation for refrigerators exists only in three countries, namely Kenya, Mauritius and South Africa (see Table 2). All the labels are comparative energy labels.

Table 2 Overview of countries that have labels in the regions including year of adoption

Country/Region	Refrigerators	Air Conditioners
EAC		
Kenya	Mandatory (2016)	Mandatory (2016)
SADC		
Mauritius	Mandatory (2017)	X
South Africa	Mandatory (2008)	Mandatory (2008)

1.3 Refrigerants

The market assessment includes analysis of the refrigerants used in room air conditioners and residential refrigerators. Room air conditioners and residential refrigerators do not only impact the environment negatively through inefficient products with high energy consumption but can also have a large climate impact due to the refrigerants used in the appliances. The findings of the market assessment showed that most room air conditioners in the region are equipped with R-410a¹, the second most common gas found is R-22².

This situation is problematic as R-22 is a HCFC gas that contributes to contribute to climate change and ozone depletion. As the use of hydrochlorofluorocarbons (HCFC's) will be banned worldwide as of 2030, several countries have enacted an Ozone Depleting Substance Regulation. The refrigerant R-410a has been deployed as a non-HCFC alternative to R-22 and is an hydrofluorocarbons (HFC) refrigerant. While it is safe for the ozone layer, HFCs have high Global Warming Potential (GWP) and are thus responsible for a large amount of GHG emissions. The findings show that R-410a is used in room air conditioners at least in Botswana, Rwanda and Seychelles.

Data on refrigerants used in residential refrigerators was scarce. In Seychelles it was found that residential refrigerators are equipped with R-134a³ and R-600a⁴, whereas Rwanda has banned these beforementioned gases from their market. R-600a seems to become more and more popular in refrigerators in South Africa. R-134a is an HFC refrigerant, whereas R-600a is a HC refrigerant with a relatively low GWP and recommended as the standard refrigerant for European domestic refrigerators and freezers.

Moreover, it was observed that three countries, namely Rwanda, Namibia and South Africa have committed to the Kigali Amendment to the Montreal protocol that aims to phase out the production and consumption of HFC's. Kenya has initiated the process of ratification.

¹ Global Warming Potential (GWP) of 2,100, Ozone Depletion Potential (ODP) of 0 based on 100-year horizon per the UNFCCC.

² GWP of 1,780, ODP of 0.05 based on 100-year horizon per the UNFCCC.

³ GWP of 1,360, ODP of 0 based on 100-year horizon per the UNFCCC.

⁴ GWP of 0, ODP of 4 based on 100-year horizon per the UNFCCC.

1.4 Institutions

A key aspect that drives the implementation of MEPS and labelling is the presence of adequate stakeholders and institutions. The findings of the market assessment show that nearly all countries have a standards body, the sole country which does not have a standards body is Comoros. Moreover, it was found that energy efficiency entities are not very common in the region, as only three countries, namely Namibia, Seychelles and South Africa have established such entities. Additionally, Eswatini is currently in the process to establish an energy efficiency entity. Noteworthy are also the cases of Namibia and Kenya, as Namibia has an energy efficiency agency but does not have an energy efficiency regulation nor MEPS, while Kenya has no energy efficiency agency but does have energy efficiency regulation and MEPS. More details on the exact name of the institutions can be found in tables 7 and 10.

An additional driver that facilitates the implementation or future updates of MEPS and labelling is the policy environment. Ambitious energy efficiency policies and strategies are required to realise the benefits of the implemented regulations. It was found that today most of the countries have general energy policies in place, except for Burundi, South Sudan, Comoros and Botswana, with the latter currently drafting its energy policy. Moreover, about half of the countries have developed energy efficiency strategies. Also, only very few countries have put in place energy efficiency policies and are only found in the SADC region, namely Eswatini, Mauritius, South Africa and Zimbabwe with a policy that is currently under development. Energy efficiency strategies are key to properly plan a full market transition to energy efficient products and to define the concrete commitment with clear and achievable targets. As a best practice example for an energy efficiency strategy on cooling appliances, the national cooling strategy of Rwanda can be named, which identifies priority interventions to optimally address the growing needs of the country for cooling.⁵

1.5 Market Monitoring Systems

Market monitoring is essential to ensure the MEPS and labels are properly monitored and enforced, to avoid non-compliant products continuing to be sold on the market. The market assessment found that currently only a few countries have or plan to introduce product registration system, which is the case for only five countries, namely Kenya, Rwanda, Mauritius, Seychelles and South Africa. The systems that are in place for these countries are not coordinated or harmonized regionally.

1.6 Financial Incentives

The effect of financial incentives in the context of a market transformation to energy efficient cooling should be highlighted. Energy efficient products are typically more expensive than inefficient products, a higher market penetration can be supported by a wide range of financial incentives which can target the residential, private or public sector. Currently, only very few countries have introduced financial incentives to support the deployment of energy efficient room air conditioners and residential refrigerators.

⁵ The Rwanda national cooling strategy can be accessed [here](#).

Seychelles has introduced a VAT exemption for energy efficient products, whereas Mauritius imposed a levy on inefficient appliances.

2. Background and Introduction

The UNEP-U4E initiative, in collaboration with EACREEE and SACREEE, commissioned and oversaw the drafting of this regional market assessment to provide information about the markets for room air conditioners and residential refrigerators in EAC and SADC. This report outlines the findings to support policies that phase-out inefficient room air conditioners and residential refrigerators (cooling products) and phase-down the use of potent greenhouse gasses used as refrigerants.

To enable an effective market transformation, a broad range of activities are planned to be conducted on the basis of this market assessment:

- Regional agreement in EAC and SADC to align on MEPS and labels for both room air conditioners and residential refrigerators; and
- Technical assistance to countries in EAC and SADC that move ahead with the implementation of the regionally agreed-upon contents.

UNEP-U4E, SACREEE and EACREEE activities on cooling products are conducted in coordination with the Energy Efficient Lighting and Appliances in Southern and East Africa (EELA) project by the United Nations Industrial Development Organization (UNIDO) on harmonizing MEPS for energy efficient lighting. Lawrence Berkeley National Laboratory (LBNL) is drafting a Technical Note with recommendations for MEPS and labels based upon this market assessment report.

The activities are focused on residential refrigerators and room air conditioners as the electricity consumption and greenhouse gas emissions for these products is forecasted to increase significantly without further policy adoption and enforcement. According to UNEP-U4E estimates, it is expected that by 2040 the electricity demand for both products will grow in both regions by more than 2.5 times. At the same time, there is remarkable potential to efficiently use energy and therefore lowering the ultimate energy demand and related indirect greenhouse gas emissions from generating electricity that powers these systems, while transitioning to lower GWP refrigerants. If policies consistent with the energy efficiency and refrigerant limits in U4E's Model Regulation Guidelines⁶ are implemented, the regions can save over 12 TWh of electricity by 2040. These electricity savings are equivalent to five power plants of 500 MW, reduced indirect CO₂ emissions of 9.2 million tonnes and 1.1 billion USD through reduced electricity bills (UNEP-U4E 2020). Through the implementation and enforcement of new, harmonised energy-efficiency regulations for room air conditioners and residential refrigerators, the region will further be able to enjoy improvements in energy security and economic development while mitigating further adverse impacts on the planet.

⁶ The model regulation guidelines can be accessed for refrigerators [here](#) and for air conditioners [here](#).

3. Methodology and Approach

This chapter presents the data collection methodology and approach which was used to deliver the market assessment report.

3.1 Objective and Scope

Regions and Countries

This market assessment includes the 21 countries of the EAC and SADC regions, namely: Republic of Angola, Republic of Botswana, Republic of Burundi, Union of the Comoros, Democratic Republic of Congo, Kingdom of Eswatini, Kingdom of Lesotho, Republic of Kenya, Republic of Madagascar, Republic of Malawi, Republic of Mauritius, Republic of Mozambique, Republic of Namibia, Republic of Rwanda, Republic of Seychelles, Republic of South Africa, Republic of South Sudan, Republic of Uganda, United Republic of Tanzania, Republic of Zambia and Republic of Zimbabwe.

Of these, six countries are part of EAC: Republic of Burundi, Republic of Kenya, Republic of Rwanda, Republic of South Sudan, United Republic of Tanzania, Republic of Uganda; and 16 countries are part of SADC: Republic of Angola, Republic of Botswana, Union of the Comoros, Democratic Republic of Congo, Kingdom of Eswatini, Kingdom of Lesotho, Republic of Madagascar, Republic of Malawi, Republic of Mauritius, Republic of Mozambique, Republic of Namibia, Republic of Seychelles, Republic of South Africa, United Republic of Tanzania, Republic of Zambia and Republic of Zimbabwe. The United Republic of Tanzania is member of both EAC and SADC and appears twice in the regional lists.

A representative set of countries has been chosen for each region to deliver more in-detailed information about the current situation. This representative set of countries has been chosen using the following criteria: reflection of the different development⁷ and electrification levels, status of policies, climate conditions, energy situation, stakeholders, a mix of coastal and landlocked countries, and the availability of data.

According to these criteria, the following countries are presented in the country-specific chapters:

Table 3 Selected countries for individual country chapters

Region	EAC	SADC
Selected countries	<ul style="list-style-type: none">● Kenya● Rwanda● Uganda	<ul style="list-style-type: none">● Botswana● Eswatini● Namibia● Seychelles● South Africa

Technologies

⁷ According to the GDP per capita.

Regarding the included products, the market assessment includes room air conditioners and residential refrigerators, the details about the scope of both technologies is listed in Table 4.

Table 4 Scope of technologies

Technologies	Room Air Conditioners	Residential Refrigerators
Scope	<ul style="list-style-type: none"> ● Self-contained systems⁸ <ul style="list-style-type: none"> ○ Wall-mounted ○ Floor-standing type ○ Cassette type ○ Under ceiling type ● Portable ● Window (unitary) 	<ul style="list-style-type: none"> ● Refrigerator only ● Freezer only ● Refrigerator-freezer combined

3.2 Information Gathering Methodology, Sources and Gaps

The data collection was done remotely. The objective is to deliver the following information:

- General economic and development data
- Type of room air conditioners and residential refrigerators that are in the market (based on trade, sales and market structure data, including price; brands; sales volumes and value)
- Energy efficiency, refrigerants, cooling capacity, age, country of origin and related information on the products in the market
- Key channels by which products enter the market and/or local manufacturers of cooling products
- Overview of current relevant policies and programmes and their impacts
- Overview of relevant stakeholders in both regions in an institutional mapping for each of the countries

Available macroeconomic data is of high quality, while detailed information on the attributes of room air conditioners and residential refrigerators in the market was rather challenging to collect. The reason for this was that mainly the response rate from the private sector on the questionnaire was low. Additionally, some of the information was contradictory when coming from different sources. Whenever possible, several sources had been consulted for the same type of information to validate the data. Moreover, modelled data from the UNEP-U4E Country Saving Assessments⁹ has been used to validate the gathered data.

Data sources and stakeholders which had been consulted include the following:

- Questionnaires for government officials
- Questionnaires for private sector (manufacturers, distributors and importers)

⁸ Split and unitary types, including both cooling-only and reversible units (i.e. which can provide cooling and heating) of which only the cooling system should be considered and having a cooling capacity of <12 kW

⁹ The UNEP-U4E Country Saving Assessments can be accessed [here](#).

- Data from project partners
- Data from key stakeholders in the region
- Internet research

The subsequent sub-chapters deliver detailed information about the data collection.

3.2.1 Questionnaires for Government Officials

A major focus of the data collection for this market assessment report had been laid on the collection of data from the countries themselves, namely from government officials. In this context the focal points from the EELA project, whose representatives are in regular contact with officials from each of the countries, had been used as a contact list. The contacts that had been requested to provide their information came from the Ministries of Energy and the Standards Bodies from each of the countries. To assure that a maximum amount of information could be collected several follow up rounds had been done by email and telephone which enabled a response rate of 52%. Out of a total number of 42 questionnaires 22 responses had been finally received, though it must be noted that the questionnaires had been partly incomplete. The questionnaire template which had been sent out is displayed in Annex 1. Table 5 displays the questionnaires which had been received and the level of completeness of each questionnaire.

Table 5 Received questionnaires from country officials

Source and Completeness of Questionnaire in (%)	Country
<ul style="list-style-type: none"> • Department of Energy (90%) 	Botswana
<ul style="list-style-type: none"> • Ministry of Hydraulics, Energy and Mines (80%) • Bureau Burundais de Normalisation en Contrôle de la Qualité (Standards Body, 90%) 	Burundi
<ul style="list-style-type: none"> • Ministry of Economy, Investments and Energy; in charge of Economic Integration, Tourism and Handicrafts (60%) 	Comoros
<ul style="list-style-type: none"> • Ministère des Ressources Hydrauliques et Electricité (Ministry of Hydraulic Resources and Energy, 80%) 	Congo (Dem. Rep. of the)
<ul style="list-style-type: none"> • Ministry of Natural Resources and Energy (30%) 	Eswatini
<ul style="list-style-type: none"> • Kenya Bureau of Standards (55%) • Energy and Petroleum Regulation Commission of Kenya (56%) 	Kenya
<ul style="list-style-type: none"> • Ministry of Energy and Meteorology (30%) 	Lesotho
<ul style="list-style-type: none"> • Department of Energy Affairs (50%) 	Malawi
<ul style="list-style-type: none"> • Energy Efficiency Management Office (90%) 	Mauritius
<ul style="list-style-type: none"> • Autoridade Tributaria – Direcção General das Alfandegas (Tax Authority, Geral Directorate of Customs, 100%) • Ministério da Terra, e Ambiente e (Ministry of Land and Environment, 40%) 	Mozambique

● Ministry of Mines and Energy (80%)	Namibia
● Rwanda Standards Board (75%)	Rwanda
● Seychelles Energy Commission (90%)	Seychelles
● Department of Minerals Resources and Energy (100%)	South Africa
● Ministry of Energy and Dams (59%)	South Sudan
● Uganda National Bureau of Standards (47%)	Uganda
● Ministry of Energy and Mineral Development (67%)	
● Ministry of Energy (50%)	Zambia
● Ministry of Energy and Power Development (70%)	Zimbabwe

3.2.2 Questionnaires for Private Sector

Simultaneously to the questionnaire for country officials, a private sector questionnaire was distributed and collected. To choose the key players in the region, internet research was conducted and after that the questionnaire was sent to key manufacturers, distributors and importers of both regions. The questionnaire is displayed in Annex 2.

Several follow up rounds were conducted which resulted in a response rate of response rate of 6%. Out of 67 questionnaires (44 in EAC and 23 in SADC) four responses were received. Table 6 displays the questionnaires which had been received and the level of completeness of each questionnaire.

Table 6 Received questionnaires from private stakeholders

Private Sector Stakeholder and Completeness of Questionnaire in (%)	Type of Business	Country
The Fridge Factory (80%)	Manufacturer	Eswatini
Armco Kenya Limited (40%)	Distributor, Retailer	Kenya
Samsutech Corporation LTD (30%)	Distributor	Kenya
Gilfilian Air Conditioning LTD (10%)	Retailer	Kenya

3.2.3 Data from Project Partners

In addition to the above, the data from the project partners, namely UNEP-U4E, EACREEE and SACREEE was taken into account as all three organisations are working with key stakeholders in the regions.

In 2019 a market assessment on lighting for both EAC and SADC region was conducted by CLASP in collaboration with EACREEE, SACREEE and the EELA project. In this context information on the energy efficiency of the countries has been gathered, which has also been taken into account for the present report. The previous market assessment mainly provided data on the supply chain, general energy situation of countries and the institutional mapping.

Another data source which had been used to validate the gathered data and to fill data gaps are the UNEP-U4E Country Saving Assessments, which are built on a model developed with a broad group of experts in the public and private sectors. The model estimates the impacts of implementing policies that improve the energy efficiency and refrigerants and shows the financial, energy, and environmental benefits of better lighting, appliances and equipment. The savings potential in each scenario assumes MEPS and HEPS are introduced in 2020 reflecting two different levels of ambition (minimum and high).¹⁰

In addition, data from UNEP-U4E projects was used, such as in the ongoing Rwanda Cooling Initiative.¹¹

3.2.4 Data from Key Stakeholders in the Region

Information requested from other key representatives is displayed in Table 7.

Table 7 Data collection from key stakeholders

Stakeholder	Collected data	Country
Ministry of Hydraulics, Energy and Mines	Policies and technologies	Burundi
Bureau Burundais de Normalisation et Contrôle de la Qualité (BBN)	Policies and technologies	Burundi
Eswatini Revenue Authority	Import/Export data of appliances	Eswatini
Eswatini Environment Authority	Refrigerant gases	Eswatini
Energy and Petroleum Regulation Authority (EPRA)	Policies, supply chain, technologies, existing MEPS and product registration, refrigerant gases	Kenya
Kenya Bureau of Standards	Policies, supply chain, existing	Kenya
Armco Kenya	Supply Chain, Refrigerant gases, technologies	Kenya
Gilfilian	Supply Chain, Refrigerant gases, technologies	Kenya
Samsung Kenya	Supply Chain, Refrigerant gases, technologies	Kenya
Rwanda Standards Board	Policies, supply chain, technologies	Rwanda
South Africa Energy Department	Data on status of standards and labelling	South Africa
Ministry of Energy and Dams	Ministry of Energy and Dams	South Sudan
Uganda National Bureau of Standards	Policies and technologies in market	Uganda
Ministry of Energy and Mineral Development	Policies, supply chain, technologies, refrigerant gases	Uganda

¹⁰ The UNEP-U4E Country Saving Assessments methodology and assumptions can be accessed [here](#).

¹¹ More details on the Rwanda Cooling Initiative can be accessed [here](#).

3.2.5 Internet Research

Additionally, internet research was conducted on both appliances and the general energy situation in the region. Databases, reports, business webpages, and internet sales were analysed. A detailed list of online information is in the references section on page 156, which shows the data used and the source.

4. Brief Overview over the Regions

The following chapter provides an overview of the general energy as well as economic and development situations in both regions. On the interregional level, it should also be noted that the African Union is currently drafting a Market Surveillance Strategy and Action plan to harmonize the regulatory framework for the electricity market in Africa.

4.1 Overview of the EAC Region

EAC consist of 6-member countries: Kenya, Rwanda, United Republic of Tanzania, Republic of Burundi and South Sudan, as shown in Figure 1. This region's intergovernmental organization was formed in 1999 with the mission to better integrate economic, political, social and cultural activities in the region to improve the quality of life of people. The co-operation of the energy sector among the EAC partner state is governed by Article 101 of the treaty. The energy subsector focuses on the supply of sufficient, reliable, cost-effective and environmentally friendly energy in the region.



Figure 1 EAC member states

4.1.1 Regional Energy Institutions

In the effort to achieve regional development of the energy sector, the following institutions were established in the EAC to promote the harmonization of the national policies in the region to promote a unified sector development. The development and implementation of harmonised MEPS for room air conditioners and residential refrigerators will leverage the mandate of these institutions.

- **EACREEEE:** is mandated to promote the uptake of appropriate and sustainable renewable energy and energy-efficient technologies in the region through the participation in policy formulation, capacity building, creation of awareness, provision of necessary knowledge and promotion of appropriate investments in the energy sector in the region.
- **Energy Regulators Association of East Africa (EREA):** Responsible for the establishment of the appropriate mechanisms that foster efficient and competitive energy market that fosters an energy union in the EAC.
- **Eastern African Power Pool (EAPP):** Mandated with the development of energy resources and improvement of the energy access to all people in the Eastern Africa region through power interconnections.

4.1.2 Economic and Development Situation

EAC region covers an area of 2.46 million km²; Tanzania covers 38% of the total area, South Sudan 26.2%, Kenya 23.7%, Uganda 9.8%, Rwanda and Burundi each share 1.1%. In 2018, the EAC region reported a population of approximately 177 million inhabitants (see Figure 2) and has an annual population growth rate of 2.9% (EAC, 2019). Most of the people in the region reside in the rural areas with only 22% of these population residing in urban areas (EAC, 2019).

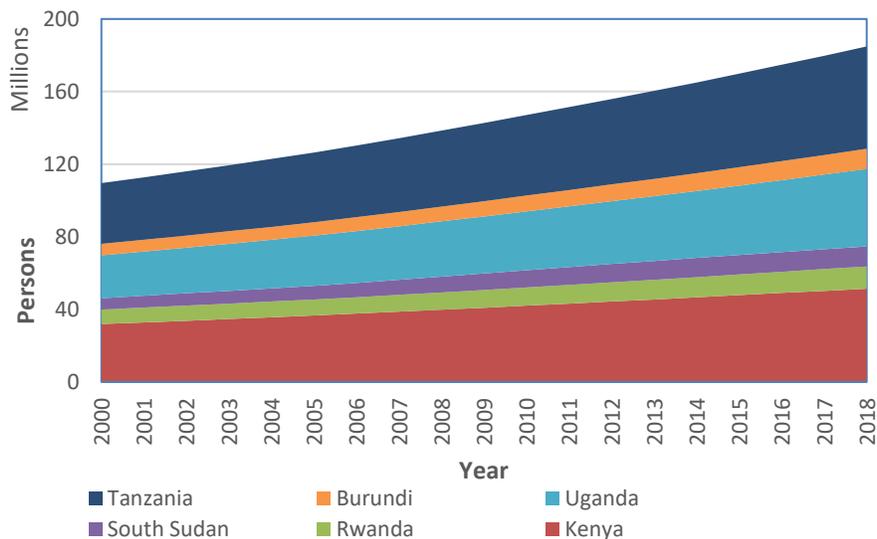


Figure 2 Population since 2000

Source: World Bank, 2018

The combined Gross Domestic Product (GDP) in 2018 amounted to 193 billion US dollars (USD) (See Figure 3). In 2018, Kenya reported the highest GDP per Capita of USD\$1,707 while Burundi had the lowest GDP per Capita of USD\$271, as seen from Figure 3 (World Bank, 2018).

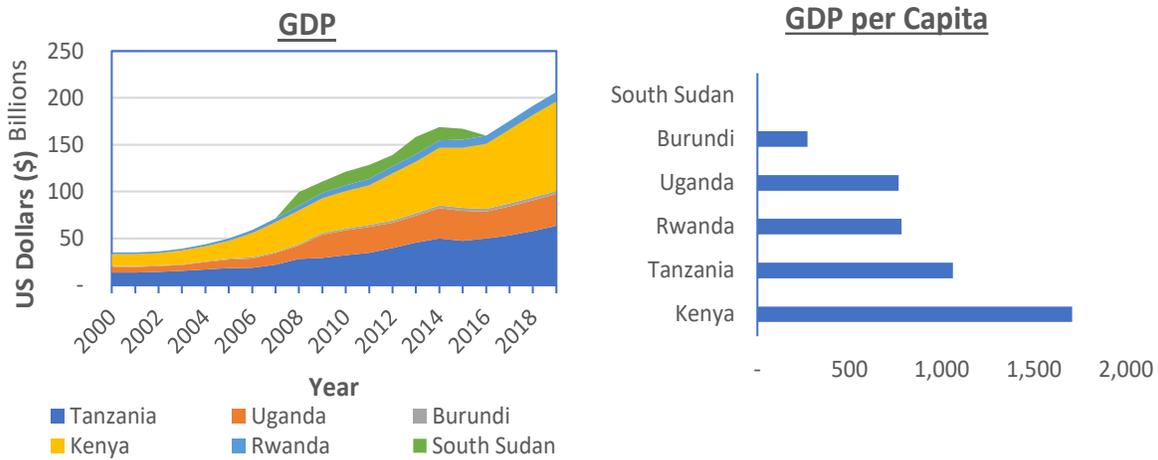
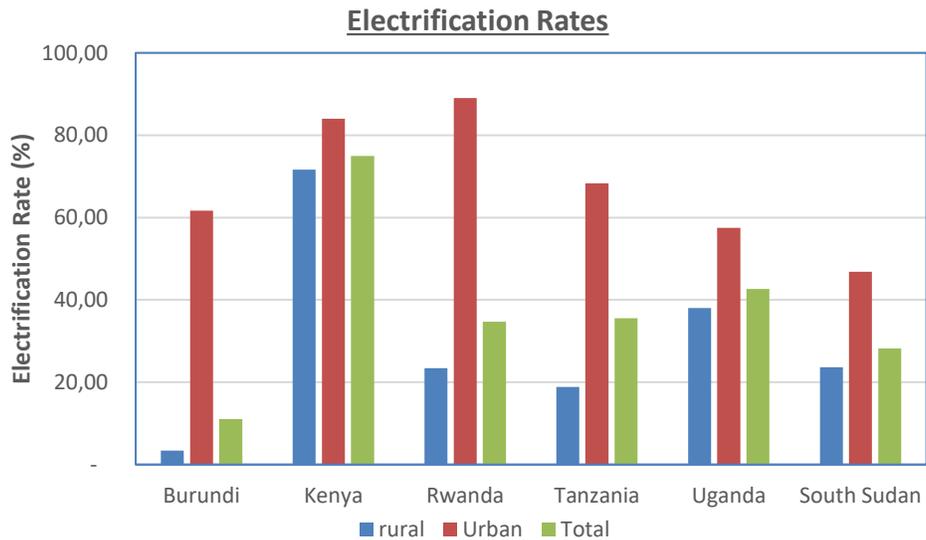


Figure 3 GDP and GDP per capita in EAC region

Source: World Bank, 2018

The electricity access in different countries in the region ranges between 11%- 75% as seen from Figure 4. High electrification rate is observed in the urban areas as compared to the rural areas and ranges between 46- 89% and 3-71% for urban and rural areas respectively (World Bank, 2018).

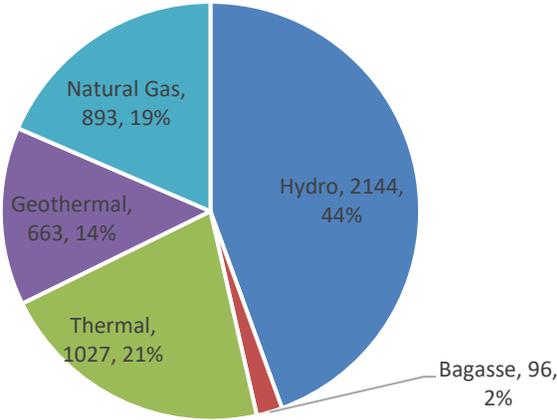


Source: World Bank, 2018

Figure 4 Electrification rates in the EAC region

The climate of the EAC varies vastly in the region, areas along the coast have a hot and humid climate, the highlands have a temperate climate and the lowlands have a hot and dry climate. High uptake of residential air conditioners is expected in the urban region due to high levels of electricity access in the urban region while the uptake of room air conditioners is highly depended on the climate with urban areas with hot and humid and hot and dry climates expecting a high uptake of room air conditioners. The electricity access at different countries in the region ranges between 11%- 75% as seen from Figure 4. High electrification rate is observed in the urban areas as compared to the rural areas and ranges between 46- 89% and 3-71% for urban and rural areas respectively (World Bank, 2018).

According to the East African Facts and Figures 2019, the total installed energy production capacity in the region by 2018 was 4,823 MW (EAC, 2019). Hydropower makes 44% of the total installed capacity while thermal generation takes 21% of the installed capacity. Natural gas, geothermal and bagasse form 19%, 14% and 2% for the total installed capacity. In 2018 the energy generation from the installed capacity was 23,300 GWh (EAC, 2019). **Error! Reference source not found.** shows the energy sources in the EAC and the installed capacity in the region. The region is mainly dominated by renewable energy sources with thermal energy sources from fossil fuels supplementing the peak demand. It is expected that with the increased demand of appliances in the cooling sector, the peak demand in the region will significantly increase. The uptake of energy efficient appliances will play a critical role in ensuring that there is a reduction in use of fossil fuels electricity sources in the generation mix to reduce greenhouse gas emission and the impact of global warming. The electricity tariffs in the region have significantly increased over the years. In 2018, the reported average electricity tariff for domestic consumers ranged from US\$ 0.13- 0.21 per kWh (EAC, 2019) while the tariffs in 2016 ranged between US\$ 0.09-0.18 (EAC, 2016).



Source: EAC, 2019

Figure 5 Electrification rates in the EAC region

4.2 Overview of the SADC Region

The SADC Region comprising 16 countries, shown in Figure 6, has a mandate to achieve regional development, peace and security, and economic growth, to alleviate poverty, enhance the standard and quality of life of the peoples of Southern Africa, and support the socially disadvantaged through regional integration, built on democratic principles and equitable and sustainable development. The strategic development of the energy sector in the SADC region is guided by the SADC Protocol on Energy which aims to promote harmonious development of regional and national energy policies, strategies and programs and matters of common interest for the balanced and equitable development of energy throughout the Region.



Figure 6 SADC Member States

4.2.1. Regional Energy Institutions

In its quest to attain regional development of the energy sector, the SADC Secretariat facilitated the establishment of three key institutions with an indispensable role in the harmonisation of regional and national policies, strategies and programs. The implementation of the harmonised MEPS for residential refrigerators and room air conditioners will leverage on the mandate of these institutions.

- **SACREEE** is mandated to contribute to increased regional energy access and energy security by promoting market-based adoption of renewable energy and energy efficiency. SACREEE has been mandated by the SADC Member States to play a key role in the implementation of the Southern Africa Renewable Energy and Energy Efficiency Strategy and Action plan (REEESAP) advocating for the implementation of MEPS and labelling programs in the SADC Region.
- **Regional Electricity Regulators Association of Southern Africa (RERA)** is a regional platform for effective cooperation among energy regulators within the SADC region. RERA's mission is to facilitate the harmonization of regulatory policies, legislation, standards and practices.

- **Southern Africa Power Pool (SAPP)** is mandated with the regional electricity coordination, planning and trading amongst utilities in the SADC Region.
- **Southern African Development Community Accreditation Services (SADCAS)** is a multi-economy accreditation body established with the primary purpose of ensuring that conformity assessment service providers (calibration/testing/medical laboratories, certification and inspection bodies) operating in those SADC Member States which do not have national accreditation bodies are subject to an oversight by an authoritative body.

4.2.2. Energy, Economic and Development Situation

The SADC countries are covering a total area of approximately 9.9 million km² and have a combined population of approximately 345 million inhabitants with an annual population growth rate of 2.5% (SADC, 2018). The largest population share in the SADC region in 2018 was from Democratic Republic of Congo (26.6%) followed by South Africa (16.7%) and Tanzania (15.7%) as summarised in Figure 7 (SADC, 2018).

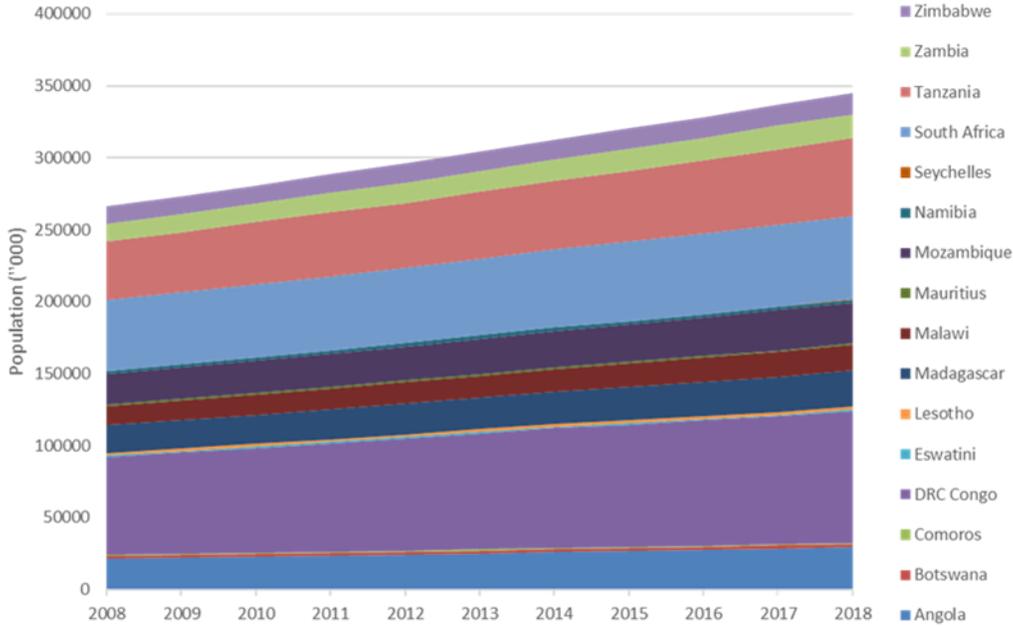


Figure 7 Population in SADC in thousand (2008 – 2018)

The combined GDP in 2018 amounted to 721 billion United States Dollar (USD) with an average GDP annual growth rate of 1.8% and an average inflation rate of 7.1% (SADC, 2018). The average GDP per capita for the region was at USD2,081, with the lowest from Malawi at 410 USD and the highest from Seychelles at 16,390 USD (SADC, 2018).

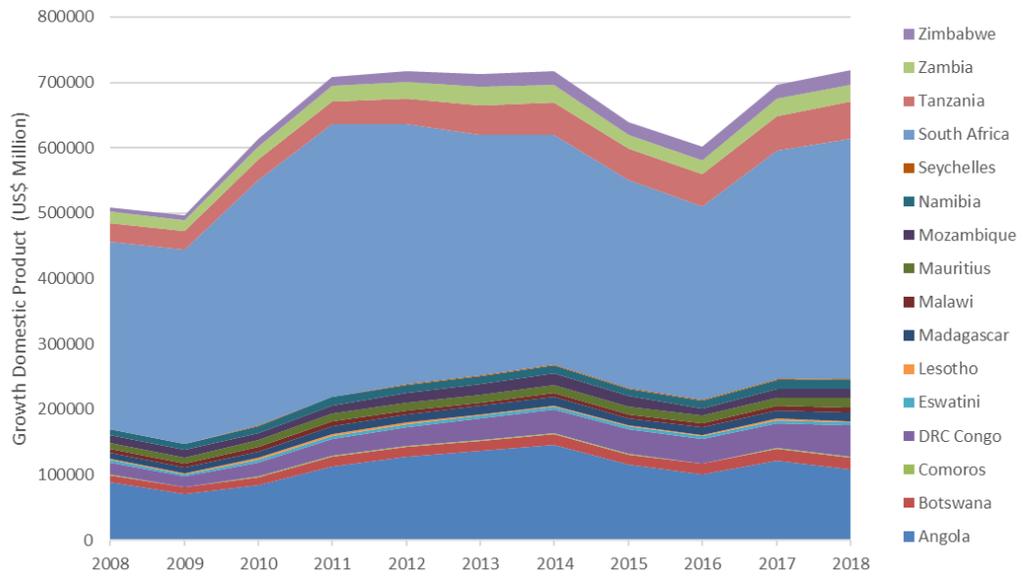


Figure 8 GDP in SADC at market prices in million USD (2008-2018)

In 2018 approximately 55% of the population in the SADC region had access to electricity. The access to electricity by country, as depicted in Figure 9, ranged between 18% and 100%, with the bulk of the countries falling in the 30 - 70% range (World Bank, 2018).

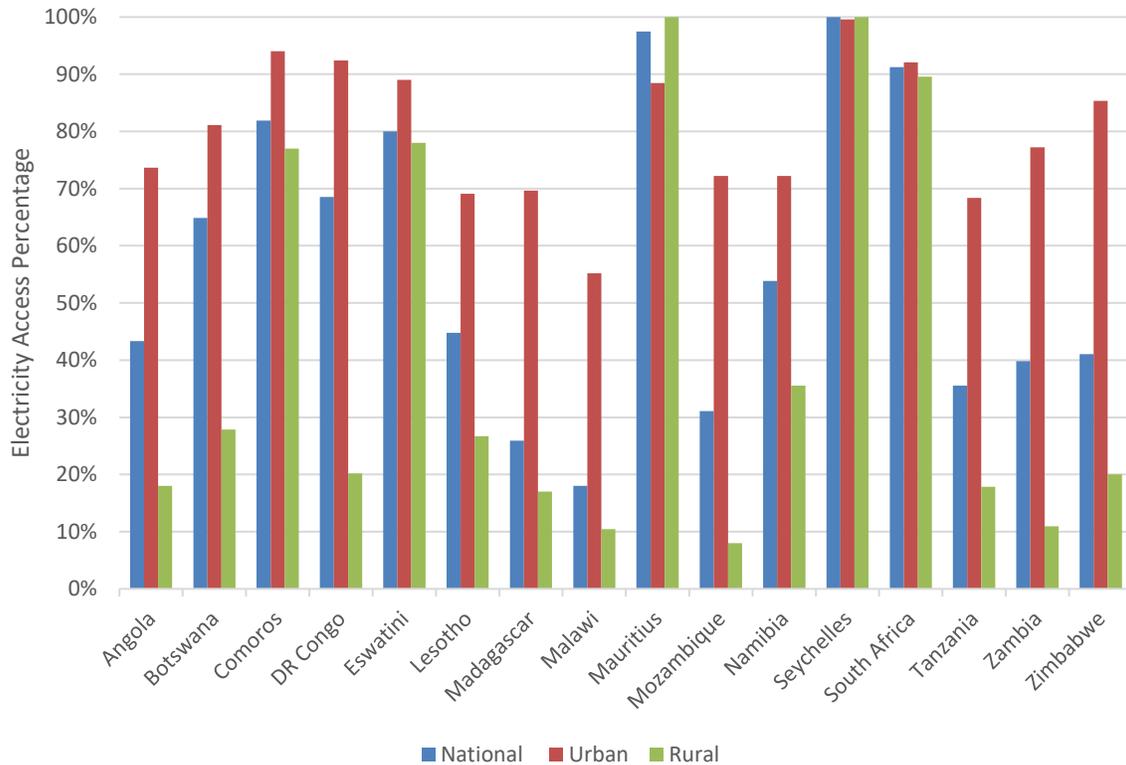


Figure 9 Electricity access by country in SADC (2018)

According to the Regional Infrastructure Development Master Plan Assessment Report of 2019 the regional power demand reached 58,100 MW in 2018 and it is expected to rise in the years to come. The operating capacity of installed power plants was reported to be 60,719 MW in 2019 (SADC, 2019). Coal continues to dominate the power generation space in SADC, and it remains one of the sources of greenhouse gas emissions contributing to the escalation of global warming. Electricity shortage continues to strain regional development since 2007 resulting in implementation of load shedding in several SADC countries. The slow development of power generation projects and availability of energy inefficient appliances are some of the contributing factors to the electricity shortage. In order to alleviate this prevailing situation in the region, SADC, amongst many initiatives, adopted the principle of cost-reflective tariffs as far back as 2004. However, most countries are failing to migrate to cost-reflective electricity tariffs due to challenges in raising local tariffs and existence of subsidies in their tariff structures. The average electricity tariffs ranged from 5 US cents/kWh to 14 US cents/kWh (SAPP, 2019).

5. Analysis of the Region on Room Air Conditioners and Residential Refrigerators

5.1 EAC

This section provides details of the institutions and stakeholders governing the uptake of room air conditioners and residential refrigerators in the EAC region and its member states. Regional and country policies, regulations, strategies and action plans promoting the adoption of energy-efficient room air conditioners and residential refrigerators in the EAC region and member states are outlined.

5.1.1 Drivers for Energy-Efficient Cooling Products

The extent of the benefits associated with efficient cooling will depend on the rate of uptake of energy-efficient cooling products in the region. The drivers for the adoption of these products will play a critical role in determining the levels of ambition with regards to achieving savings associated with efficient cooling. Factors that accelerate the uptake of energy-efficient cooling products in the region include:

- **Knowledge and Awareness:** Knowledge and awareness of the technological and environmental benefits of energy-efficient cooling products is a key driver that motivates the stakeholders to adopt these products in the market. With the necessary knowledge created from awareness, regulators develop the necessary policies to regulate the market, and the manufactures and importers provide the appropriate technologies to the market.
- **Policies:** Regional and national policies governing the use of energy-efficient cooling appliances, and the need for environmentally friendly refrigerants plays a critical role in restricting the use of inefficient appliances in the market. The analysis of the EAC cooling sector shows that member states with existing policies on cooling appliances have active programs that aim to accelerate the use of energy-efficient air conditioners and refrigerating appliances in the region.
- **Climate Change Mitigation:** Commitment of countries to the mitigation of effects of climate changes is a key driver to use of energy-efficient products in the cooling sector. Several countries in the EAC region have committed to global policies such as Kigali Amendment to Montreal Protocol which has led to the development of strategies that aim at reducing GHG emissions and the impact of climate change.
- **Financial Incentives and Programs:** High cost of energy-efficient cooling products is a key barrier to the adoption of the products in these regions. Provisions of financial incentives and programs that promote the use of energy-efficient cooling products are a crucial factor that ensures that energy-efficient products remain competitive in the market.
- **Energy Security and Prices:** Energy security can serve as a driver to the adoption of energy-efficient cooling products in the region. The growing population leads to increased energy demand in different sectors in the region, including the cooling sector. This consequently leads to increased energy prices and thus, efficient products in the cooling sector provides an alternative to reduce cooling costs

5.1.2 Regional Policies on Room Air Conditioners and Residential Refrigerators

The EAC does not have a common energy policy, available in other African regional groupings such as ECOWAS and SADC, despite its pivotal role as the regional organization addressing energy issues in the East Africa. The establishment of policies surrounding energy efficiency in the region is done at the country level. Energy efficiency policies, strategies, actions plan, MEPS and regulatory frameworks available to the EAC member states are summarized in Table 8.

Table 8 Summary of the energy policy framework in EAC

Country	Energy Policy	Energy Efficiency Policy	Energy Efficiency Strategy	MEPS for Refrigerators	MEPS for Air Conditioners	EE Regulation	Environmental Regulation	Kigali Amendment to Montreal Protocol
Kenya	Yes	No	Yes	Mandatory	Mandatory	Yes	Yes	On Process
Uganda	Yes	No	Yes	Voluntary	Voluntary	No	Yes	Ratified
Rwanda	Yes	No	Yes	Voluntary	Voluntary	No	Yes	Ratified
Burundi	No	No	No	No	No	No	No	No
South Sudan	No	No	No	No	No	No	No	No

(a) Energy Policy and Energy Efficiency Policies

An analysis of the data reveals that in the EAC, only Kenya, Uganda and Rwanda have put in place energy policies covering the energy sector. In the region, energy efficiency policies are embedded in the energy policy which is the case for Kenya and thus have regulations surrounding energy efficiency without a specific energy efficiency policy. Energy efficiency strategies are available in Kenya, Uganda, which provides the roadmap of the measures the countries plan to undertake to ensure that different sectors are energy efficient, including the cooling sector.

Environmental regulations are available in Kenya, Uganda and Rwanda. These regulations categorize refrigerating gases as controlled substances and outline the plan of the different phase-down plans for the use of specific refrigerants in these countries. Figure 10 shows the level of policy adoption in the EAC region.

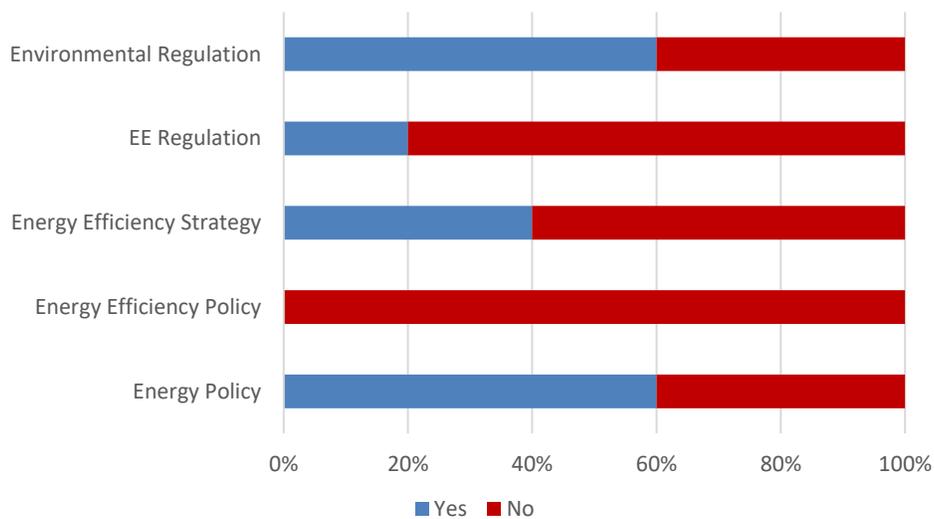


Figure 10 Level of policy adoption in the EAC region¹²

(b) Minimum Energy Performance Standards

The uptake of MEPS for residential refrigerators and room air conditioners in the EAC has been slow. In Kenya, the MEPS for air conditioners and refrigerators are mandatory, while in Rwanda the developed MEPS for air conditioners and refrigerators will come into force in January 2021. In Uganda, the existing standards that define the MEPS for air conditioners and refrigerators in the country have not been implemented due to lack of regulation enforcing the standards.

The definition of MEPS for air conditioners and refrigerators in the region is based on the technology type. For instance, the Rwanda National Cooling Strategy requires fixed compressor air conditioning appliances with a cooling capacity of less than 4.5 kW to have a minimum Rwanda Seasonal Energy Efficiency Ratio (RSEER) of 3.8. In contrast, an equivalent appliance with a variable compressor should have a minimum Rwanda Seasonal Energy Efficiency Ratio (RSEER) of 4.6 (MININFRA, 2019).

(c) Environmental Regulations

Kenya, Uganda and Rwanda have regulations that govern the use of refrigerating gases commonly regarded as controlled substances. These regulations aim at phasing out and phasing down the use of ozone-depleting substances which include: Chlorofluorocarbons, Bromochlorofluorocarbons, Halons, Carbon Tetrachloride, 1,1,1 Trichloroethane, Hydrobromofluorocarbons and Bromochloromethane.

The use of second-hand appliances is still common due to inadequate policies restricting the importation of used cooling appliances. In the EAC region, Rwanda is the only country that has initiated a ban on the importation of used electrical appliances, including air conditioners and residential refrigerators. Restrictions on the importation of second-hand appliances in Kenya are tied to the cost associated with the testing of the used appliances. Nevertheless, selling of second-hand appliances is still common in the

¹² Informed by Data by country focal points through the questionnaire in October 2020

region; for instance, Burundi reported that 13% of the refrigerators imported in the region are second-hand appliances. Also, the resale of locally used refrigerating appliances is common in most of the countries in the region.

In the region, Uganda and Rwanda have ratified the Kigali Amendment to Montreal Protocol that entered into force on 1st of January 2019. Kenya has initiated the ratification process for the protocol. In Rwanda, the refrigerants used for cooling appliances once the National Cooling strategy is implemented in January 2021 will have zero ozone-depleting potential (ODP) with the upper limits of GWP of the refrigerants used for different appliances and technologies provided. Uganda has laid out a phase-out and phase-down plan of ozone-depleting substances in the country under the Management of Ozone Depleting Substances and Products Regulation of March 2020.

5.1.3 Key Stakeholders and Institutions in the Cooling Sector

A number of institutions and entities were identified as key stakeholders that play a fundamental role in ensuring that environmentally friendly and energy-efficient cooling appliances are adopted in the EAC region. These bodies include regional bodies, government ministries, national regulation institutions and other national institutions, manufacturers, distributors, retailers, and cooling sector associations.

(a) Regional Bodies

Several institutions exist in the East African Community (EAC) promoting energy efficiency in the region. These include:

- **East African Centre for Excellence on Renewable Energy and Energy Efficiency (EACREEEE):** the centre is mandated to promote the uptake of renewable energy and energy efficiency in the EAC region, through activities such as capacity development, knowledge management and creation of awareness.
- **East African Power Pool (EAPP):** is mandated with the coordination and optimization of the regional electrical energy resources to create an affordable, sustainable and reliable electricity in the region through regional integration to foster electricity access among the population in the region.
- **Energy Regulators Association of East Africa (EREA):** The body is responsible for the establishment of the appropriate mechanisms that foster efficient and competitive energy market that fosters an energy union in the EAC. The Primary function of the association is to facilitate the development of policies, proposals and legislation that promote best practices in the energy sector in the East Africa region.
- **Common Market for Eastern and Southern Africa (COMESA):** is a free trade area with 21 Member States of which 4 are EAC countries namely; Kenya, Uganda, Rwanda and Burundi. COMESA endeavours to achieve sustainable economic and social progress in all Member States through increased co-operation and integration in all fields of development particularly in infrastructure development, Agriculture, Industry and private sector development, trade and custom services, gender and social affairs. COMESA is also on the drive to develop harmonised MEPS for its members.

- **East African Standards Committee (EASC):** is mandated with the coordination of activities relating to standardization, metrology and conformity assessment through monitoring and implementation of its activities at regional and national level. The committee also maintains the catalogue and authoritative texts declared East African Standards.

(b) In Country Institutions

The cooling sector regulators in EAC are at member state levels and include government agencies specializing in energy consumption and regulations, customs and environmental protection agencies. The regulators are mandated with the establishment of cooling appliances performance standards in the region. Table 9 shows the government institutions playing different roles in the cooling sector across EAC member states.

Table 9 Institution in cooling sector in EAC member states

Country	Ministries	Regulator	Standards body	Energy Efficiency Entity	Utility	Environment	Customs
Kenya	Ministry of Energy	Energy and Petroleum Regulation Authority	Kenya Bureau of Standards	None	Kenya Power	National Environmental Regulation Authority	Kenya Revenue Authority
Uganda	Ministry of Energy and Mineral Development	Electricity Regulatory Authority	Uganda National Bureau of Standards	None	Umeme	National Environmental Management Authority	Uganda Revenue Authority
Rwanda	Ministry of Infrastructure	Rwanda Utility Regulatory Authority	Rwanda Standards Board	None	Rwanda Energy Group	Ministry of Environment	Rwanda Revenue Authority
Burundi	Ministry of Hydraulics, Energy and Mines	Agence de Contrôle et de Régulation du secteur de l'eau potable et de l'électricité	Burundian Bureau of Standards and Norms	None	REGIDESO	National Environment and Nature Conservation Institute	Burundian Revenue Authority
South Sudan	Ministry of Energy and Dams	South Sudan Electricity Regulation Authority	South Sudan Bureau of Standards	None	South Sudan Electricity Corporation	Ministry of Environment	South Sudan National Revenue Authority

(c) Manufacturing of Room Air Conditioners and Residential Refrigerators

The East African Community has two refrigerator manufacturers namely: Gayaza electronic works manufacturing refrigerators in Uganda and Almaha manufacturing refrigerators and freezers in Rwanda. Table 10 shows the different refrigerating products manufactured by the manufacturers in the region. There are no manufacturers of room air conditioners in the EAC Region

Table 10 List of manufacturers in the EAC region

Country	Manufacturer	Products
Rwanda	Almaha	<ul style="list-style-type: none"> ● Chest Freezers ● Combined double door refrigerators
Uganda	Gayaza Electronic Works Limited	<ul style="list-style-type: none"> ● Chest freezers, ● Top freezer refrigerators ● Commercial refrigerators ● Bar refrigerators

(d) Stakeholders in the Distribution of Room Air Conditioners and Residential Refrigerators

The current production from the manufacturers in the region does not meet the demand; thus, most of the refrigerators in the region are imported. Room air conditioners and residential refrigerators in the region are imported from Asian countries such as China, Thailand and South Korea, with china being the major country of import the region. There are also significant imports from United Arab Emirates, Europe, and the USA. The customs in each of the member states play a critical role in ensuring the products in the regional market is of high energy performance which includes the control of the importation of second-hand appliances. From the questionnaire, it was established that there are no direct policies that prohibit the importation of second-hand appliances, although, in some countries like Kenya, the cost implication of second-hand testing appliances is prohibitive. Nevertheless, the importation of second-hand appliances was reported in the region with Burundi reporting significant value of 13%¹³ for second hand refrigerators being imported in the country.

The stakeholders involved in the distribution of room air conditioners and refrigerators in the region include; international brands with direct subsidiaries in the region, brand dealers or representatives of international companies and independent distributors. The retail of refrigerators is commonly from furniture stores, electrical and electronic shops, supermarkets and online stores

(e) Product Registration

From the information gathered in the region, only Kenya has a product registration system for air conditioners and refrigerating appliances. The product register is provided by the Energy and Petroleum Regulation Authority (EPRA) and is accessible to the public in the authority’s website. Importation of unregistered products is illegal in the country. In Rwanda, the Rwanda Utilities Regulatory Authority (RURA) is on the process of developing a product registration system as the country plans to implement the National Cooling Strategy in January 2021.

¹³ Informed by Data by country focal points through the questionnaire in October 2020

5.1.4 Analysis of the Regional Market on Cooling Products

This section presents the technology analysis of room air conditioners and residential refrigerators in the EAC region. The existing MEPS in the region and the impact of introducing harmonized MEPS for room air conditioners and residential refrigerators in the region is discussed.

5.1.4.1 Technology and Efficiency of Residential Refrigerators

Refrigerator importers are brand subsidiaries, brand dealers and individual importers importing common brands such as Samsung, LG, Armco and Gree. The common countries of import for the refrigerating appliances include China, India and Thailand (ITC, 2018). In 2018, Imports from China represented 34% of the total product value in the region with Thailand and India each representing 10%. Significant value of imports was also reported from Luxembourg, Denmark, South Africa, Italy among other countries (ITC, 2018). Common refrigerating appliances found in the region include chest freezers, freezer refrigerator, side by side door refrigerator and bar refrigerator illustrated in Figure 11.



Figure 11 Types of refrigerators and freezers found in the EAC region

In the EAC region, Kenya and Rwanda have developed energy labels for refrigerating appliances. While in Kenya the labels are mandatory, in Rwanda the implementation is planned for January 2021. Refrigerators labels in Kenya are outlined in Energy (Appliance Energy Performance and Labels) Regulation 2016 use appliance Star Rating Index (SRI) which is the ratio calculated from the appliance model comparative energy consumption and base energy consumption per annum. The MEPS required is that the appliance Projected MEPS Energy Consumption (PMEC) less than 7.4% the evaluated Projected MEPS cut-off level. Based on the SRI the refrigerating appliances are given a 1-5 Star labels with appliances with high SRI having high star ratings. The developed labels in Rwanda uses the Rwanda Seasonal Energy Efficiency Ratio (RSEER) developed using ISO and Cooling Seasonal Performance Factor with a Rwanda outdoor temperature distribution. Table 11 summarizes the developed labels in the region and the applicable country of development. According to the National Cooling Strategy, the maximum annual energy consumption (AEC_{max}) the refrigerating appliances is as follows; refrigerators is $0.183 \times AV^{14} + 120$,

¹⁴ AV is the Average Volume

refrigerator freezer $0.286 \times AV + 190$ and freezers is $0.238 \times AV + 193$. In addition, refrigerants used for refrigerating appliances must have a GWP of <20 and zero Ozone Depleting Potential.

Table 11 Comparison of Kenya and Rwanda Refrigerator Energy Labels for refrigerators

Kenya		Rwanda	
Star Equivalent	SRI	Grade	RSER
5	≥ 8.5	A	$2.0 \leq R$
4	$6.5 \geq SRI < 8.5$	B	$1.75 \leq R < 2.0$
3	$5.5 \geq SRI < 6.5$	C	$1.50 \leq R < 1.75$
2	$2.5 \geq SRI < 4.5$	D	$1.25 \leq R < 1.50$
1	$2.5 > SRI$	E	$1.00 \leq R < 1.25$

The adoption level of energy labels for refrigerating appliances is currently high in Kenya due to the existing regulation and product registration system. It was established that most of the refrigerating products registered for sale in Kenya market are rated 1-2 star. Other countries in the region have appliances with energy labels such as European Energy Label and the South African Energy Label European Energy Label and the India Energy Label depending on the country of origin of the appliance.

5.1.3.2 Technology and Efficiency of Room Air Conditioners

There is no manufacturing of air conditioners in the region; thus, all the room air conditioners in the market are imported. Most of the room air conditioners in the region are imported from countries such as China Thailand and South Korea and United Arab Emirates. Other countries of imports include; India, South Africa, Germany, Japan and USA. In 2018, Imports from China represented 49% of the total product value in the region with Thailand and Korea representing 17% and 11% of the product value imported the same year respectively (ITC, 2018). The common room air conditioner brands include Gree, LG, Samsung, Daikin, Toshiba, Von, Skyworth Sonashi and Samsung¹⁵. Standard room air conditioner technologies in the region include wall-mounted, ceiling cassette, portable units, window units, as shown in Figure 12. Fixed speed air conditioning appliances dominate the market, but the use of inverter technology appliances is becoming common in the region.

¹⁵ Data from country focal points through a questionnaire in October 2020.



Figure 12 Types of room air conditioners found in the EAC region

The analysis of questionnaire from the key focal in the EAC region, established that energy efficiency labels in the region are in place in Kenya and Rwanda. Air conditioners having Kenya Star Rating energy efficiency label are compliant to the labelling requirement of Energy (Appliances Energy and Labels) Regulation of 2016. In the Kenyan context, the energy star label for air conditioners, EER is used to determine the number of energy stars for the air conditioners. Labels for air conditioners in Rwanda are still under development. Different classes of air conditioners are based on the Rwanda Seasonal Energy Ratio (RSER) and the appliances' rated cooling capacity. A comparison of Kenyan star rating and the different classes of energy efficiency performance developed in Kenya and Rwanda are illustrated in Table 12.

Table 12 Comparison of Kenya and Rwanda Refrigerator Energy Labels for air conditioners

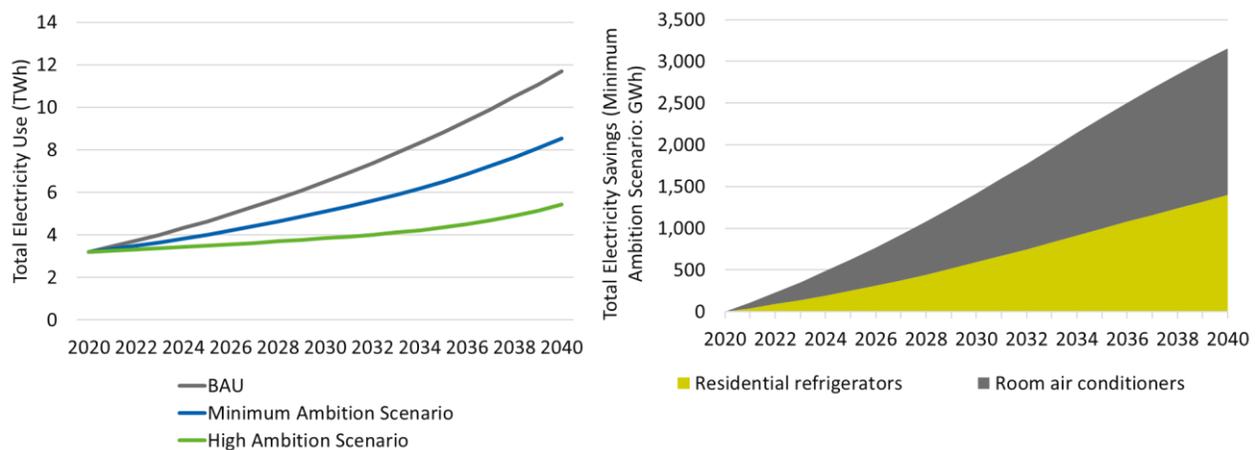
Kenya		Rwanda				
EER	Star Equivalent	Grade	Rated Cooling Capacity ≤ 4.5 kW	4.5 < Rated Cooling Capacity ≤ 9.5 kW	9.5 < Rated Cooling Capacity ≤ 16.0 kW	
5	Above 4.0	A	$6.9 \leq \text{RSSER}$	$6.40 \leq \text{RSSER}$	$5.90 \leq \text{RSSER}$	
4	3.75 to 3.70	B	$6.33 \leq \text{RSSER} < 6.90$	$5.91 \leq \text{RSSER} < 6.40$	$5.36 \leq \text{RSSER} < 5.90$	
3	3.15 to 3.40	C	$5.75 \leq \text{RSSER} < 6.33$	$5.38 \leq \text{RSSER} < 5.91$	$4.88 \leq \text{RSSER} < 5.5.36$	
2	2.8 to 3.10	D	$5.18 \leq \text{RSSER} < 5.75$	$4.84 \leq \text{RSSER} < 5.38$	$4.39 \leq \text{RSSER} < 5.4.88$	
1	Below 2.0	E	Variable (Split)	$4.60 \leq \text{RSSER} < 5.18$	$4.30 \leq \text{RSSER} < 4.84$	$3.90 \leq \text{RSSER} < 5.4.39$
			Fixed (Split)	$3.80 \leq \text{RSSER} < 5.18$	$3.50 \leq \text{RSSER} < 4.84$	$3.20 \leq \text{RSSER} < 5.4.39$
			Variable (Unitary)	$4.60 \leq \text{RSSER} < 5.18$	$4.00 \leq \text{RSSER} < 4.84$	$4.00 \leq \text{RSSER} < 5.4.39$

			Fixed (Unitary)	$3.50 \leq \text{RSSER} < 5.18$	$3.50 \leq \text{RSSER} < 4.84$	$3.50 \leq \text{RSSER} < 5.4.39$
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As mentioned earlier, most of the air conditioning appliances in the region are imported and thus some carry energy efficiency labels from their countries of origin. Commonly used room air conditioner labels reported in the region include; European Energy Label and South African Energy Label and Indian Energy Label.

5.1.3.3 Projected Market Demand for Room Air Conditioners and Residential Refrigerators

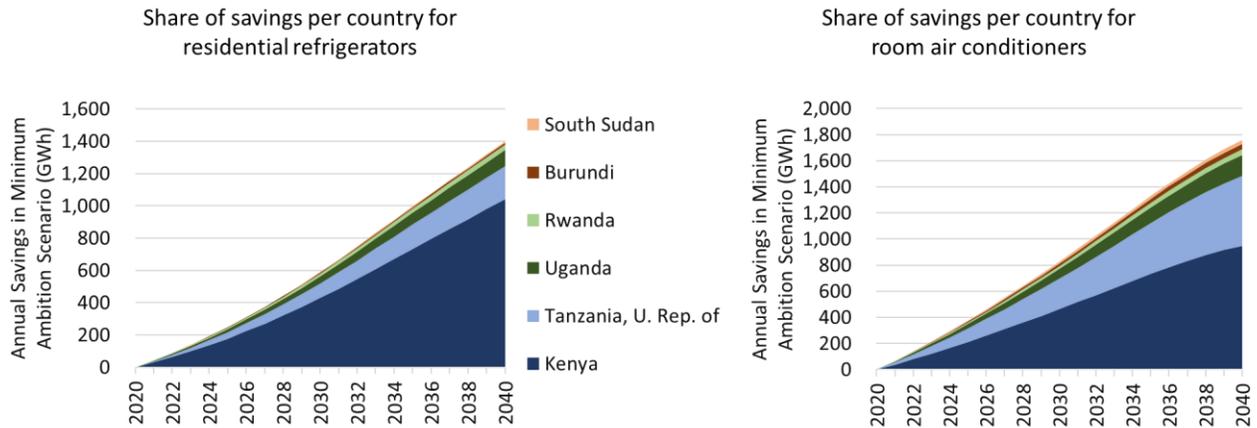
The adoption of energy-efficient room air conditioners and residential refrigerators will play a key role in the reduction of energy demand and greenhouse gas emission in the EAC region. According to an estimate of the UNEP-U4E CSA, the region could save 3.2 TWh by 2040 if the market would transition to energy-efficient room air conditioners and residential refrigerators. These savings are equivalent to the capacity of one Power station of 500MW, 2.3 Million tonnes of CO₂ savings and 366 Million USD through reduced electricity bills. The share of the savings is almost equal for room air conditioners and residential refrigerators: Room air conditioners represent 1.8 TWh, while the latter accounts for 1.4 TWh (UNEP-U4E, 2020). As illustrated in Figure 13, through the implementation of more stringent regulation, even higher savings could be achieved.



Source: UNEP-U4E 2020

Figure 13 Electricity savings in EAC through the transition to energy-efficient room air conditioners and residential refrigerators

Figure 14 displays the share of electricity savings per country for each of the products. Kenya represents for room air conditioners and residential refrigerators the biggest share and is followed by Tanzania.



Source: UNEP-U4E 2020

Figure 14 Share of savings in EAC per country

5.2 SADC Region

This section provides the general analysis of room air conditioning and residential refrigerators in the SADC region and its member states. The analysis provides details on the key factors driving the deployment of energy efficient cooling products, institutional arrangement and status of regional and country policies, regulations, strategies, standards, action plans and financial incentives that promote the deployment of energy efficient room air conditioners and residential refrigerators in the SADC region.

5.2.1 Drivers for Energy Efficient Cooling Products

The key drivers towards the implementation of MEPS to enhance the adoption of energy efficient refrigerators and room air conditioners include:

- **Inadequate Electricity Supply:** Inadequate electricity supply is one of the common challenges that threatens energy security in SADC countries. This phenomenon has prompted countries to implement policies that aim to improve the demand side of electricity, including the implementation of energy efficiency measures. The implementation of MEPS can enhance the adoption of energy efficient technologies and can address several challenges on the demand side.
- **Increasing Cost of Electricity:** The cost of electricity in the SADC region is expected to increase in the years to come due to the plans that have been established to improve the electricity supply within member states. The availability of regulated and energy efficient appliances, with low operation cost, in the market can alleviate the impact of high electricity tariffs on consumers
- **Climate Change:** The SADC region is experiencing abnormally high temperatures, especially in summer months, as a result of climate change. This has resulted in an increase in energy demand for refrigeration and space cooling. A region whose electricity generation is still dominated by coal resources, an increase in energy demand for cooling purposes will certainly make cooling a contributor to greenhouse gas emissions.

- **Phase out of Ozone Depleting Substances:** Ozone depleting substances are still in use in the SADC region even though countries have introduced legislation to prohibit their use. The transition to refrigerants with low GWP requires energy efficiency improvements of cooling products. Having MEPS that take into consideration phase out of Ozone Depleting substances will also contribute to the reduction of greenhouse gas emissions.

5.2.2 Regional Policies on Room Air Conditioners and Residential Refrigerators

The SADC Protocol on Energy 1996 has set the tone for the policy environment at regional level. Member States (MS) can derive their national policy frameworks using the protocol as a guide to ensure harmonised development of the energy sector. This protocol endeavours to harmonise regional and national energy policies, strategies, and programmes on matters of common interest based on equity, balance and mutual benefit. In 2016, SADC developed the Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP) aiming to accelerate the uptake of renewable energy and implementation of energy efficiency measures in SADC countries. Development of energy efficiency policies and strategies at country level is one of the strategic interventions identified in the REESAP. One of the priorities identified under energy efficiency is the regional coordination in the establishment of MEPS and appliance labelling programmes with the intention to strengthen the distribution of energy efficient appliances in all Member States (SADC, 2016). Energy efficient and environment friendly cooling is one of the areas that needs to be improved in order to reduce the consumption of electricity within SADC.

The status of policy and regulatory frameworks for air conditioners and refrigerators in the SADC is summarised in Table 13. These include the energy efficiency policies, strategies and action plans, MEPS, regulatory frameworks and financial incentives.

Table 13 Summary of the energy policy framework in SADC

Country	Energy Policy	Energy Efficiency Policy	Energy Efficiency Strategy	MEPS for Refrigerators	MEPS for Air Conditioners	EE Regulation	Environment Regulation	Financial Incentives
Angola	YES	NO	YES	NO	NO	NO	YES	NO
Botswana	Draft	NO	YES	NO	NO	NO	YES	NO
Comoros	NO	NO	NO	NO	NO	NO	YES	NO
DRC Congo	YES	NO	NO	NO	Voluntary	NO	NO	NO
Eswatini	YES	YES	YES	NO	NO	NO	YES	NO
Lesotho	YES	NO	NO	NO	NO	NO	YES	NO
Madagascar	YES	NO	NO	NO	NO	NO	YES	NO
Malawi	YES	NO	NO	NO	NO	NO	YES	NO
Mauritius	YES	YES	YES	Mandatory	NO	YES	YES	YES
Mozambique	YES	NO	Draft	NO	NO	NO	YES	NO
Namibia	YES	NO	NO	NO	NO	NO	YES	NO
Seychelles	YES	NO	YES	Voluntary	Voluntary	NO	YES	YES
South Africa	YES	YES	YES	Mandatory	Mandatory	YES	YES	NO
Tanzania	YES	NO	Draft	NO	NO	NO	YES	NO
Zambia	YES	NO	Draft	NO	NO	NO	YES	NO
Zimbabwe	YES	Under Development	YES	NO	NO	NO	YES	NO

a) Energy Policy and Energy Efficiency Policies

An analysis of the data, as depicted in Figure 15, reveals that 88% of SADC countries have put in place energy policies covering the entire energy sector. Only Comoros was found to not have an energy policy. Botswana has completed the draft policy and is currently awaiting approval. It was observed that most SADC countries have energy policies that do not address energy efficiency in detail. In most countries the policy refers to the promotion of energy efficiency measures in different sectors. Very few countries, like South Africa, have prescribed a clear policy direction on energy efficient and environment friendly cooling, such as the establishment of the standards and labelling program for the household appliances in their energy policy.

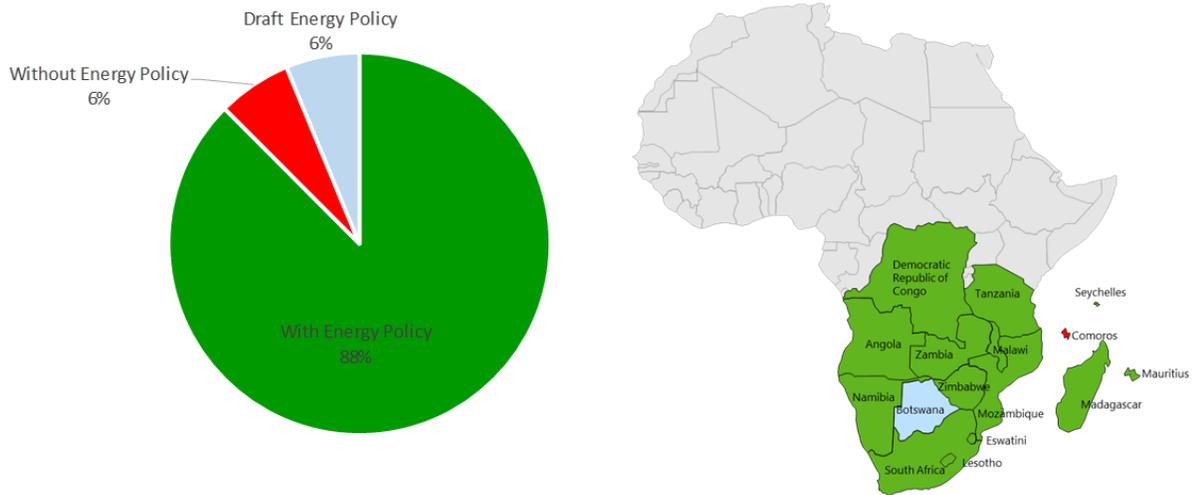


Figure 15 Existence of energy policies in SADC region

The REEESAP encourages SADC countries to develop dedicated energy efficiency policies with the much-needed details to increase the implementation of energy efficiency measures in the respective countries. Figure 16 reveals most SADC countries do not have energy efficiency policies. Eswatini, Mauritius and South Africa are only countries having enacted detailed energy efficiency policies. Zimbabwe has started the process to develop its energy efficiency policy.

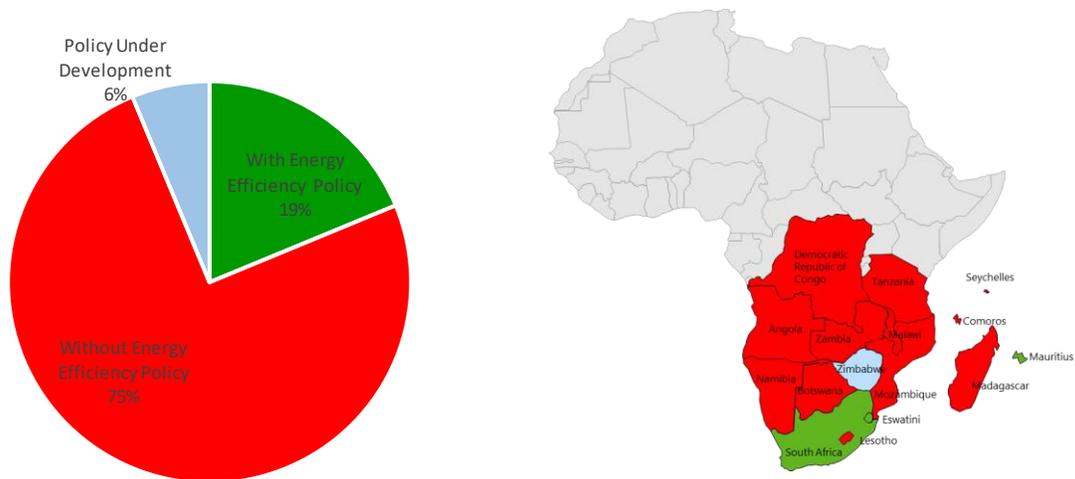


Figure 16 Existence of energy efficiency policy in SADC

In terms of energy efficiency strategies, Figure 17 shows that only 50% of the SADC countries have put in place strategies and action plans that aim to establish standards and labelling programs for household appliances. These countries include Angola, Botswana, Eswatini, Mauritius, Seychelles, South Africa, and Zimbabwe. Tanzania has completed the draft strategy and awaiting approval.

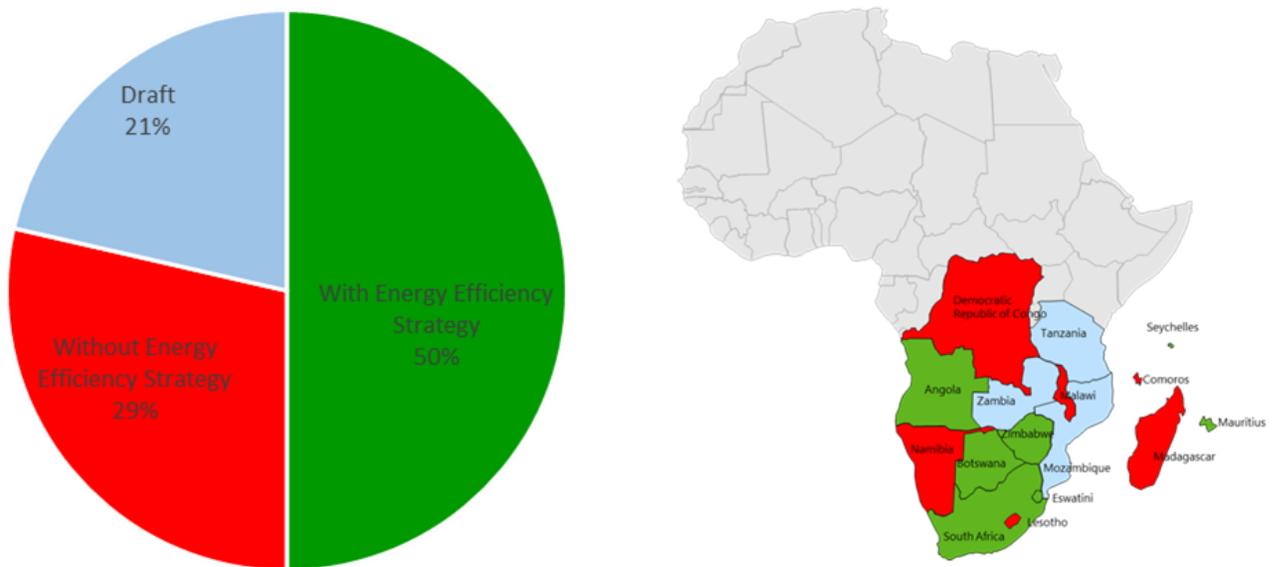


Figure 17 Existence of energy efficiency strategies in SADC countries

b) Minimum Energy Performance Standards

The SADC Region is lagging behind when it comes to development of MEPS for air conditioners and refrigerators. South Africa, Mauritius and Seychelles are the only countries that have put in place MEPS for refrigerators, as shown in Figure 18. Zimbabwe has started the process to introduce MEPS for refrigerators.

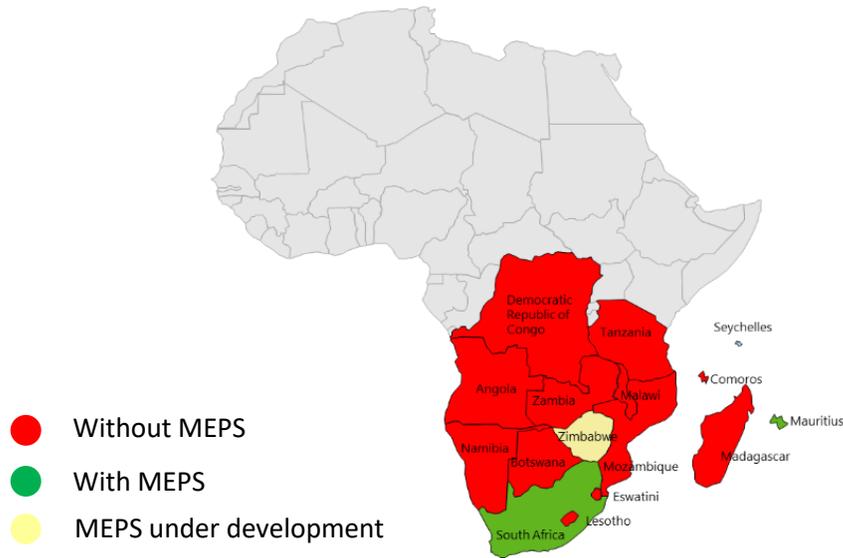


Figure 18 Presence of MEPS for refrigerators in SADC

For air conditioners, Figure 19 shows that MEPS exist in the Democratic Republic of Congo, Seychelles and South Africa. Seychelles is the only country having voluntary standards for both air conditioners and refrigerators. Zimbabwe has started the process to introduce MEPS for refrigerators.

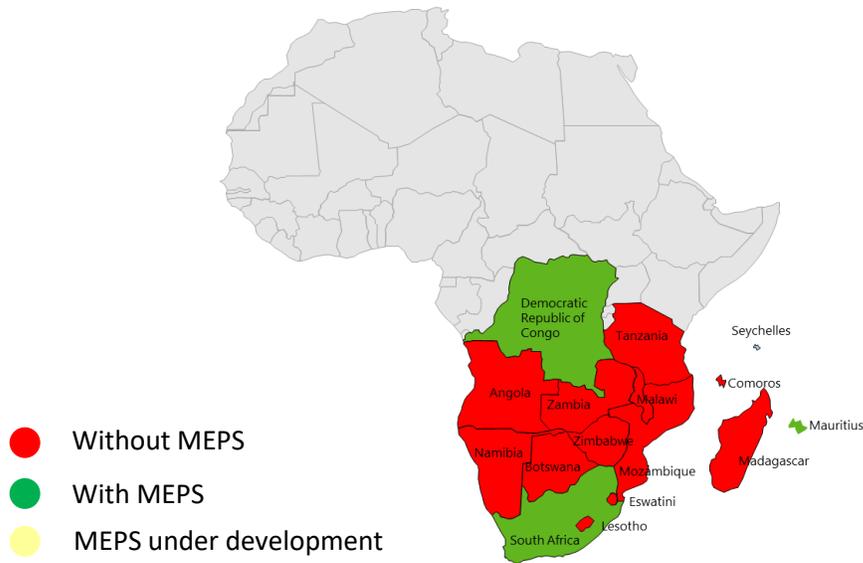


Figure 19 Presence of MEPS for air conditioners in SADC

In terms of enforcement, Mauritius enacted the Energy Efficiency (Labelling of Regulated Machinery) Regulations of 2017 which currently applies to three (3) regulated appliances (household electric dishwashers, household electric ovens and household refrigerating appliances). A draft amendment to the Energy Efficiency (Labelling of Regulated Machinery) Regulations 2017 which will extend the mandatory energy labelling to air conditioners and washing machines is underway and is expected to come into force by the end of 2020¹⁶.

South Africa enacted the Compulsory Specification for Energy Efficiency and Labelling of Electrical and Electronic Apparatus (VC9008) which require several household appliances, including room air conditioners, and refrigerators and freezers, sold in South Africa to comply with the country's set of MEPS and labelling system¹⁷.

c) Environment Regulations

In response to the Montreal Protocol on Substances that Deplete the Ozone Layer, SADC countries have put in place regulations and phase down schedule for ozone depleting substances, including:

- a) Chlorofluorocarbons;
- b) Bromo Chlorofluorocarbons;
- c) Halons;
- d) Carbon Tetrachloride;
- e) 1,1,1 Trichloroethane;
- f) Hydrobromofluorocarbons; And
- g) Bromochloromethane.

South Africa is now one of the countries that have ratified the Kigali Amendment to the Montreal Protocol, which commits South Africa to start the phase down of HFC's from 2024.

These initiatives have resulted in the introduction of several refrigerant gases that have low GWP, such as the R600a.

d) Financial Incentives

Very few countries have introduced financial incentives to support the deployment of energy efficient room air conditioners and refrigerators in SADC. These countries include Mauritius, and Seychelles:

- **Seychelles:** In the absence of regulations to enforce MEPS, Seychelles introduced VAT exemption for air conditioners and refrigerators as a financing mechanism to support the deployment of these energy efficient products. The eligibility criterion uses the existing energy efficiency grading displayed on the labels from other countries/regions for the refrigerators and Energy Efficiency Ratio for Air conditioners. The current applicable standard VAT rate is 15%¹⁸.

¹⁶ Data was obtained from the questionnaire in October 2020.

¹⁷ Data was obtained from the questionnaire in October 2020.

¹⁸ Data was obtained from the questionnaire in October 2020.

- **Mauritius**, through the Mauritius Revenue Authority imposes a 25% levy on energy inefficient appliances, including refrigerators and air conditioners based on their EEI and energy efficiency ratio, respectively. The thresholds for the application of the levy are set by a Technical Committee on Energy Standards and Labelling¹⁹.

5.2.3 Key stakeholders and Institutions in the Cooling Sector

There are several types of institutions that were identified and are instrumental in the deployment of environmentally friendly and energy efficient cooling. These include regional bodies, government ministries, national regulatory institutions, national environmental institutions, manufacturers, distributors and retailers, air conditioner and refrigerator associations and maintenance and service personnel.

A) Regional Bodies

- **SACREEE** is mandated to contribute to increased regional energy access and energy security by promoting market-based adoption of renewable energy and energy efficient products/technologies SACREEE is mandated to support:
 - The sustainable development objectives of SADC Member States by promoting the use of renewable energy and energy efficiency technologies and energy services;
 - the regional sustainable development objectives through resource mobilisation, policy formulation, quality assurance, capacity building and knowledge management, communication, promoting investments in renewable energy and energy efficiency projects and programmes;
 - the implementation of the Southern Africa Renewable Energy and Energy Efficiency Strategy and Action plan.
- **SAPP** is mandated with the regional electricity coordination, planning and trading amongst utilities in the SADC Region. The SAPP has 12 member countries represented by their respective electric power utilities organized through SADC. SAPP coordinates the planning and operation of the electric power system among member utilities. It also provides a forum for regional solutions to electric energy problems, including encouraging and supporting its members to implement energy efficiency measures.
- **SADCAS** is mandated by the SADC Council of Ministers to coordinate standardisation activities and services in the region with the purpose of achieving harmonization of standards in support of the objectives of the SADC Protocol on Trade. The organisation is working under the umbrella of the SADC Expert Group that is responsible for coordinating regional standardisation, quality assurance, accreditation and metrology activities.
- **Regional Energy Regulators Association of Southern Africa (RERA)** is mandated by the SADC Council of Ministers as a capacity building institution to facilitate the harmonization of regulatory policies, legislation, standards and practices and to be a platform for effective cooperation among energy

¹⁹ Data was obtained from the questionnaire in October 2020.

regulators within the SADC region. Currently the organisation is undergoing a transformation into an authority that aims to deal with regulatory issues related to cross-border energy trade and investment in the region. The proposed name for this new regional specialized institution is SADC Regional Energy Regulatory Authority (SARERA).

- **Southern African Customs Union (SACU)** is a customs union covering only five countries, namely Botswana, Eswatini, Lesotho, Namibia and South Africa. SACU aims to maintain the free interchange of goods between member countries. It provides for a common external tariff and a common excise tariff to this common customs area. All customs and excise collected in the common customs area are pooled into South Africa's National Revenue Fund. The Revenue is then shared among members according to an agreed revenue-sharing formula.
- **Common Market for Eastern and Southern Africa (COMESA)** is a free trade area with 21 Member States of which 9 are SADC countries, namely Comoros, the Democratic Republic of the Congo, Eswatini, Madagascar, Malawi, Mauritius, Seychelles, Zambia and Zimbabwe. COMESA endeavours to achieve sustainable economic and social progress in all Member States through increased co-operation and integration in all fields of development particularly in trade, customs and monetary affairs, transport, communication and information, technology, industry and energy, gender, agriculture, environment and natural resources. COMESA is also on the drive to develop harmonised MEPS for its members.

B) In Country Institutions

The actors involved in the implementation of energy efficiency measures, energy efficient residential refrigerators and room air conditioners are summarised in

Table 14. These include ministries, regulators, standards bodies, utilities, energy efficiency agencies, environment agencies and, customs and excise department.

Table 14 Institutions cooling sector in SADC member states

Country	Ministries	Regulators	Standards Body	Energy Efficiency entity	Utility	Environment	Customs
Angola	Ministry of Energy and Water of Angola	Instituto Regulador do Sector Eléctrico (IRSE)	<ol style="list-style-type: none"> Instituto Angolano de Normalização e Qualidade – IANORQ Instituto Angolano de Acreditação - IAAC 	None	Rede Nacional de Transporte de Electricidade		
Botswana	Ministry of Mineral Resources, Green Technology and Energy Security	Botswana Energy Regulatory Agency (BERA)	Botswana Bureau of Standards	None	Botswana Power Corporation,	Ministry of Environment, Natural Resources Conservation and Tourism	Botswana Unified Revenue Services
Comoros	Ministry of Production, Environment , Energy, Industry and Handicrafts	None	None	None	<ol style="list-style-type: none"> Gestion de l’Eau et de l’Electricité aux Comores (MAMWE) Electricité d’Anjouan (EDA) 	Ministry of Production, Environment, Energy, Industry and Handicrafts	Central Revenue Department
DRC Congo	Ministry of Mines, Energy and Hydrocarbons	Electricity Regulation Authority	Office Congolais de Contrôle	None	Société National d’Electricité (SNEL)	Ministry of the Environment, Nature Conservation and Tourism	Ministry of Finance, Department of Revenue and Custom

Country	Ministries	Regulators	Standards Body	Energy Efficiency entity	Utility	Environment	Customs
Eswatini	Ministry of Natural Resources and Energy	Eswatini Energy Regulatory Authority (ESERA)	Eswatini Standards Authority (SWASA)	Being Established	Eswatini Electricity Company	1. Ministry of Tourism and Environmental Affairs 2. Eswatini Environment Authority	Eswatini Revenue Authority
Lesotho	Ministry of Energy and Meteorology	Lesotho Electricity and Water Authority	Department of Standards and Quality Assurance under the Ministry of Trade and Industry	None	Lesotho Electricity Corporation	Ministry of Tourism, Environment and Culture	Lesotho Revenue Authority
Madagascar	Ministry of Energy and Hydrocarbons	Board of Electricity Regulation	Madagascar Bureau of Standards	None	JIRAMA – Jiro sy Rano Malagasy	Ministry of the Environment and Sustainable Development	Madagascar Revenue Authority
Malawi	Ministry of Natural Resources, Energy and Mining	Malawi Energy Regulatory Authority	Malawi Bureau of Standards	None	Electricity Supply Corporation of Malawi	Ministry of Natural Resources, Energy and Environment	Malawi Revenue Authority
Mauritius	Ministry of Energy and Public Utilities	Utility Regulatory Authority	Mauritius Standards Bureau	None	Central Electricity Board	Minister of Environment, Solid Waste Management and Climate Change	Mauritius Revenue Authority.

Country	Ministries	Regulators	Standards Body	Energy Efficiency entity	Utility	Environment	Customs
Mozambique	Ministry of Mineral Resources and Energy	Autoridade Reguladora de Energia – ARENE	Instituto Nacional de Normalização e Qualidade (INNOQ)	None	Electricidade de Moçambique	Ministry of Land and Environment.	Mozambique Revenue Authorities
Namibia	Ministry of Mines and Energy	Electricity Control Board	Namibian Standards Institution	Namibia Energy Institute	Namibia Power Corporation Regional Electricity Distributors	Ministry of Environment and Tourism	Namibia Revenue Authority
Seychelles	Ministry of Environment, Energy and Climate Change	Seychelles Energy Commission	Seychelles Bureau of Standards	Seychelles Energy Commission	The Public Utilities Corporation (PUC)	Ministry of Agriculture, Environment and Climate Change.	Seychelles Revenue Authority
South Africa	Department of Mineral Resources and the Department of Energy (DMRE)	1. The National Energy Regulator of South Africa (NERSA) 2. National Regulator for Compulsory Specifications (NRCS)	The South African Bureau of Standards (SABS)	The South African National Energy Development Institute (SANEDI)	ESKOM Municipalities	The Department of Environmental Affairs	South African Revenue Service
Tanzania	Ministry of Energy	Energy and Water Utilities Regulatory Authority	Tanzania Bureau of Standards	None	Tanzania Electric Supply Company Limited (TANESCO)	National Environment Management Council	Tanzania Revenue Authority

Country	Ministries	Regulators	Standards Body	Energy Efficiency entity	Utility	Environment	Customs
Zambia	Ministry of Energy	Energy Regulation Board	1. Zambia Bureau of Standards (ZABS), 2. Zambia Compulsory Standards Agency (ZCSA)	None	ZESCO	Ministry of Water Development, Sanitation and Environmental Protection	Zambia Revenue Authority
Zimbabwe	Ministry of Energy and Power Development	Zimbabwe Energy Regulatory Authority	Standards Association of Zimbabwe	None	Zimbabwe Electricity Supply Authority,	Ministry of Environment, Water and Climate	Zimbabwe Revenue Authority

D) Manufacturing of Room Air Conditioners and Residential Refrigerators

The manufacturing of residential refrigerators is happening in Eswatini, South Africa, and Zimbabwe. Table 15 presents a list of refrigerator manufacturers found in the three countries.

Table 15 List of manufacturers in the SADC region

Country	Manufacturer	Products
Eswatini	The Fridge Factory (Palfridge)	<ul style="list-style-type: none"> ● Chest Freezers & Combined double door refrigerators ● Commercial refrigerators
South Africa	Whirlpool/KIC Defy Hisense (assemble plant)	<ul style="list-style-type: none"> ● Chest freezers, ● standing freezers and refrigerators ● Combined double refrigerators ● Side by side door refrigerators
Zimbabwe	CAPRI Imperial/Commercial Refrigeration REF AIR DELFY	<ul style="list-style-type: none"> ● Domestic fridges and freezers ● Freezers, fridges, chillers, ● Coldrooms and Freezers ● Display freezers

There are no manufacturers of room air conditioners in the SADC Region.

E) Stakeholders in the Distribution of Room Air Conditioners and Residential Refrigerators

The bulk of residential refrigerators sold in the region are imported from international production facilities located outside of the SADC region. Refrigerators are sold to consumers through furniture stores, household appliance stores, electrical and electronic shops and online stores, hence the actors in these platforms form part of the key stakeholders. Based on the information gathered from the country questionnaire, South Africa plays a significant role in the distribution of residential refrigerators, as most of the household appliance stores found across the region originate from South Africa. The oceanic states import residential refrigerators from Europe, China, and India.

The supply of room air conditioners is completely characterised by imports from various parts of the world. Air conditioning units are generally not “off-the shelf” items as such they require the services of an agency that can also provide after sales services, such as maintenance services. The key stakeholders involved in the distribution of room air conditioners in the region can be categorised as follows:

- International brands with direct subsidiaries in the local market,
- Representatives or agencies, distributing on behalf of international companies
- Independent distributors who sell room air conditioners under their own brands.

South Africa plays a significant role in the distribution of room air conditioners, as most of these agencies and distributors are headquartered in South Africa. Moreover, South Africa was found to be the main entry point of room air conditioners imported into the region.

F) Product Registration

A product registration system for air conditioners and refrigerators exists in only three countries in the region, namely Mauritius, Seychelles, and South Africa.

- **Mauritius** has established an online registration system known as the Energy Efficiency Information Management System (EEIMS), which facilitates the registration of both dealers and the three regulated appliances (household electric dishwashers, household electric ovens and household refrigerating appliances) commercialised in Mauritius²⁰.
- **Seychelles'** product registration system for air conditioners and refrigerators is under the administration of the Seychelles Energy Commission. Currently importers of air conditioners and refrigerators compliant to the minimum energy requirements are exempted from paying VAT. Seychelles' product registration system was established for products that qualify for the VAT exemption. If a product is non-compliant, the importer, irrespective of their status (VAT registered and non-VAT registered businesses as well as private individuals) and irrespective of the purpose of the import (for commercial and private/personal use), must pay VAT with the Customs Department at the point of entry²¹.
- **South Africa's** product registration system for the regulated room air conditioners and refrigerators is administered by the NRCS. All manufacturers and distributors of air conditioners and refrigerators must be issued with a Letter of Agreement before it is sold to the market. South Africa is developing a new product registration system which is currently being tested. It is expected to become mandatory in 2021²².

5.2.4 Analysis of the Regional Market on Cooling Products

This section presents the technology analysis of room air conditioners and residential refrigerators in the SADC region. It also provides information regarding the electricity consumption for air conditioners and refrigerators in the SADC region as a result of introducing harmonised MEPS.

²⁰ Data was obtained from the questionnaire in October 2020.

²¹ Data was obtained from the questionnaire in October 2020.

²² Data was obtained from the questionnaire in October 2020.

5.2.4.1 Technology and Efficiency of Residential Refrigerators

The different refrigerator designs found in the SADC region include chest freezers, upright freezer/refrigerator only, combined refrigerator-freezer, French door refrigerator, side by side refrigerator, as shown in Figure 20. The common brands include Samsung, Defy, Bosch, LG, Hisense, Siemens, Whirlpool, KIC, Kelvinator, AEG, Ocean, Russell-Hobbs, and Sansui, to name a few. These brands come with refrigeration systems that are either frost free or direct cool systems. The frost-free refrigerators are expensive when compared to the direct cool units. A majority of households that have access to electricity in the respective countries were found to have a refrigerator in their homes. With electricity access around 50%, the demand for refrigerators is certainly going to increase in response to increased electricity access and the continued rise in temperatures in the region.



Figure 20 Types of residential refrigerators found in the SADC region

Information gathered from the questionnaires from Members States confirmed that most refrigerators sold in the region originate from South Africa hence the South Africa energy efficiency label was found displayed on the products. There are other labels that were found in the region, mainly from European Union, India, China, United Arab Emirates, and Kenya. Refrigerators having the South Africa energy efficiency label are compliant to South Africa's standards and labelling requirements elucidated in VC9008 Regulation which require refrigerator-freezers and freezers to have a minimum energy efficiency rating of Class B ($55 \leq \text{EEI} < 75$) and Class C ($75 \leq \text{EEI} < 90$) respectively, as shown in Table 16 (SA, 2017). In the South African context, EEI is used to determine the energy label class for refrigerators and freezers. Mauritius adopted the European Union energy efficiency label²³ having similar requirements with the South Africa's label shown in Table 16.

²³ Data was obtained from the questionnaire in October 2020.

Table 16 Comparison of label classes in South Africa and Europe for refrigeration appliances

Label Class	SANS EEI	Current EU 1060/2010
A+++	N/A	EEI < 22
A++	EEI < 30	22 ≤ EEI < 33
A+	30 ≤ EEI < 42	33 ≤ EEI < 42*
A	42 ≤ EEI < 55	*42 ≤ EEI < 55
B	55 ≤ EEI < 75	55 ≤ EEI < 75
C	75 ≤ EEI < 90	75 ≤ EEI < 95

The bulk of residential refrigerators sold to consumers have higher energy efficiency class ('A' or best available option) than the current MEPS level. This shows the commitment of manufacturers in continuous improvement of products thus ensuring the market is supplied with energy efficient products. The resale of used or refabricated residential refrigerators is happening but not very common across the region. Information gathered from the questionnaires, there are countries, such as Comoros, Malawi and the Democratic Republic of the Congo, that reported importation of used residential refrigerators mainly from overseas countries.

5.2.4.2 Technology and Efficiency of Room Air Conditioners

Room air conditioners are mainly used in the commercial and residential sectors. The types of room air conditioners sold across the region include the split type, window, and portable, as shown in Figure 21. The common brands include Samsung, LG, GREE, Carrier, AEG, York, Midea, Panasonic, Alliance, Siemens, Hitachi, Hisense, Goldair, Chigo, Sharp, and Bosch. These brands supply both the inverter and non-inverter type of technologies. The inverter type air conditioners are widely used in the region. Most Member States reported that room air conditioners sold in their markets have the South Africa energy efficiency label. There are other labels that were found, mainly from European Union, India, China, and United Arab Emirates.



Figure 21 Types of air conditioners found in the SADC region

Air Conditioners having the South Africa energy efficiency label are compliant to South Africa’s standards and labelling requirements elucidated in VC9008 Regulation which require room air conditioners to have a minimum energy efficiency rating Class B. The Energy Efficiency Ratio (EER, kW/kW) is used to grade the energy efficiency of the different types of air conditioners, as shown in Table 17. The classes marked in red are not permitted according to South Africa’s standards. The minimum EER requirements for split air conditioners in the Seychelles is equivalent to Class B ($3.2 \geq \text{EER} > 3.0$) of the South African minimum energy efficiency requirements²⁴. It was established that the energy ratings of most room air conditioners sold in the region have an energy efficiency rating of Class A or best available option.

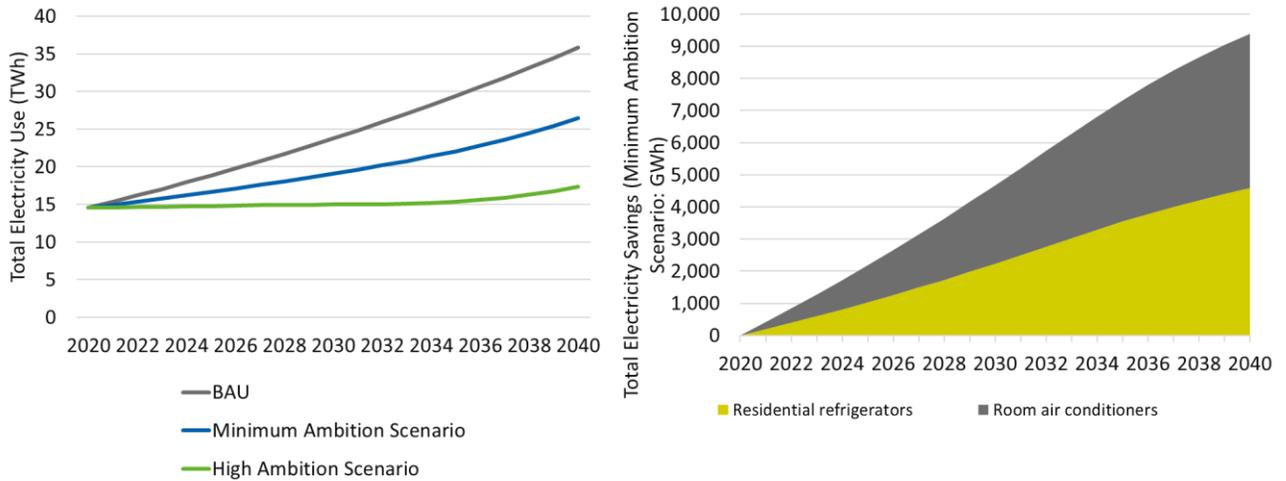
Table 17 Comparison of efficiency level by label class for the three-room air conditioners in South Africa

Efficiency level	Split	Portable	Window
$\text{EER} > 3.6$	A++	A	A
$3.6 \geq \text{EER} > 3.4$	A+	A	A
$3.4 \geq \text{EER} > 3.2$	A	A	A
$3.2 \geq \text{EER} > 3.0$	B	A	A
$3.0 \geq \text{EER} > 2.8$	C	A	B
$2.8 \geq \text{EER} > 2.6$	D	A	C
$2.6 \geq \text{EER} > 2.4$	E	B	D

5.2.4.3 Projected Market Demand for Room Air Conditioners and Residential Refrigerators

According to an estimate of the UNEP-U4E CSA the region could save approximately 9.4 TWh by 2040 if the market would transition to energy-efficient room air conditioners and residential refrigerators. These savings are equivalent to the capacity of 4 power stations of 500MW. Approximately 6.9 Million tonnes of CO₂ savings and 760 Million USD through reduced electricity bills could be realised. The share of the savings is almost equal for room air conditioners and residential refrigerators: Room air conditioners represent 4.8 TWh, while the latter accounts for 4.6 TWh as depicted in Figure 22. The graph shows the implementation of a more stringent regulation (under the high ambition scenario) can result in even higher savings (UNEP-U4E, 2020).

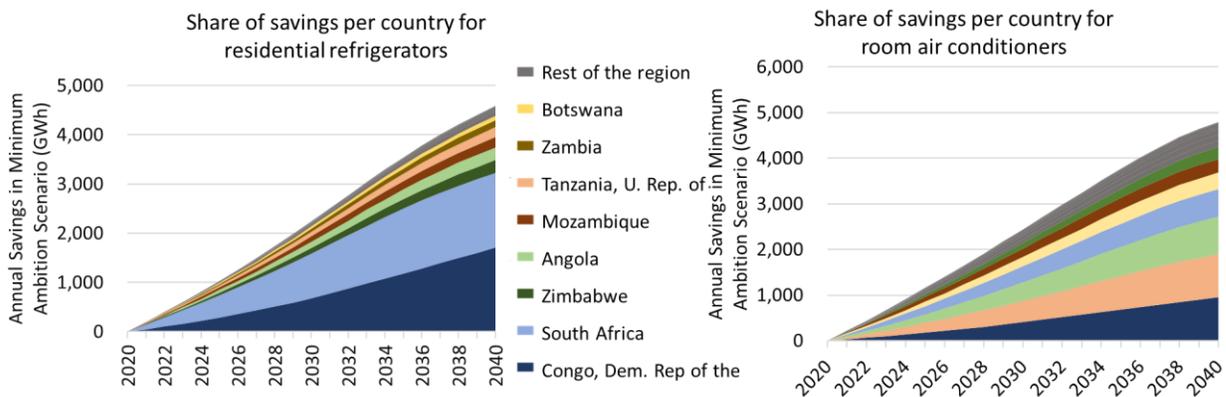
²⁴ Data was obtained from the questionnaire in October 2020.



Source: UNEP-U4E 2020

Figure 22 Electricity savings in SADC through the transition to energy-efficient room air conditioners and residential refrigerators

Figure 23 displays the share of electricity savings per country for each of the products. The Democratic Republic of Congo represents the biggest share of savings for room air conditioners and residential refrigerators, and is followed by South Africa for residential refrigerators and by Tanzania for room air conditioners.



Source: UNEP-U4E 2020

Figure 23 Share of electricity savings in SADC per country

6. Country Specific Assessments on Room Air Conditioners and Residential Refrigerators

In addition to the analysis at the regional level, this chapter presents a detailed analysis for the room air conditioners and residential refrigerators market of a representative set of countries for each region.

6.1 EAC Region

This chapter delivers more information on the cooling market in Kenya, Rwanda and Uganda which had been selected as representatives for the region.

6.1.1 The Republic of Kenya

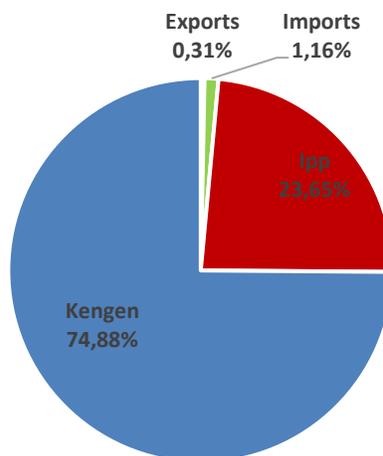
The Republic of Kenya is located in the eastern equatorial region and covers a total area of 580,000 km². The country borders South Sudan and Ethiopia in the north, the United Republic of Tanzania in the south, Somalia in the East and Uganda in the west. Kenya has a total population of 47.8 million, of which 73% of the population is found in the rural areas and 27% in urban areas (World Bank, 2018). The climate of Kenya varies vastly across the different regions in the country. Generally, the coastal region is hot and humid the highlands have a temperate climate while the lowlands are hot and dry. In 2018 the total GDP was reported to be USD 87.9 billion, and the GDP per Capita of USD 1,707.9 (World Bank, 2018). Summary of the energy and economic indicators of Kenya is provided in Table 18.

Table 18 Overall energy and economic indicators for Kenya

Indicator	Data
Population 2018 ¹	47.8 Million
GDP in 2018 ¹	87.9 Billion USD
GDP per Capita 2019 ¹	1,707.9 USD
Access to electricity 2018 (% Population) ¹	75%
Access to electricity 2018 (% Urban Population) ¹	84%
Access to electricity (% rural Population) ¹	72%
System Maximum Demand ²	1,919 MW
Installed capacity 2018 ³	2,638 MW
Annual Electricity Consumption 2018 ³	8,702 GWh
Electricity Imports (2018) ³	130 GWh
Electricity Exports (2018) ³	35 GWh
Total Electricity Units Generated (2018) ³	10,667 GWh

Sources: (1) World Bank, 2018 (2) EPRA, 2019 (3) EAC, 2019

The Kenya electricity sector broadly comprises the three subsectors, namely; generation, transmission and distribution. In terms of generation, Kenya Electricity Generating Company (KenGen) is the key player in the production of electricity with most of the generation infrastructure dominated by hydropower and geothermal power stations. In 2018, KenGen generated 74.9% of the electricity consumed in Kenya. Independent Power Producers (IPP's) play an important role in Kenya's power generation mix and contributed to 23.7% of the power generated in Kenya in 2018 Imports from Uganda and United Republic of constituted 1.2% while exports to Uganda and United Republic of Tanzania constituted 0.3% of the power generated in Kenya (EAC, 2019). The distribution of electricity generation in Kenya is illustrated in Figure 24.



Source: EPRA, 2019

Figure 24 Distribution of electricity generation in Kenya

Kenya Power and Lighting Company (KPLC) is the off-taker of the power market buying power from the power generators for transmission and consumer supply. Other key players involved in the generation, transmission and distribution of electricity in the country include; electricity sector include:

- **Rural Electrification and Renewable Energy Corporation (REREC)** mandated with the implementation of the rural electrification program and the uptake of renewable energy sources in the country.
- **Kenya Electricity Transmissions Company (KETRACO):** Responsible for design, development, operation, planning and maintaining electricity lines and associated substation in the country's national grid.
- **Geothermal Development Company (GDC):** Mandated to promote rapid development of geothermal resources in Kenya through surface exploration and drilling for steam; avail steam to power plant developers for electricity generation;
- **Nuclear Power and Energy Agency (NuPEA):** is responsible for promoting and implementing the Kenya's Nuclear power program and carrying out research and development for the energy sector

Kenya has the highest electrification rates in EAC. The world bank reported that approximately 75% of the population in Kenya has access to electricity with the reported electrification rates in rural and urban of 72% and 84% respectively (World Bank, 2018).

6.1.1.1 Policy Context

In 2004, the Ministry of Energy of Kenya issued the sessional Paper No.4 on energy which described the challenges that the country's energy sector faced and included the vision "to promote equitable access to quality energy services at least cost while protecting the environment" (MoE, 2004). It further articulated various short and long-term measures to be taken in the energy sector. Energy efficiency was identified as one of the cross-cutting issues and a specific objective for the energy sector.

This led to the formation of the Energy Act 2006 and the establishment of a single energy sector regulator- the Energy Regulation Commission (ERC) in 2007. In 2012 the ERC formulated the Energy Management Regulations 2012 under the powers conferred to the regulator by the Energy Act 2006. This regulation required all institutions with an annual energy consumption exceeding 180,000 kWh to conduct a mandatory energy audit once every three years and implement 50% of the savings identified during the audit before the next audit cycle. In 2016, the ERC commission formulated the Appliances’ Energy Performance Regulation 2016 which imposed the following obligations on manufactures, importers and retailers:

- Manufacturers and importers must apply for registration of imported appliances and provide a sample for testing and labelling to ensure that the appliance conforms with the standard.
- Once the registration is successful, importers need to affix on the appliance the labels provided by the regulator.
- Simultaneously, all retailers must ensure that all appliances in their stores have the Kenya star rating label positioned in a visible position.

The 2019 Energy Act replaced the Energy Act 2006 and created the Energy and Petroleum Authority (EPRA) mandated with the following activities regarding energy efficiency:

- Development and implementation of national energy efficiency and conservation programmes.
- Regulation and enforcement of actions such as MEPS and the integration of energy efficiency to building codes

6.1.1.2 Institutional Mapping

The key institutions that play a major role in promoting energy efficiency of air conditioners and refrigerators in Kenya are summarized in Table 19.

Table 19 Key energy efficiency institutions in Kenya

Main Organization	Description/Role
Ministry of Energy (MOE)	Government institution mandated with the articulation of policies in the energy sector and the creation of enabling environment for efficient growth of the sector.
Energy and Petroleum Regulation Authority (EPRA)	The EPRA is the country’s energy regulator established under the Energy Act 2019. EPRA’s functions are outlined in the Energy Act 2019 Section 10. It includes the regulation of the electricity and petroleum sectors, which comprises setting up of tariffs, overseeing and coordinating the development of indicative plans and monitoring and enforcement of sector regulations.
Kenya Bureau of Standards (KEB)	The Kenya Bureau of Standards is the government institution formed under the Standards Act; Chapter 496. Its mandates include the development of standards that guide the quality of products entering the Kenyan market.

National Environmental Management Authority (NEMA)	This authority is responsible for ensuring that the citizens have a clean, healthy and sustainable environment by coordinating and supervising all the matters related to the Kenyan environment.
Kenya Revenue Authority (KRA)	This institution is among other duties responsible for the facilitation of imports and exports in the country.

6.1.1.3 Market Analysis for Room Air Conditioners and Residential Refrigerators

This section outlines the situation of room air conditioners and residential refrigerators in the Kenyan market. The section provides the details of key stakeholders in the cooling sector, existing policies and regulations governing the market penetration of energy-efficient appliances and use of refrigerating gases in the Kenyan market.

6.1.1.4 Overview of Refrigerating Appliances

Since the introduction of the Appliances' Energy Performance Regulation 2016, more companies have focused on continuous improvement of their refrigerating products to ensure their stocks are compliant with the regulations.

The test method for the performance of refrigerating appliances follows the Kenya Standards for household refrigerating appliance characteristics and test method; KS IEC 62552-1 2015, KS IEC 62552-2 2015 and KS IEC 62552-3 2015 for general requirements, performance requirement and energy consumption and volume respectively. The SRI²⁵ is used to determine the energy label for different refrigerators and freezers. The SRI ranges for energy star label applied in Kenya star rating is shown in Table 20

Table 20 Star Rating Index (SRI) and star equivalent for air conditioners in Kenya

Refrigerators	
SRI	Star Equivalent
≥ 8.5	5
$6.5 \geq \text{SRI} < 8.5$	4
$5.5 \geq \text{SRI} < 6.5$	3
$2.5 \geq \text{SRI} < 4.5$	2
$2.5 > \text{SRI}$	1

Source: (MoE, 2016)

The technologies of refrigerators supplied to the Kenyan market include; chest freezer, freezer refrigerator, side by side door refrigerator and bar refrigerators as shown in Figure 25²⁶.

²⁵ The SRI is a ratio of energy consumption of an appliance as measured with accordance with the test method over the reference of base energy consumption and comparative energy consumption of the model per annum.

²⁶ Data was obtained from the questionnaire in October 2020.



Figure 25 Types of refrigerators and freezers supplied in the Kenyan market

6.1.1.4.1 Stock in Use

Refrigerators in Kenyan market are used in both commercial areas and residential buildings. Market penetration for refrigerating appliances is high in the urban areas as compared in the rural area and with the high rates of rural- urban migration and the high rate of urbanization as a result of devolution, the use of refrigerating appliances in the country is expected to increase significantly. The Country Saving Assessment modelled by U4E estimated that the stock of residential refrigerators in Kenya would increase to approximately 6 million units by 2030, as illustrated in Figure 26. The average unit sales per annum by 2030 is forecasted to reach around 700,000 units (UNEP-U4E, 2020).



Source: UNEP-U4E, 2020

Figure 26 Projected stock and sales of residential refrigerators in Kenya

6.1.1.4.2 Manufacturing of Residential Refrigerators and Freezers

Kenya does not have manufacturers of refrigerating appliances in the country. The country imports all its refrigerating appliances.

6.1.1.4.3 Distribution of Residential Refrigerators and Freezers

Since there are no refrigerator manufacturers in the market, distributors import all their products. The distributors are usually subsidiaries of international brands, representatives of international companies or independent distributors. The imported refrigerators originate mainly from Thailand, China, the United Arab Emirates, South Korea, Turkey and India (ITC, 2018). The supply chain of residential refrigerators and freezers to the Kenyan market is as shown in Figure 27.

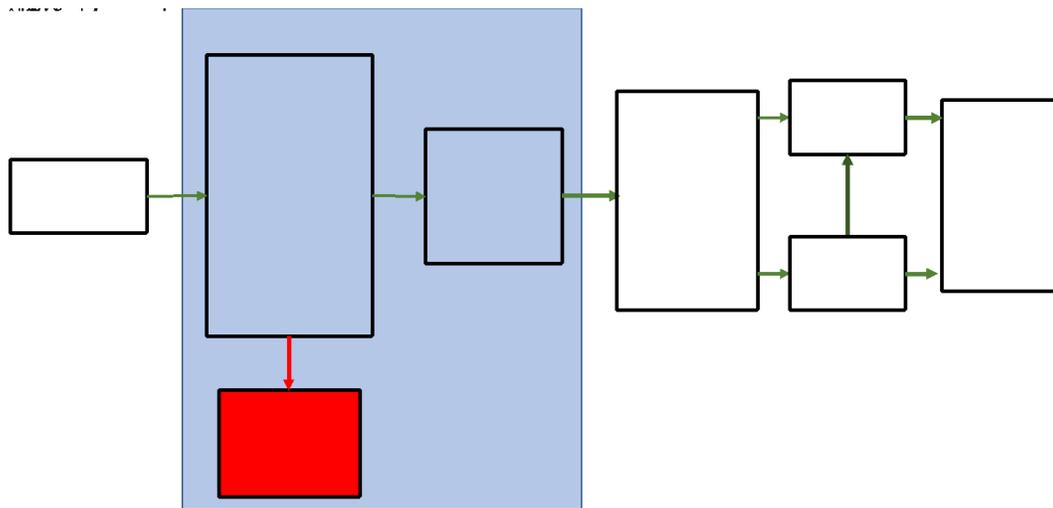


Figure 27 Supply chain of refrigerators in Kenya

Refrigerator appliances retailers in Kenya include supermarkets, electrical and electronic shops, online shops and brand subsidiaries that retail the products in the market. Table 21 shows the residential refrigerator retail stores in the Kenya market.

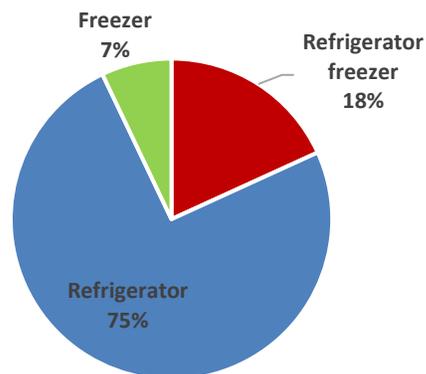
Table 21 Types of retail stores for residential refrigerators in the Kenyan market

Type of retail	Retail Stores (Popular)
Supermarkets	Naivas Carrefour Tuskys QuickMart Shoprite Khetia Tesia Mathais Muleis Magunas
Brand subsidiary retail	LG Service Centre

	Armco Kenya LTD Samsung Experience Stores
Electrical and Electronics Shop	Pride Home Appliances Newmatic Kitchen appliances Ideal Appliances Al Yassin Appliances Housewife Paradise Nairobi Home Appliances Hoist Refrigeration Sale and Service Electromart
Online Shops	Jiji Avechi Masoko Kilimall Jumia

6.1.1.4.4 Product Registration

The supply chain for residential refrigerators and freezers in Kenya involves several stakeholders. Prior to importation, a sample of a model of refrigerating appliance must undergo a compliance test and registered with the regulator for sale in Kenyan market. The Appliances’ Energy Performance and Labelling Regulation 2016 regulation requires testing of refrigerating appliances from an accredited laboratory following Kenya standards KS IEC 62552-1 2015, KS IEC 62552-2 2015 and KS IEC 62552-3 2015. If the product meets the minimum performance requirement a test certificate is issued for application of registration of the product with Energy and Petroleum Authority (EPRA). Importation only commences once the product is registered with the regulator. Currently all the products sold in Kenyan market are registered with EPRA. Currently the distribution of registered products is 75% refrigerator, 18% refrigerator- freezer and 7% freezer as illustrated in Figure 28 (EPRA, 2020b).

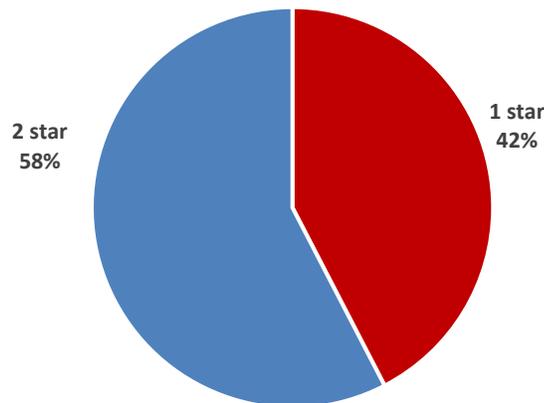


Source: EPRA, 2020

Figure 28 Distribution of registered refrigerating appliances in Kenya (2020)

6.1.1.4.5 Energy Efficiency of Residential Refrigerators and Freezers

As mentioned earlier, the energy efficiency testing of refrigerators in Kenya follows three standards, KS IEC 62552-1 2015, KS IEC 62552-2 2015 and KS IEC 62552-3 2015 for general requirements, performance requirement and energy consumption and volume respectively. Refrigerators registered for importation to the Kenyan market must comply with these standards. The rating of the majority of refrigerating appliances in EPRA refrigerators register authorised for sale in the Kenyan market is between 1-2 stars. There is no product registered with EPRA rated above 3 stars at the moment. Currently, 58% of the appliances are rated 2 stars while 42% of the appliances as illustrated in Figure 29 (EPRA, 2020b).



Source: EPRA, 2020

Figure 29 Energy efficiency rating of registered refrigerating products in Kenya

6.1.1.5 Overview of Room Air Conditioning Appliances

The regulation of room air conditioners in Kenya follows the Appliances’ Energy Performance Regulation 2016, which enforces the existing MEPS on non-ducted air conditioners. These non- ducted air conditioners include; wall mounted split air conditioners, portable air conditioner and window air conditioners.

The test method for the performance of air conditioning appliances is per KS 2463 2019 Kenya standard – Non- ducted air conditioners- testing and rating performance. The basis of the existing MEPS uses the Energy Efficiency Ratio (EER) to provide a star rating for the appliance on a scale of 1-5. Table 22 shows the different energy efficiency ratio for the air conditioners in Kenya and the corresponding star equivalent as per Appliances’ Energy Performance Regulation 2016.

Table 22 Energy efficiency ratio and star equivalent for air conditioners in Kenya

Room Air Conditioners	
EER ²⁷	Star Equivalent
Above 4.0	5

²⁷ EER is defined as the ratio of the appliance cooling capacity in kW and the rated power input

3.75 to 3.70	4
3.15 to 3.40	3
2.8 to 3.10	2
Below 2.0	1

Source: (MoE, 2016)

The technologies of room air conditioning appliances supplied to the Kenyan market include: wall-mounted, ceiling cassette units, window units and portable units as shown in Figure 30²⁸.

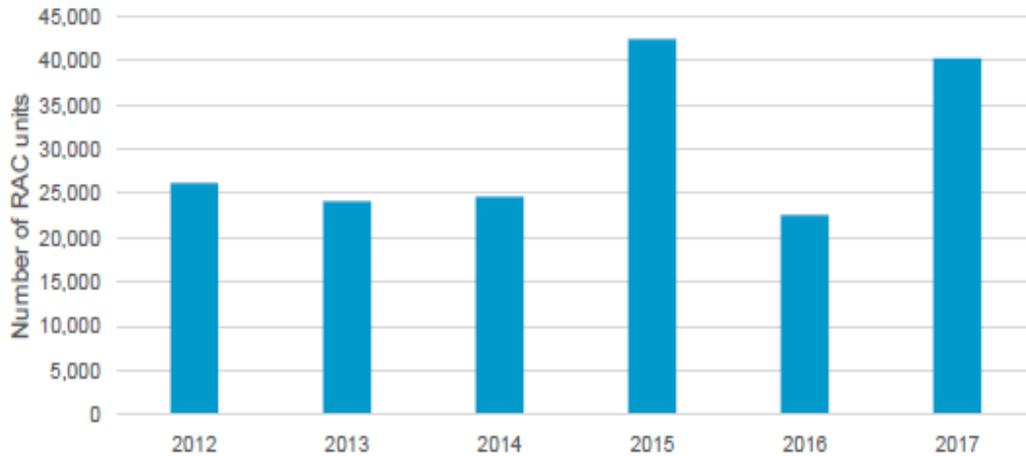


Figure 30 Types of room air conditioners supplied in Kenya market

6.1.1.5.1 Stock in Use

The historical importation of room air conditioning appliances to Kenya during 2012-2017 is represented in Figure 31. A maximum of 43,000 air conditioners were imported in 2015 while 2013 witnessed minimum imports of 24,000 units (CLASP, 2019). The Country Saving Assessment modelled by the U4E estimated that the stock of room air conditioners in Kenya would increase to approximately 700,000 units by 2030, as illustrated in Figure 32. The average unit sales per annum by 2030 is forecasted to reach around 80,000 units (UNEP-U4E, 2020).

²⁸ Data was obtained from the questionnaire in October 2020.



Source: CLASP, 2019

Figure 31 Historical room air conditioners imports¹¹

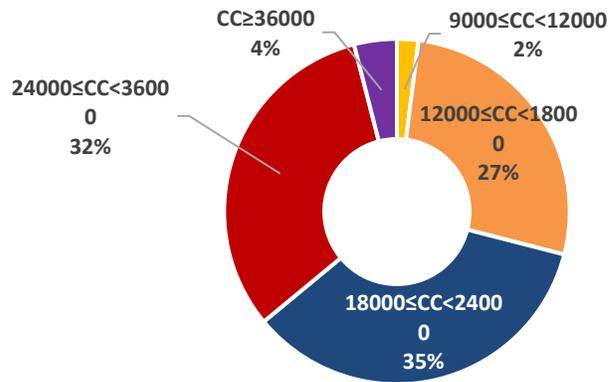


Source: UNEP-U4E, 2020

Figure 32 Projected stock and sales of room air conditioners in Kenya

Air conditioners with a cooling capacity between 18,000 - 24,000 Btu/hr dominate the market representing 35% of the air conditioners while those with cooling capacity of 24,000 - 36,000 Btu/hr represent 32% of the air conditioners in the market (CLASP, 2019). Source: CLASP, 2019

Figure 33 shows the cooling capacities (CC) of the different air conditioners in the market.



Source: CLASP, 2019

Figure 33 Cooling capacities (CC) in Btu of air conditioners in the Kenyan market

6.1.1.5.2 Manufacturing of Room Air Conditioners

According to the report provided by Clasp, Kenya does not manufacture air conditioners though some manufactures have integrated brands with a direct subsidiary in the local market or a representative distribution on behalf of the manufactures. Besides, some independent distributors import air conditioners to the Kenyan market. Kenya's room air conditioners market is mainly dominated by single split units representing 87% while multi-split units, portable and window air conditioners represent 9%, 3% and 1% of the market share respectively as shown in Figure 34 (CLASP, 2019).

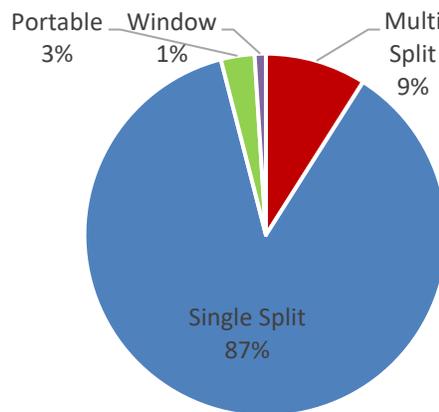
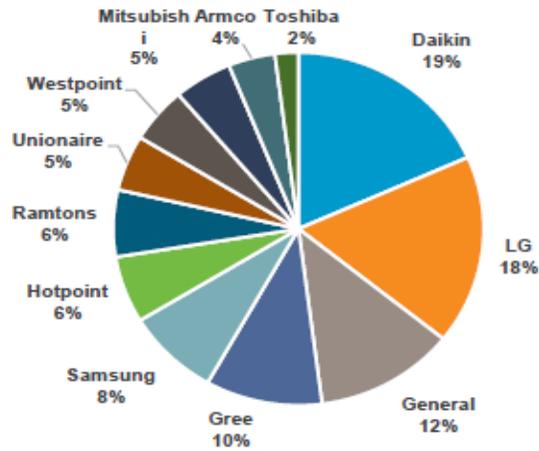


Figure 34 Air conditioners imported into the Kenyan market

6.1.1.5.3 Sales of Room Air Conditioners

The market share of room air conditioner brands in Kenya market is illustrated in Figure 35. Daikin and LG brands dominate the market, with each representing about 19% and 18% respectively of the total brand's units in the market. Gree contributed to 10% while Samsung, Hotpoint, Ramtoms, Unionaire, Mitsubishi, Toshiba and Armco have a combined share of 36%. Other brands without a name accounted for 10% of the market share (CLASP, 2019).



Source: CLASP, 2019

Figure 35 Room air conditioners brands in Kenya

6.1.1.5.4 Distribution of Room Air Conditioners

Figure 36 illustrates the room air conditioners supply chain in Kenya. Since there are no manufactures in the country, the distribution begins with the importers who ship the appliances to the country. The importers include international brands, representative agencies and independent distributors selling their brands.

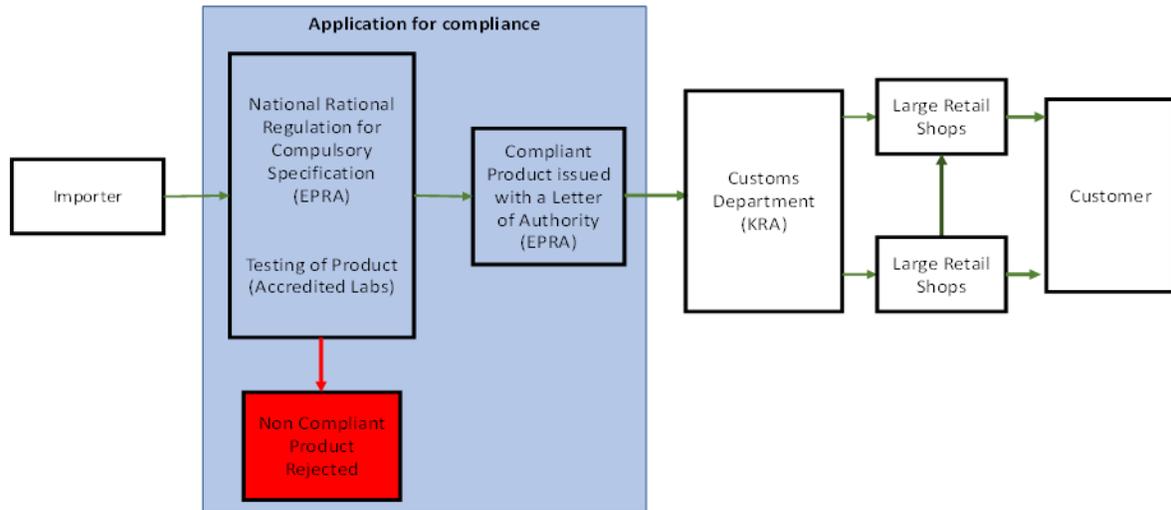


Figure 36 Room air conditioner supply chain in Kenya

Table 23 Types of retail stores for room air conditioners in the Kenyan market

Type of retail	Retail Stores (Popular)
Brand subsidiary retail	LG Service Center Armco Kenya LTD Samsung Experience Stores
Dealers	Refnet Air Gilfield services Kool Breeze Solutions Snow Desert (EA) LTD
Online Shops	Jiji Avechi Masoko Kilimall Jumia

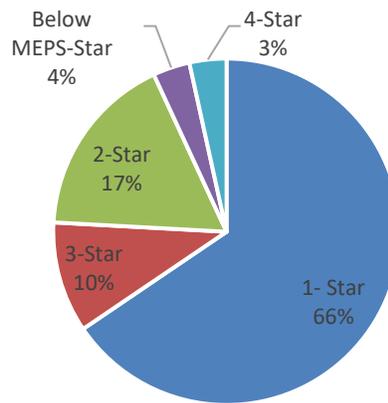
6.1.1.5.5 Product Registration

Air conditioners imported to the Kenyan market must comply with Appliances’ Energy Performance and Labelling Regulation 2016. The Appliances’ Energy Performance and Labelling Regulation 2016 regulation requires testing of refrigerating appliances from an accredited laboratory following Kenya standards KS 2633 2015. If the product meets the minimum performance requirement a test certificate is issued for application of registration of the product with Energy and Petroleum Authority (EPRA).

Importation only commences once the product is registered with the regulator. Currently, all the room air conditioning products sold in Kenyan market are registered with EPRA.

6.1.1.5.6 Energy Efficiency of Room Air Conditioners

The energy efficiency of room air conditioners in Kenya follows the Kenya Standard KS 2463 2015, which uses the Energy Efficiency Ratio (EER) to provide a star rating for the appliance on a scale of 1-5. At the moment, 66% of the products registered with EPRA are rated 1-star, 17% 2-star, 10% 3-star, 3% 4-star with 4% of the product applied for registration being below the required MEPS as illustrated in Figure 37 (EPRA, 2020a).

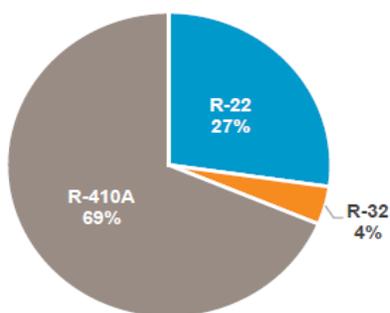


Source: (EPRA, 2020a)

Figure 37 Energy efficiency rating of registered room air conditioners in Kenyan market

6.1.1.6 Refrigerant Gases and Emissions

The use of refrigerant gases in the Kenyan market is controlled and regulated by the National Environmental Management Authority (NEMA), Environmental Management and Coordination Controlled Substances Regulation 2007. This regulation restricts the importation and use of ozone-depleting (hydrochlorofluorocarbons) substances, including refrigerant gases based on their ozone-depleting potential. The common refrigerant used in room air conditioners in the Kenya market is R-410 which accounts for 69% of the appliances in the market. Also, R-22 is significantly used in the market, as shown in Figure 38 (CLASP, 2019). The common refrigerants used for residential refrigerators in the Kenyan market are R-600a and R134a.



Source: CLASP, 2019

Figure 38 Refrigerant gases in use in Kenya

6.1.2 The Republic of Rwanda

The Republic of Rwanda is a landlocked country located in the Eastern part of central Africa and covers a total area of 26,338 Km². The country borders Uganda in the North, Burundi in the South, the United Republic of Tanzania in the East and the Democratic Republic of Congo in the West. Rwanda has a total population of 12.1 million, of which 82% of the population is found in the rural areas and 18% in urban areas (World Bank, 2018). Rwanda has a temperate tropical highland climate due to high altitude. Typical average daily temperature ranges between 12-27°C. In 2018, the total GDP was reported to be USD 9.5 billion and the GDP per capita at USD 1,090 (World Bank, 2018). Table 24 provides a summary of the country's overview of the population, economic development, and electricity access in Rwanda.

Table 24 Overall energy and economic indicators of Rwanda

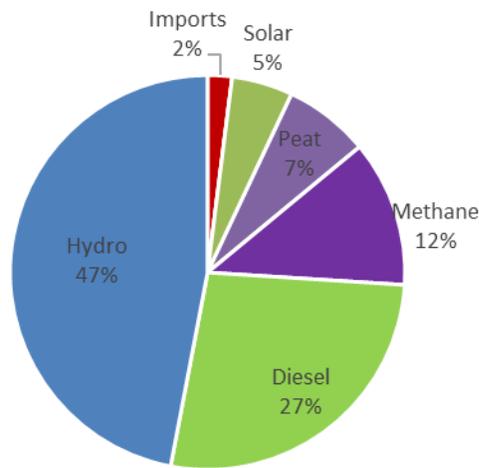
Indicator	Data
Population 2018 ¹	12.1 Million
GDP in 2018 ¹	9.5 Billion USD
GDP per Capita 2019 ¹	1,090 USD
Access to grid electricity 2018 (% Population) ¹	35%
Access to electricity 2018 (% Urban Population) ¹	89%
Access to electricity (% rural Population) ¹	23%
System Maximum Demand ²	131 MW

Installed capacity 2018 ²	218 MW
Annual Electricity Consumption 2018 ²	653.9 GWh
Electricity Imports (2018) ³	93 GWh
Electricity Exports (2018) ³	35 GWh
Total Electricity Units Generated (2018) ³	817 GWh

Sources: (1) World Bank, 2018 (2) RURA, 2019 (3) EAC, 2019

Rwanda’s electricity sector broadly comprises the three subsectors; generation, transmission and distribution. The Rwanda Energy Group is the government institution responsible for the generation, transmission and distribution of electricity in the country and conducts its activities through its subsidiaries Energy Utility Corporation Limited (EUCL) and Energy Development Corporation Limited (EDCL).

Rwanda commits to provide affordable, reliable and sustainable energy to its citizens. The key electricity sources in Rwanda are hydropower, diesel, methane, solar and peat. As of 2018, the installed capacity in Rwanda was dominated by hydropower with 47% of the installed capacity (EAC, 2019). Diesel and methane contribute to 27% and 12% of the installed capacities in the country respectively., other sources are solar with 5% and peat with 7% while imports contribute 2% of the total installed capacity (EAC, 2019).



Source: EAC, 2019

Figure 39 Distribution of electricity generation in Rwanda

6.1.2.1 Policy Context

The Government of Rwanda has put in place several policies aimed to provide a sustainable and efficient energy access to its citizens. The National Green Growth and Climate Resilience Strategy of 2011 for climate change and low carbon development intends to promote the assimilation of low carbon and low water system, reduced energy demand and energy efficiency into building codes.

The Rwanda Building Code of 2019 requires the Rwandan built environment to incorporate energy efficiency in the design, construction and operation of new buildings with the minimum use of non-

renewable sources of energy following the Rwanda Green Building Minimum Compliance system. In reference room air conditioners, the code outlines the need for energy- efficiency in cooling and the operations of room air conditioning and ventilation appliances.

The Energy Sector Strategic Plan (2018/19- 2023/24) lays out a plan of the country’s priorities and energy sector targets on energy efficiency relating to electricity generation, transmission, distribution and consumption.

The Rwanda Energy Policy of 2015 defines the country’s commitment to energy efficiency and demand side management plans. The approaches highlighted in the policy to promote energy efficiency in the country include; changes in electricity tariffs to incentivize demand side management, provision of mandatory regulations and new codes of standards, provision of subsidies and incentives for installation of solar water heaters and industrial user’s energy audits and the removal of barriers restricting adoption of energy- efficient technologies in buildings.

In 2013, the RURA published guidelines that provided a recommendation on the best practices for energy efficiency for different appliances among them room air conditioners and residential refrigerators. Regarding refrigerators, the guidelines recommend; few refrigerator doors opening, regular defrost, keeping refrigerators well ventilated, cleaning condensing coils and setting right refrigerator temperatures. Regarding room air conditioners the guidelines recommend regular maintenance, use of natural ventilation when necessary, use of curtains to reduce heating loads and switching off lights to reduce heating loads among others.

Rwanda’s Paris Agreement of 4th November 2016 and the Kigali Amendment to Montreal Protocol of 1st January 2019 gave the country an obligation to phase out the use of HCFC’s and phase down of HFC’s as refrigerating gases for cooling appliances.

The National Cooling Strategy developed by the Ministry of Environment in 2019 with support from U4E laid down the plan on the interventions to be implemented for air conditioning and refrigeration appliances to promote the reduction of carbon emission in the cooling sector and support the country’s commitment to the Kigali Amendment to the Montreal Protocol.

The Rwanda Standards Board (RSB) carries out the assessment of different products in the market to ensure that they meet the required standard. In the current Ministry of Environment (MoE) cooling strategy, the adopted standard for testing cooling appliances follows ISO 16358-1 standard to calculate the appliance performance efficiency and seasonal performance factor.

6.1.2.2 Institutional Mapping

The key institutions that play a major role in energy efficiency in residential refrigerators and room air conditioners in Rwanda are summarised in Table 25.

Table 25 Key institutions in Rwanda

Main Organization	Description/ Role
Ministry of Environment (MoE)	The Ministry of Environment is the government institution mandated with the development, dissemination, evaluation and implementation of policies and programmes surrounding

	environment and climate change following prime minister order No 121/03 of 23/12/2107.
Ministry of Infrastructure (MININFRA)	The Ministry of Infrastructure is the government institution mandated with the formulation of policies in the infrastructure and energy sector. The Ministry also oversees functions of the institution in the electricity sector including the Rwanda Energy Group (REG).
Rwanda Utilities Regulation Authority (RURA)	RURA is mandated with the regulation of the energy sector, which includes setting up of tariffs, overseeing and coordinating the development of indicative plans and monitoring and enforcement of sector regulations.
Rwanda Standards Board (RSB)	RSB is a public institution mandated with the provision of standards that protect the consumers and promotes economic growth in a safe and stable environment.
Rwanda Environmental Management Authority (REMA)	The Rwanda Environmental Management Authority (REMA) is mandated with overseeing the implementation of the government environmental policies and the formulation of policies and strategies that aim at protecting the environment.
Rwanda Revenue Authority (RRA)	RRA was established in 1997 and is mandated with the collection of taxes and duties regarding imports and exports to the country.
Rwanda Inspectorate, Competition and Consumer Protection (RICA)	Rwanda Inspectorate, Competition and Consumer Protection (RICA) is a newly set-up public institution mandated with surveillance of compliance for products on the market to ensure consumer protection.

6.1.2.3 Market Analysis for Room Air Conditioners and Residential Refrigerators

This section outlines the situation of room air conditioners and residential refrigerators in Rwandan market. The section provides the details of key stakeholders in the Rwanda cooling sector, existing policies and regulations governing the market penetration of energy efficient appliances and use of refrigerating gases in Rwandan market.

6.1.2.4 Overview of Refrigerating Appliances

Rwanda recently developed strategies promoting the implementation of energy efficiency measures in refrigerating appliances. These measures are detailed in the National Cooling Strategy that plans the implementation of MEPS for both refrigerators and room air conditioners in the Rwandan Market. The National Cooling Strategy plans that refrigerating appliances with a total volume between 10-1500 litres powered by grid electricity should not exceed a maximum annual energy consumption evaluated using the equation outlined in Table 26 at an ambient reference temperature of 25 C (MININFRA, 2019).

Table 26 Required maximum annual energy consumption for refrigerators in Rwanda

Reference Ambient Temperature	Product Category	AEC (kWh/year)
25	Refrigerators	$0.183 \times AV^{29} + 120$

²⁹ Where AV is the Adjusted Volume of the appliance

	Refrigerator- Freezer	0.286 X AV+120
	Freezers	0.238 X AV+120

Source: MININFRA, 2019

The developed MEPS requirement for refrigerating appliances in Rwanda is based on the methods defined Rwanda Seasonal Energy Efficiency Ratio IEC 62552 2015 and the U4E Model Regulation Guidelines for determination of energy consumption. Table 27 illustrates the efficiency grades classified by R which is the inverse of energy efficiency index, for refrigerators, refrigerator-freezer and freezers in Rwanda as per the National Cooling Strategy. The planned time for the implementation of the labels on refrigeration appliances as per the National Cooling Strategy is January 2021.

Table 27 Comparison of efficiency level by grade for residential refrigerators in Rwanda

Grade	Refrigerators	Refrigerator Freezers	Freezers
A	$2.0 \leq R$	$2.0 \leq R$	$2.0 \leq R$
B	$1.75 \leq R < 2.0$	$1.75 \leq R < 2.0$	$1.75 \leq R < 2.0$
C	$1.50 \leq R < 1.75$	$1.50 \leq R < 1.75$	$1.50 \leq R < 1.75$
D	$1.25 \leq R < 1.50$	$1.25 \leq R < 1.50$	$1.25 \leq R < 1.50$
E	$1.00 \leq R < 1.25$	$1.00 \leq R < 1.25$	$1.00 \leq R < 1.25$

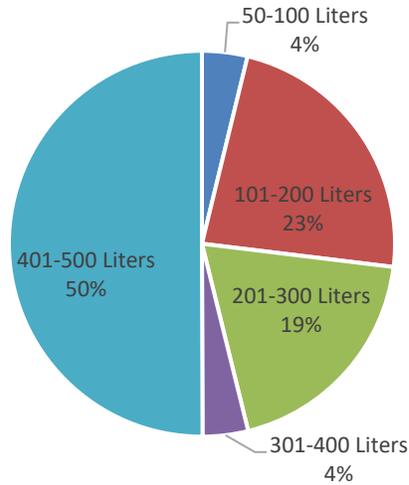
Source: MININFRA, 2019

Despite having introduced these strategies that outlined the measures for MEPS in refrigerating appliances, currently, no regulation requires refrigerating appliances to comply with the developed MEPS. Rwanda plans to enforce the MEPS for refrigerating appliances in January 2021. The existing labels on residential refrigerators in the Rwandan market are the European Union Energy Labels and Kenya Star labels.

6.1.2.4.1 Stock in Use

The Rwanda National Cooling Strategy estimates the current stock of residential refrigerators in the market at 75,000 units (MININFRA, 2019). The use of refrigerators in Rwanda is dominant in hotels and restaurants, food and beverage production, agribusiness and commercial and industrial buildings.

According to the report on the feasibility assessment of domestic refrigerating and room air conditioner market conducted by the Rwanda Cooling Finance Initiative (RCOOL FI), it is estimated by 2019, 3.3% (RCOOL FI, 2020) of Rwanda households' own refrigerators with high ownership reported in the urban areas compared to rural areas. The survey also shows that 50% of the refrigerators stock in the market has a volume of between 401-500 litres, 23% between 101-200 litres, 19% between 201-300 litres and appliances with a volume of 301-400 litres and 50-100 litres each representing 4% of the total stock as illustrated in Figure 40 (RCOOL FI, 2020).



Source: RCOOL FI, 2020

Figure 40 Volume of refrigerators in Rwanda

The Country Saving Assessment modelled by U4E estimated that the stock of residential refrigerators in Rwanda will increase to approximately 257,000 units by 2030, as illustrated in Source: UNEP-U4E, 2020

Figure 41. The average unit sales per annum by 2030 is forecasted to reach around 25,000 units (UNEP-U4E, 2020).



Source: UNEP-U4E, 2020

Figure 41 Projected stock and sales of residential refrigerators in Rwanda

6.1.2.4.2 Manufacturing of Residential Refrigerators and Freezers

Almaha is the only fridge manufacture in Rwanda. The company specializes in the production of household refrigerators and freezers among other household products such as cookers. The company

produces three brands of refrigerator-freezers and three brands of chest freezers for sale in the local market and export.

6.1.2.4.3 Distribution of Residential Refrigerators and Freezers

Rwanda imports most of the refrigerating appliances in the market. Despite the fact that though there is a manufacture in the country production of residential refrigerators recently stated and produced volume do not meet the market demand. The importers are usually brand representatives or companies such as LG, Mika, Von, Sharp, Panasonic, Samsung, Konka, Glamstar, Super General and Midea brand. The imported residential refrigerators originate mainly from Thailand, Korea and China. Different refrigerating appliances supplied to the Rwandan Market include chest freezers, freezer refrigerators, side by side door refrigerators and bar refrigerators as shown in Figure 42.



Figure 42 Types of residential refrigerators supplied in the Rwandan market

Refrigerators appliances retailers in Rwanda include supermarkets, electrical and electronic shops, online shops and brand subsidiaries that retail the products in the market. Figure 43 shows the supply chain of residential refrigerators to the Rwandan Market.

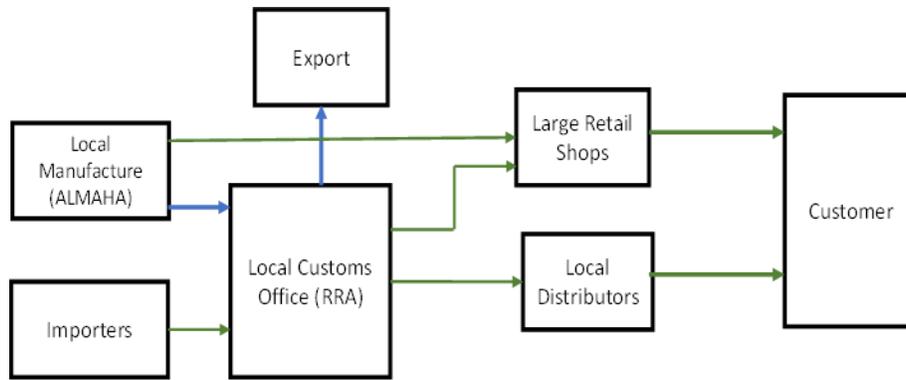


Figure 43 Supply chain of residential refrigerators in Rwanda

6.1.2.4.4 Product Registration

Currently, Rwanda does not have a specific product registration system that focuses on the energy performance of refrigerating appliances in the market. Limited data available with the Rwanda revenue authority does not focus on the energy performance of the appliances.

6.1.2.4.5 Energy Efficiency of Residential Refrigerators and Freezers

Refrigerator energy labels in the Rwandan market currently vary due to lack of regulation enforcing the National Cooling Strategy. Nevertheless, the penetration of energy-efficient refrigerators in Rwanda is above average due to the existing program. Existing energy labels in the market include the European Energy Labels and Kenya Star label. More than 61% (RCOOL FI, 2020) of refrigerating appliances in Rwanda’s market have an energy label. Most of the refrigerators supplied to the Rwandan market are graded class A and A+ as per the European Energy label.

6.1.2.5 Overview of Room Air Conditioning Appliances

As mentioned earlier, the planned MEPS for room air conditioners in Rwanda are outlined in the National Cooling Strategy. The outlined requirement for room air conditioners applies to split air conditioners that should meet or exceed the Rwanda SEER levels outlined in Table 28. The minimum RSEER requirement for Self-Contained Air Conditioner with a cooling capacities ≤ 16 kw is 3.5 for fixed speed appliances and 4.0 for variable speed compressor type appliances.

Table 28 Minimum RSEER for air conditioners in Rwandan market

Capacity	Compressor Type	
	Fixed	Variable
Rated Cooling Capacity ≤ 4.5 kW	3.8	4.6
4.5 kW < Rated Cooling Capacity ≤ 9.5	3.5	4.3
9.5 kW < Rated Cooling Capacity ≤ 16	3.2	3.9

Source: MININFRA, 2019

The technologies of room air conditioners supplied to the Rwandan market include wall-mounted, ceiling cassette units, window units and portable units as shown in Figure 44.



Figure 44 Types of room air conditioners supplied in Rwanda market

6.1.2.5.1 Stock in Use

The National Cooling Strategy of 2019 estimates the stock of room air conditioners in Rwandan market at 50,000 units (MININFRA, 2019). Room air conditioners are commonly used in commercial building such as hotels, hospitals, and office buildings. Figure 45 shows technology use in commercial and residential buildings. It is observed that more than 90% (UNEP- U4E, 2019) of the air conditioners in Rwanda market are used in the commercial areas.

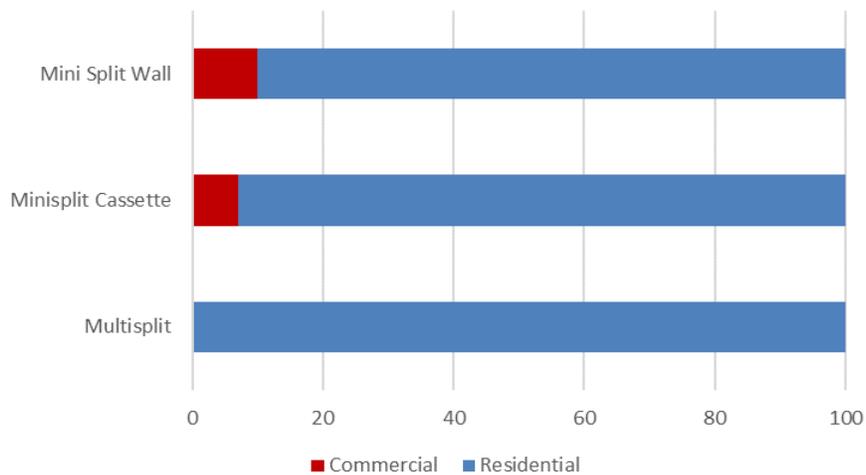


Figure 45 Use of room air conditioner technologies at commercial and residential areas

6.1.2.5.2 Manufacturing of Room Air Conditioners

Rwanda does not have air conditioner manufacturing companies in the country, but there are authorized brand distributors and dealers for common air conditioning brands in the market.

6.1.2.5.3 Distribution of Room Air Conditioners

The supply chain for air conditioners in Rwanda market is illustrated in Figure 46. Rwanda imports all its air conditioners mainly from Asian countries such as Thailand, Korea and China. The importers are usually subsidiaries of international brands, representative agencies and independent distributors selling their brands. In Rwanda, the retail of air conditioning appliances is from brand retailer shops, supermarkets, brand dealers and through online shops.

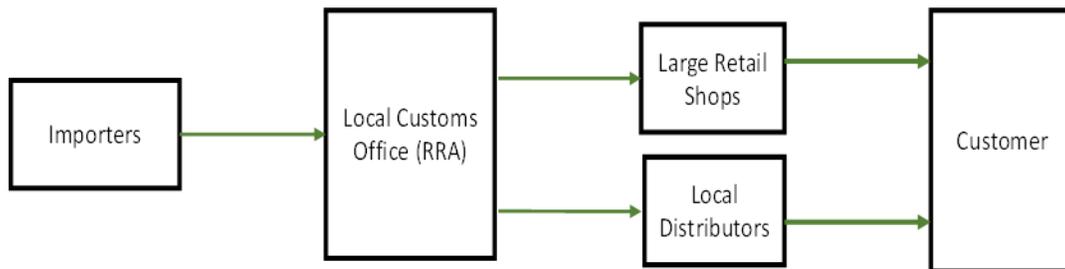


Figure 46 Supply chain of room air conditioners in Rwanda

6.1.2.5.4 Product registration

The Rwanda standard board is mandated with testing and registration of room air conditioners in the Rwanda market. The board is also responsible for the development of national product registration system for room air conditioners compliant with the national cooling strategy.

6.1.2.5.5 Energy Efficiency of Room Air Conditioners

Most of the room air conditioners supplied to the Rwandan market mainly carry the European Energy Efficiency label. The energy efficiency rating of the of the room air conditioners varies significantly. The minimum energy efficiency requirements based on RSEER for new products imported to Rwanda market is outlined in the National Cooling Strategy. Implementation of MEPS as outlined in the National Cooling strategy is planned to start in January 2021.

6.1.2.6 Refrigerant gases and Emissions

One of the objectives of the Rwanda National Cooling Strategy is to support Rwanda's obligation underlined in the Kigali Amendment to the Montreal Protocol concerning the phase out of HFCs. According to the National Cooling Strategy, the use of refrigerants for room air conditioners and residential refrigerators in the Rwandan market will be governed by the Montreal protocol starting from January 2021. Rwanda should take the following measures as per the Montreal protocol to the production and use of HFC's;

- Reduce the use of HFC's by 35% by the end of the year 2020

- Reduce the use of HFC's by 67.5% by the end of the year 2025
- Total phase-out of HFC's by 2030.

The main refrigerant gases for room air conditioners in the Rwandan market are; R410a, R-290 and R-32. The ozone-depleting HCFC's R-22 refrigerants were phased out from the Rwandan market after its ban. The common refrigerants used for residential refrigerators in Rwandan Market are R-600a and R134a (RCOOL FI, 2020).

6.1.3 The Republic of Uganda

The Republic of Uganda is a landlocked country in East Africa covering a total land area of 197,100 km² and a total area of 241,038 km². The country borders South Sudan in the North, United Republic of Tanzania and Rwanda in the South, Kenya in the East and Democratic Republic of Congo in the West. Uganda has a total population of 42.7 million people, of which 76% of the population live in rural areas and 24% in urban areas (World Bank, 2018). Uganda has a warm tropical climate with temperature ranges of about 17-25°C and an annual rainfall ranges of 1000-1500 mm. In 2018, the total GDP was reported to be USD 32.7 billion and the GDP per capita USD 767 (World Bank, 2018). A summary of the country's overview of the population, economic development, and electricity access in Uganda is provided in Table 29.

Table 29 Overall energy and economic indicators of Uganda

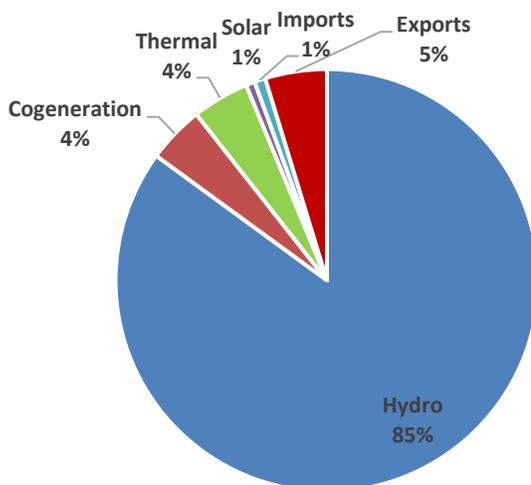
Indicator	Data
Population 2018 ¹	42.7 Million
GDP in 2018 ¹	32.7 Billion USD
GDP per Capita 2019 ¹	767 USD
Access to electricity 2018 ¹ (% Population)	43%
Access to electricity 2018 ¹ (% urban Population)	58%
Access to electricity ¹ (% rural Population)	38%
System Maximum Demand ²	724 MW
Installed capacity 2018 ²	984 MW
Annual Electricity Consumption 2018 ³	3,182 GWh
Electricity Imports 2018 ³	39 GWh
Electricity Exports 2018 ³	224 GWh
Total Electricity Units Generated (2018) ³	4,453 GWh

Sources: (1) World Bank, 2018 (2) Umeme, 2019 (3) EAC, 2019

The key players in Uganda's electricity sector are tasked with the generation, transmission and distribution of electricity, each of these activities tasked to a separate entity. Uganda Electricity Generation Company Limited (UEGCL) is tasked with the generation of electricity together with Independent Power Producers (IPP's) in the country. Uganda Electricity Transmission Company Limited (UETCL) is the sole off-taker buying and transmitting electricity generated in Uganda. Umeme dominates the distribution of electricity in Uganda with 94.3% share market distribution in 2018.

Uganda Electricity Distribution Company Limited (UEDCL) and other distributors had a market share of 1.6% and 4.1% in the same year, respectively (Umeme, 2019).

The key electricity sources in Uganda are hydropower, bagasse, thermal and solar. In 2018, the electricity generation was dominated by hydropower which contributed to 85% of the total power generated. Thermal sources and cogeneration had a significant generation, with each contributing to 4% of the total power generated. The country exported about 5% of the total generation, while imported power was 1% as illustrated in Figure 47 (EAC, 2019). The average electricity tariff for residential sector is USD 0.13/kwh (Umeme, 2020).



Source: EAC, 2019

Figure 47 Distribution of electricity installed capacities in Uganda

6.1.3.1 Policy Context

The Electricity Act of 1999 was established to enhance efficiency in the electricity sector through privatization and liberalization of the sector by creating an independent regulator Energy Regulatory Authority (ERA). Through the act, the rural electrification fund was established to accelerate electricity access in Ugandan rural areas.

Energy Policy of 2002 advocates for an increase in access to modern and reliable energy sources through the exploitation of clean and sustainable renewable energy resources in the country. This policy outlines the government’s goal in managing the energy sector as to meet the energy needs of Uganda population for social-economic development in an environmentally sustainable manner” (MEMD, 2002). The policy also seeks to increase energy access by the provision of reliable energy services and improvement of governance and administration in the energy sector. Moreover, the policy provides the management of energy-related environmental impacts

In 2007 Uganda developed the Renewable Energy Policy which provided the government vision, goals, principles, objectives and criteria of adoption of renewable energy and how the government intends to promote sustainable utilization of the resources available in the country.

The energy efficiency roadmap for 2010 - 2020 aimed at the establishment of programs that promote energy efficiency at different sectors in the country. The approach provided in the road map advocated for energy efficiency through; Creation of awareness and information on energy efficiency through training and education and Promotion of research and development in energy efficiency through financing and provision of legislation frameworks.

6.1.3.2 Institutional Mapping

The key institutions that play a major role in energy efficiency in refrigerators and air conditioners in Uganda are summarised in Table 30.

Table 30 Key institutions in Uganda

Main Organization	Description/ Role
Ministry of Energy and Mineral Development (MEMD)	The Ministry of Energy and Mineral Development is the government institution mandated with the development of strategies and policies that safeguard and promote sustainable use, exploitation and utilization of energy resources in Uganda for the country's social and economic development
Electricity Regulatory Authority (ERA)	The Electricity Regulatory Authority is mandated with the regulation of all the functions of the electricity sector, which includes the generation, transmission, distribution, sale, export and importation of electricity in Uganda.
Uganda National Bureau of Standards (UNBS)	The Uganda National Bureau of Standards was established under the UNBS Act Cap 327 in 1989. The institution is mandated with the formulation and enforcement of standards in Uganda for the protection of public and safeguard of the environment against harmful products.
National Environmental Management Authority (NEMA)	The National Environmental Management Authority (NEMA) is the principal environmental management authority in Uganda, established in 1995. It is mandated with the development of government policies, regulations, standards and guidelines under the powers of the authority following the National Environmental Act No.5. 2019.
Uganda Revenue Authority (URA)	Uganda Revenue Authority is mandated with the facilitation of imports and exports in the country, among other duties, and controls all the regulated products into the country.

6.1.3.3 Market Analysis for Room Air Conditioners and Residential Refrigerators

This section outlines the situation of room air conditioners and residential refrigerators in the Ugandan market. The section provides the details of key stakeholders in the cooling sector, existing policies and regulations governing the market penetration of energy-efficient appliances and use of refrigerating gases in the Ugandan market

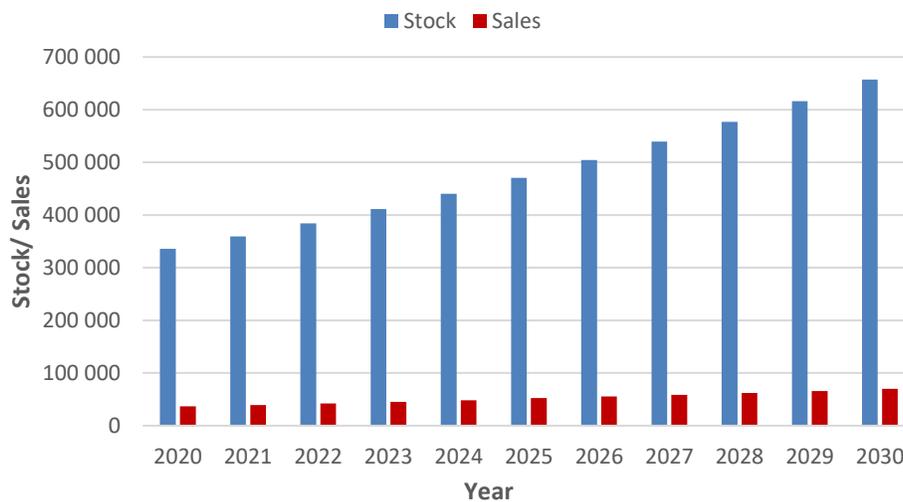
6.1.3.4 Overview of Refrigerating Appliances

Uganda National Bureau of Standards (UNBS) is the institution mandated with the development of standards and tests for refrigerators in Uganda. The Bureau has two standards that define MEPS,

namely Uganda Standards US 900-1-2011 and US 900-2-2011. The former standard defines the appliances' energy labelling and MEPS requirements while the latter determines the energy consumption and performance of the appliance. Currently, the enforcement level of the standards is voluntary. Common labels in refrigeration appliances in Uganda are the European Union Energy Label, China Energy Label and the India Energy label.

6.1.3.4.1 Stock in Use

Refrigerators are used in both commercial and residential buildings in Uganda. The Country Saving Assessment modelled by U4E estimated that the stock of residential refrigerators in Uganda will increase to approximately 660,000 units by 2030, as illustrated in Figure 48. The average unit sales per annum by 2030 is forecasted to reach around 70,000 units (UNEP-U4E, 2020).



Source: UNEP-U4E, 2020

Figure 48 Projected stock and sales of residential refrigerators in Uganda

6.1.3.4.2 Sales of Residential Refrigerators and Freezers

Refrigerating technologies that can be found in the Ugandan market are freezer only, refrigerator only and freezer-refrigerators. Typical volumes for refrigerating appliances sold in Uganda is as follows: Freezer only 500 litres; refrigerator only 300-500 litres and for freezer-refrigerator, it is 300 litres as outlined in Table 31³⁰.

Table 31 Typical volumes of refrigerating appliances in the Uganda market¹

Type of Refrigerator	Typical Volume (L)
Freezer only	500L
Refrigerator only	300 – 500 L
Freezer-refrigerator	300 L

³⁰ Data obtained from the questionnaire in October 2020.

In Uganda, the freezers are more costly as compared to refrigerators and freezer refrigerators. A typical price for a freezer sold in the Ugandan market is about USD854, while for residential refrigerator and freezer-refrigerators it is USD657 and USD735 respectively as illustrated in Figure 49³¹.

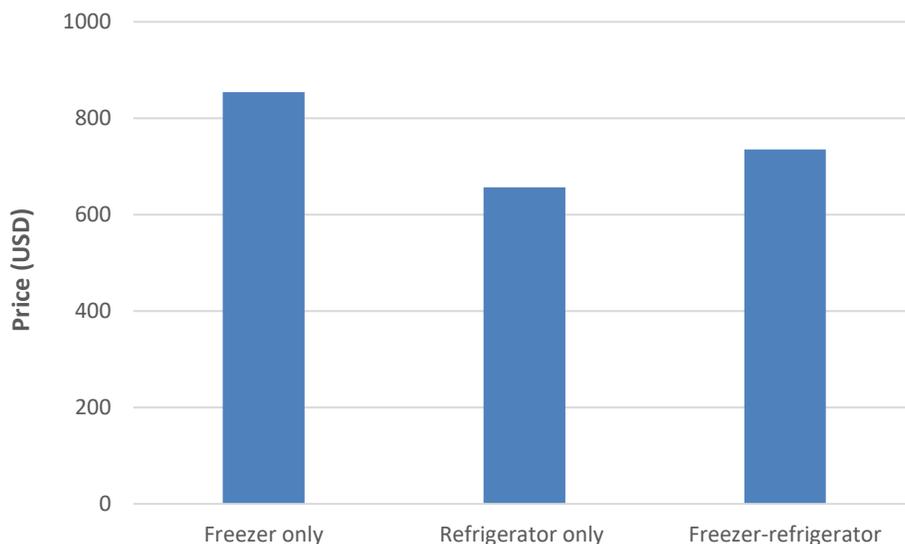


Figure 49 Typical prices of residential refrigerating appliances in Uganda

6.1.3.4.3 Manufacturing of Residential Refrigerators and Freezers

Gayaza electronic works ltd is the only refrigerator manufacturer in Uganda. The company specializes in the production of both commercial and household refrigerators and freezers. In terms of residential refrigerators, the company produces chest freezers, fridges and freezer refrigerators.

6.1.3.4.4 Distribution of Residential Refrigerators and Freezers

Although there is manufacture of refrigerators in the Ugandan market, importers play a key role in supplementing residential refrigerators, and room air conditioners demand in the market. The importers are usually brand representatives or companies retailing refrigerator brands LG, Toshiba, Samsung, Hisense, Hitachi and Sony. The imported refrigerators are mainly from China, Thailand, India, Indonesia, South Africa and the United Arab Emirates. Different refrigerating appliances supplied to the Ugandan Market include Chest freezer, freezer-refrigerator, side by side door refrigerator and bar refrigerators, as shown in Figure 50. The supply chain of refrigerating appliances in Uganda is illustrated in Figure 51.

³¹ Data obtained from the questionnaire in October 2020.



Figure 50 Types of refrigerators supplied in the Ugandan market

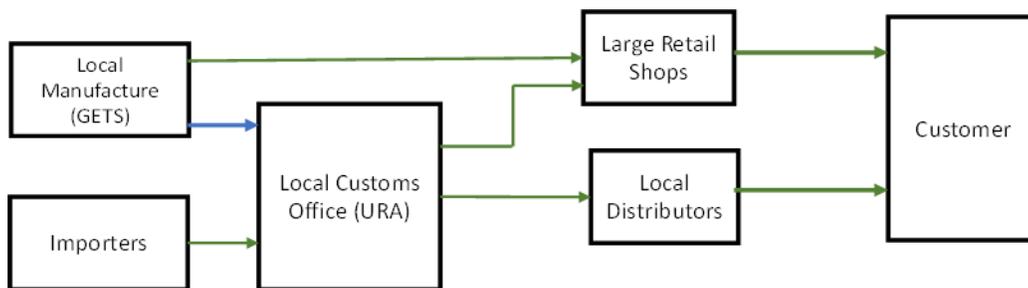


Figure 51 Supply chain of refrigerators in Uganda

Refrigerators appliances retailers in Uganda include supermarkets, electrical and electronic shops, furniture shops, online shops and brand subsidiaries that retail the products in the market. Table 28 shows the refrigerator retail stores in the Ugandan market.

Table 28: Key players in the distribution of residential refrigerators in Uganda

Type	Company
Furniture Shops	German home choice Madrijo furniture and appliances
Supermarkets	Tuskys Game Standard Supermarket
Brand Subsidiaries/ Dealers	LG appliance World ADH group Uganda
Electrical and Electronics Shop	Africool Uganda Modern Electronics Limited
Online retail	Jumia Nofeka online shopping

6.1.3.4.5 Product Registration

Currently, Uganda does not have a specific product registration system that focuses on the energy performance of refrigerating appliances in the market.

6.1.3.4.6 Energy Efficiency of Residential Refrigerators and Freezers

The penetration of energy-efficient residential refrigerators in the Ugandan market is low due to lack of awareness and regulation to enforce the existing MEPS in the country. The common labels carried by refrigerating appliances in Uganda are the following: European Union Energy Label, China Energy Label or India Energy Label. The average volume of refrigerators supplied to the Ugandan market is 382 litres with an average input power of 550 W and average annual energy consumption of 481 kWh³².

6.1.3.5 Overview of Room Air Conditioning Appliances

Air conditioner testing in Uganda follows the Uganda Standard US 901-2011 Non ducted air conditioners testing and rating for performance specifies the standard test conditions on which the ratings of air conditioners with air cooled condensers can be applied in Uganda market. The level of enforcement of existing MEPS in the country is voluntary at the moment and is expected that these standards will be mandatory once the draft energy efficiency policy is passed. Energy efficiency labels for air conditioners in the country have not been developed but some of the appliances imported to the market have energy labels from their country. The main energy labels in the country include; European Union Energy Label, China Energy Label and the India Energy Label. The technologies of air conditioners supplied to the Ugandan market include: Wall-mounted, ceiling cassette units, window units and portable units as shown in Figure 52.



Figure 52 Types of room air conditioners supplied in the Ugandan market

³² Data obtained from the questionnaire in October 2020.

6.1.3.5.1 Stock in Use

Air conditioners are mainly used in urban areas in commercial and residential buildings for cooling. The Country Saving Assessment modelled by U4E estimated that the stock of room air conditioners in Uganda will increase to approximately 230,000 units by 2030, as illustrated in Figure 53. The average unit sales per annum by 2030 is forecasted to reach around 25,000 units (UNEP-U4E, 2020).



Figure 53 Projected stock and sales of room air conditioners in Uganda

6.1.3.5.2 Sales of Room Air Conditioners

As mentioned earlier, the room air conditioners technologies in Uganda market are wall-mounted, split paced units, portable non-ducted units and window units. The prices of these appliances increase with the cooling capacity. In Uganda, the prices range between USD550-3430 for air conditioning appliances with cooling capacities ranging between 9000-40,950 Btu/h, as illustrated in Figure 54⁴.

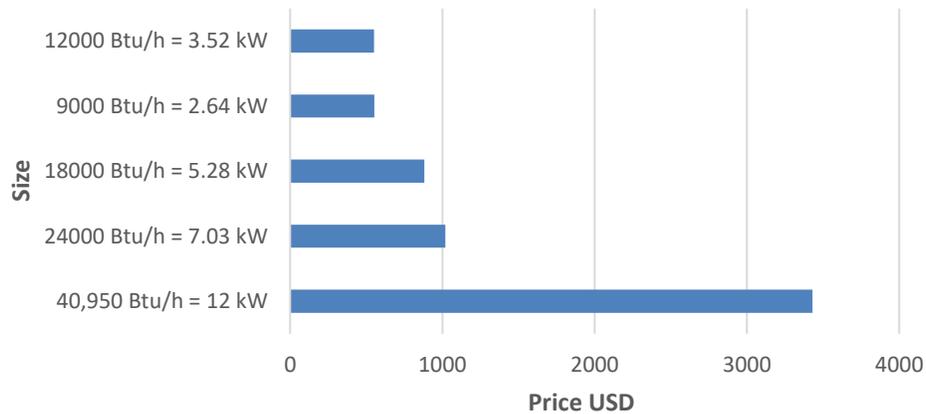


Figure 54 Typical prices of room air conditioning appliances in Uganda

6.1.3.5.3 Manufacturing of Room Air Conditioners

Uganda does not have air conditioner manufacturing companies in the country, but there are authorized brand distributors and dealers for common air conditioning brands in the market.

6.1.3.5.4 Distribution of Room Air Conditioners

Air conditioners imported to Uganda mainly come from India, Belgium, China, Pakistan and South Africa (ITC, 2018). The importers are usually subsidiaries of international brands, representative agencies and independent distributors selling their brands. The main brands of room air conditioners in the Uganda market are LG and Samsung. The supply chain for room air conditioners to the Uganda market is illustrated in Figure 55.

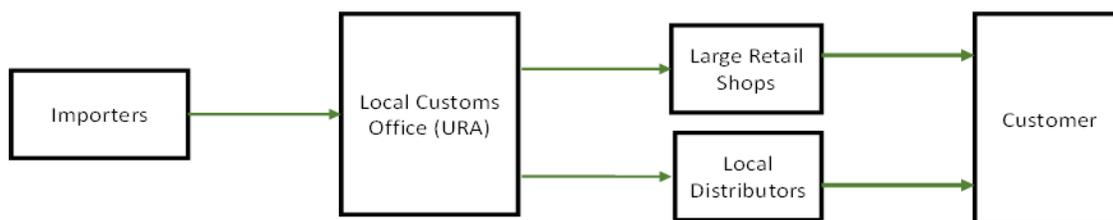


Figure 55 Supply chain of room air conditioners in Uganda

The retailers of air conditioning appliances in Uganda include Furniture shops, electrical and electronic shops, and brand subsidiaries that retail the products in the market. The key players in the retail of air conditioner in Uganda are provided in Table 32.

Table 32 Key players in the distribution of room air conditioners in Uganda

Type	Company
Furniture Shops	Homotech Appliances Buildplus (EA) Ltd Sanpic showroom
Brand Subsidiaries/ Dealers	LG appliance World ADH group Uganda
Electrical and Electronics Shop	Africool Uganda Noor Global Technologies Uganda Technology Masters Ltd ProAV Africa Ltd

6.1.3.5.5 Product registration

Currently, Uganda does not have a product registration system that focuses on the energy performance of room air conditioning appliances in the market.

6.1.3.5.6 Energy Efficiency of Room Air Conditioners

The penetration of energy-efficient room air conditioners in the Ugandan market is low due to lack of awareness and regulation to enforce the existing MEPS for air conditioners in the country. The common

labels on room air conditioning appliance imported to Ugandan market are the following: European Union Energy Label, China Energy Label or India Energy Label⁵.

6.1.3.6 Refrigerant Gases and Emissions

The use of refrigerant gases in Uganda is controlled by the National Environmental Management Authority (NEMA) through the management of ozone-depleting substances and products regulation 2020. According to the management of ozone-depleting substances regulation of 2020, the use of HCFC's as refrigerant gases in Uganda will be prohibited by 2030. The regulation also lays out a plan to phase down the use of HFC's as follows;

- Freeze date is set at 1st of January 2024
- 10% reduction by the 1st of January 2035
- 50% reduction by the 1st of January 2040
- 80% reduction by 1st of January 2045

Importers of room air conditioners and refrigerating appliances containing the restricted substances are required by the law to apply for a license authorising the importation of the appliances indicating the number of appliances imported. Currently, the commonly used refrigerant gases in Uganda include Hydrocarbons, ammonia, carbon dioxide and blends of HFCs³³.

6.2 SADC Region

This section presents an overview of the five countries selected for a detailed analysis on room air conditioners and residential refrigerators in the SADC region. These countries include Botswana, Eswatini, Namibia, Seychelles, and South Africa.

6.2.1 The Republic of Botswana

The Republic of Botswana is a landlocked country located in the centre of southern Africa and is covering a total area of 582,000 km². The northwest is bordered by Namibia, the northeast by Zimbabwe and southeast by South Africa, as shown in Figure 56. Majority of Botswana's landscape (up to 70%) is covered by the Kalahari Desert and the summer months can be very hot with mean temperatures occasionally rising above 39 °C. Botswana has a total population of 2.2 million of which 36% is found in rural areas and 64% in urban areas. In 2018 the total GDP current was reported to be USD18.7 billion and a GDP per capita (current) of USD8,280 (World Bank, 2018).

³³ Data obtained from the questionnaire in October 2020.

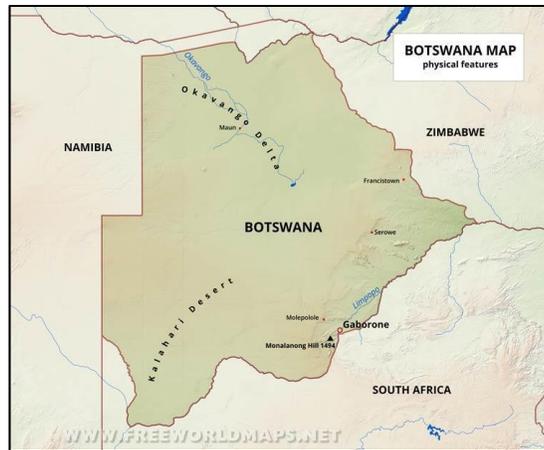


Figure 56 Map of Botswana

Table 33 Overall energy and economic indicators for Botswana (2018)

Indicators	Data
Population in 2018 (million)	2.2 Million
GDP in 2018 (current) Billion USD	18.66 Billion USD
GDP per Capita in 2018 (current USD)	8,280 USD
Access to electricity, total in 2018 (% population)	65%
Access to electricity, urban in 2018 (% of urban population)	81%
Access to electricity, rural in 2018 (% of rural population)	28%
System Maximum Demand	610 MW
Installed capacity in 2018	892 MW
Annual electricity consumption in 2018	3,208 GWh
Electricity imports (2018)	1,101 GWh
Electricity exports (2018)	86 GWh
Total Electricity Units Generated (2018)	2,824 GWh

Sources: BPC Annual Report 2019, World Bank data, Botswana Demographic Survey Report 2017

Botswana’s electricity sector broadly comprises three sub sectors, generation, transmission, and distribution. The state utility, Botswana Power Corporation, is responsible for the generation, transmission, and distribution of electricity in the country. In terms of energy security, Botswana generated most electricity using coal-based power stations to meet the country’s demand. Approximately, 1,101GWh was imported due to the poor performance of the coal plants. In terms of electricity consumption by sector, the residential and commercial sectors had the highest contribution, as shown in figure 57 (BPC, 2018), and each sector having contributed a third in overall electricity consumption. Botswana’s electrification rate was reported to be around 65% in 2018 (World Bank, 2018). Botswana continues to implement the rural electrification program with the aim to increase access to electricity. The average electricity tariff for the residential sector is USD0.09.

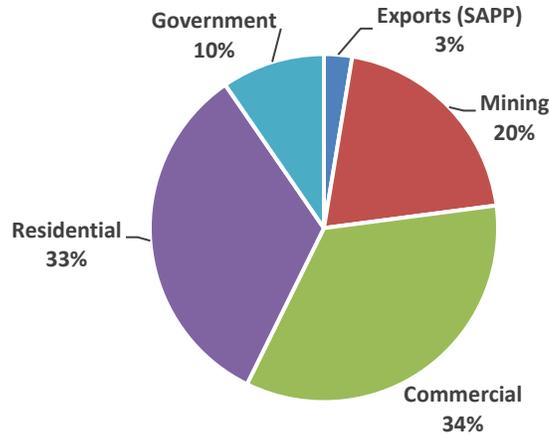


Figure 57 Electricity consumption by sector in Botswana (2018)

6.2.1.1 Policy Context

In December 2018, the Department of Energy under the Ministry of Mineral Resources, Green Technology and Energy Security, through support from the World Bank, completed a National Energy Efficiency Strategy document with key short and medium-term initiatives aiming to achieve 25% reduction in total final energy consumption by 2032 relative to 2017 (NEES, 2018). In terms of sectors the strategy provides the following targets:

- **Public buildings:** 25% reduction in specific energy consumption.
- **Commercial buildings:** 30% reduction in specific energy consumption.
- **Public Services:** 40% reduction in energy consumed per head of population.
- **Residential Buildings:** 36% reduction in energy consumption
- **Mining and Manufacturing:** 20% reduction in energy consumption
- **Agriculture:** 20TJ saving in energy used for pumping water per year and 80TJ saving in fuel for vehicles per year
- **Transport:** 20% improvement in average fuel efficiency of road vehicle stock.

Botswana's strategy identified MEPS and labelling programme as one of the key strategic interventions to reduce energy consumption for household appliances. It is envisaged the successful implementation of this programme can result in annual energy savings amounting to 394 GWh and 267 GWh for space cooling and household appliances, respectively.

It is recognised that energy efficiency still has a low profile in Botswana and thus presents an opportunity to consider energy efficiency measures across different economic sectors.

6.2.1.2 Institutional Mapping

The key institutions that play a major role in promoting energy efficiency in residential refrigerators and room air conditioners are summarized in Table 34.

Table 34 Key institutions in Botswana

Main Organization	Description/Role
Department of Energy under the Ministry of Mineral Resources, Green Technology and Energy Security	The Department of Energy is also responsible for the formulation of the national energy policy and related strategies.
Department of Environmental Affairs under the Ministry of Environment, Natural Resources Conservation and Tourism	The Department of Environment is mandated to promote environmental based initiatives for the conservation and protection of the environment.
The Botswana Energy Regulatory Agency (BERA)	Established through the BERA Act of 2016, BERA is responsible for providing an efficient energy regulatory framework for electricity, gas, coal, petroleum products, solar and all forms of renewable energy with the primary mandate of providing the economic regulation of the sectors.
Botswana Bureau of Standards (BOBS)	BOBS was established with the primary objectives of formulating Botswana standards and co-ordinating quality assurance activities in Botswana with a mission to improve the quality of life of the citizens of Botswana.
Botswana Power Corporation	Botswana Power Corporation, a parastatal utility which was formed in 1970 by an Act of Parliament is responsible for the generation, transmission and distribution of electricity within Botswana.
Botswana Unified Revenue Services	Botswana Unified Revenue Services is mandated with the Customs declarations at points of entry and control of imports and exports in Botswana.

6.2.1.3 Overview of Residential Refrigerators and Freezers in Botswana

Botswana currently does not have regulations that require refrigerators to comply with a set of MEPS. This is particularly important to notice as most households that have access to electricity own a refrigerator. Refrigeration appliances, including freezers, used in Botswana are imported from South Africa.

6.2.1.3.1 Stock in Use

In 2011, approximately 61.4% of households owned a refrigerator, including a freezer. (Statistics-Botswana, 2011). The Country Saving Assessment modelled by U4E estimated that the stock of residential refrigerators in Botswana will increase to approximately 690,000 units by 2030, as illustrated in Figure 58. The average unit sales per annum by 2030 is forecasted to reach around 66,000 units (UNEP-U4E, 2020).

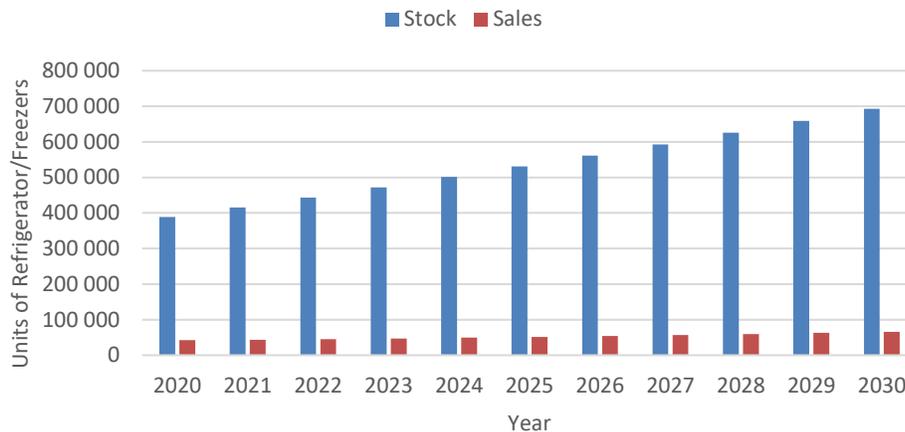


Figure 58 Projected stock and sales of residential refrigerators in Botswana

6.2.1.3.2 Manufacturing of Refrigerators and Freezers

There is no manufacturing of refrigerators and freezers taking place in Botswana.

6.2.1.3.3 Distribution of Residential Refrigerators and Freezers

The market is supplied with different types and sizes of household refrigeration systems including chest freezers, upright freezers/refrigerators, combined double door refrigerator, side by side door refrigerator, French Door Fridges, and Bar Fridges³⁴. The most popular brands available in the market include Defy, Hisense, Kelvinator, Samsung, KIC, LG, and Russel Hobbs. Residential refrigerators are sold mainly at furniture stores or household appliance stores. Some of the large retailers include Game, Bears, Furniture City, Bradlows, OK Furniture, Lewis, Morkels, Best Electric, Distron Botswana, Kruger Agencies, A-Z Hardware and Builders. The sale of residential refrigerators in supermarkets is becoming common in Botswana. There are agencies distributing refrigerators on behalf of big brands, such as the Ray Morgan Agency distributing Defy products. The market is supplied with both frost free and direct cool designs. The frost-free refrigerators are expensive when compared to the direct cool units.

The typical retail prices for residential refrigerators and freezers are summarised in Table 35³⁵, ranging between USD230 and USD800, depending on the type and volume-size.

Table 35 Typical prices of residential refrigerators in Botswana

Type of Refrigerator	Typical Volume (L)	New products Price Range (USD)
Freezer only	254 (L)	USD400
Refrigerator only	192 - 199 (L)	USD230
Freezer-refrigerator	443 (L)	USD800

³⁴ Data obtained from the questionnaire in October 2020.

³⁵ Data obtained from the questionnaire in October 2020.

The overview of the supply chain of residential refrigerators in Botswana is summarised in Figure 59.

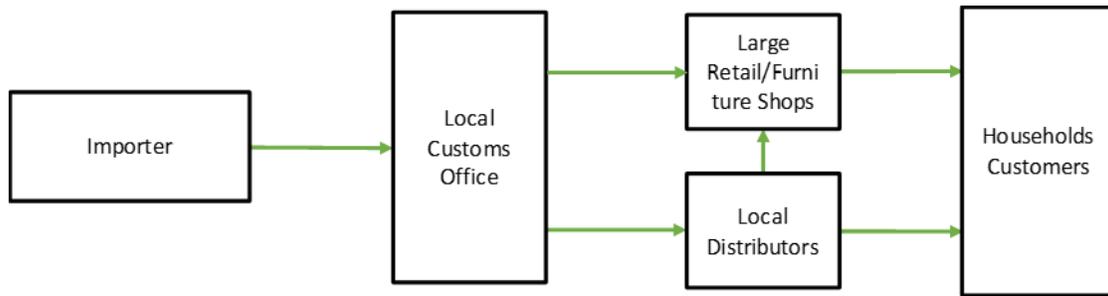


Figure 59 Supply chain of residential refrigerators in Botswana

The repair of residential refrigerators after the expiry of the warranty period was found but not very common in Botswana. There are very small refrigerator repair industries found mostly in low-income areas, but no data was found to quantify this activity. There are no cases of importation of used residential refrigerators found in Botswana.

6.2.1.3.4 Energy Efficiency of Residential Refrigerators and Freezers

Most residential refrigerators and freezers products have the South African energy efficiency label displayed on the outside front of the door. The energy efficiency label displays information pertaining to annual energy consumption, volume, and the minimum energy efficiency class starting from Class B ($55 \leq EEI < 75$) for refrigerators and Class C ($75 \leq EEI < 90$) for freezers in accordance with the South African MEPS and labelling system. The most popular residential refrigerators in the market have a volume ranging from 192L – 250L with an average annual consumption of 208 kWh³⁶. The absence of regulations and MEPS for refrigerators presents a risk of importing substandard/inefficient refrigerators into Botswana.

Applying the U4E Country Saving Assessments to estimate the impact of MEPS for residential refrigerators at two levels of ambition (minimum and high), Figure 60 illustrates the electricity savings potential for both scenarios up to 2040 (UNEP-U4E, 2020). Implementation of MEPS under the minimum ambition scenario can reduce electricity consumption by 90 GWh in 2040 using the Business as Usual as reference. Implementation of MEPS under the minimum and high ambition scenarios has potential to reduce electricity consumption by 90 GWh and 206 GWh in 2040 respectively as compared to the Business-as-Usual scenario (UNEP-U4E, 2020).

³⁶ Data obtained from the questionnaire in October 2020.

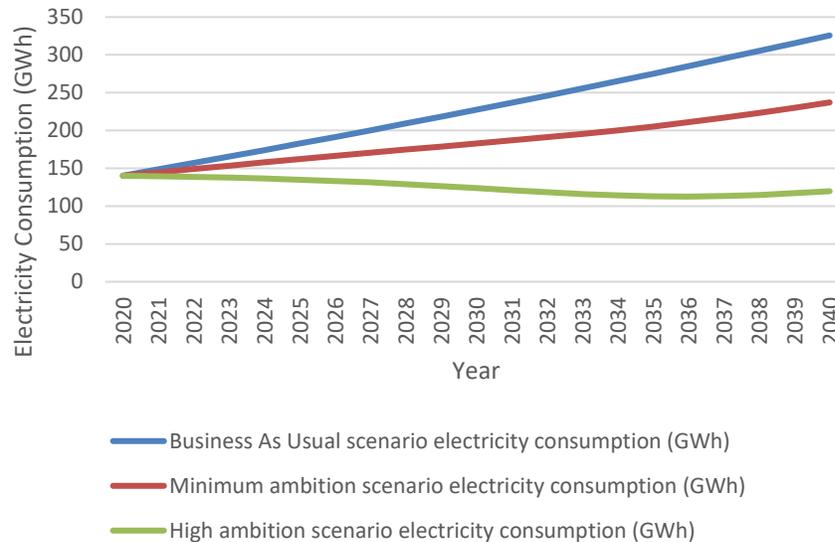


Figure 60 Projected electricity consumption of residential refrigerators in Botswana

6.2.1.3.5 Overview of Room Air Conditioners in Botswana

In general, Botswana climate is characterised by high temperatures, rising to 39°C. These high temperatures make room air conditioning a necessity. Currently, there are no regulations, standards, and financing schemes to promote adoption of energy efficient room air conditioners. Air conditioning equipment sold in Botswana is imported from South Africa.

6.2.1.3.5.1 Stock in Use

Room air conditioning equipment is very common in commercial buildings, such as offices, hotels and shops. The use of air conditioning in homes remains insignificant. There are various types of air conditioning systems used in buildings, with room air conditioning being the most dominant (CTCN 2018 b). The room air conditioning equipment constituted the window units, split system, and portable types. The penetration of air conditioners is estimated to be 20% to 50%³⁷.

The total installed stock could not be ascertained. However, the U4E Country Saving Assessment estimated that the stock of room air conditioners in Botswana will increase to approximately 450,000 units by 2030, as illustrated in Figure 61. The average unit sales per annum by 2030 is forecasted to reach around 40,000 units (UNEP-U4E, 2020).

³⁷ Data obtained from the questionnaire in October 2020.



Figure 61 Projected stock and sales of room air conditioners in Botswana

6.2.1.3.5.2 Manufacturing of Room Air Conditioner

There is no manufacturing of air conditioning equipment taking place in Botswana.

6.2.1.3.5.3 Distribution and Sales of Room Air Conditioners

The supply of room air conditioners is characterised by imports, mainly from South Africa and China. The distribution of air conditioners is different from that of residential refrigerators. Since room air conditioning units are generally not “off-the shelf” items, service providers or local distributors and agencies distributing on behalf of international companies are key distributors of room air conditioners in Botswana. There are several agencies involved in the distribution of room air conditioners. These include DEFY Botswana, Distron Botswana, Metraclark, Tecja, Mr Fan, Botsand, Climate Control and A-Z Hardware³⁸.

Further, there are electrical and electronic stores, such as Hifi Corporation, that were found selling room air conditioning equipment directly to customers. The most popular brands offered to the market include Defy, Botsand, Elite, Whirlpool, Hisense, Midea, TCL, MBO, Samsung, and York. The overview of the supply chain of room air conditioners in Botswana is summarised in Figure 62.

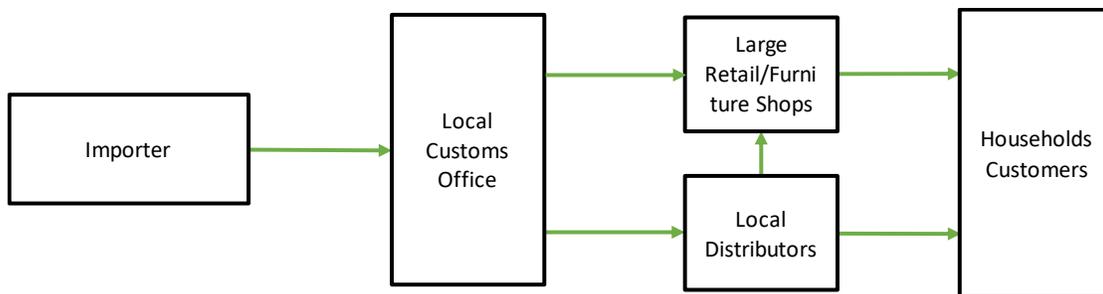


Figure 62 Supply chain of room air conditioners in Botswana

³⁸ Data obtained from the questionnaire in October 2020.

6.2.1.3.5.4 Energy Efficiency of Room Air Conditioners

The room air conditioning equipment supplied to the market has the South African energy efficiency label. The energy efficiency label displays information pertaining to energy efficiency ratio, annual energy consumption of cooling, cooling output, and the energy efficiency class ranging from Class B or better in compliance with the South African MEPS and labelling. The bulk of units available in the Botswana market are graded Class A or better in terms of energy efficiency. The market is supplied with both the inverter type and non-inverter type of room air conditioning systems.

Applying the U4E Country Saving Assessments to estimate the impact of MEPS for room air conditioners at two levels of ambition (minimum and high), Figure 63 illustrates the electricity savings potential for both scenarios up to 2040 (UNEP-U4E, 2020). Implementation of MEPS under the minimum and high ambition scenarios has potential to reduce electricity consumption by 360 GWh and 670 GWh in 2040 respectively as compared to the Business as Usual (BAU) scenario (UNEP-U4E, 2020).

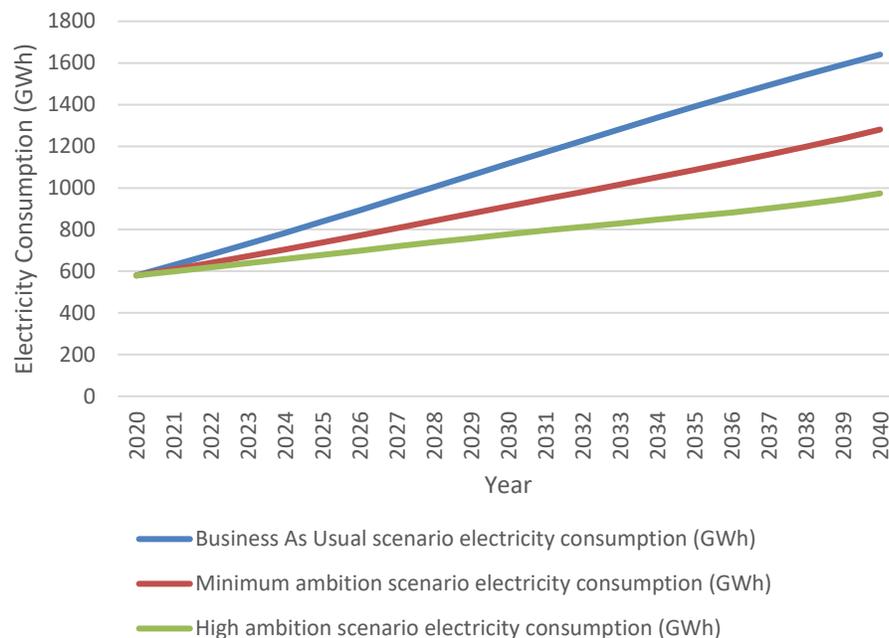


Figure 63 Projected electricity consumption for room air conditioners in Botswana

6.2.1.3.5.5 Product Registration

There is no product registration system for refrigerators and air conditioners in Botswana.

6.2.1.3.6 Refrigerant Gases and Emissions

In the fight against climate change, Botswana enacted the Ozone Depleting Substance Regulations of 2014 which also include a schedule to phase out Ozone Depleting Substances. The production of any controlled substance, as stated in the regulations or any other substance likely to deplete the ozone layer is prohibited. The sale, importation or exportation of controlled substances or products, including

residential refrigerators and room air conditioners, containing a controlled substance is prohibited (Botswana-Government, 2014). The regulations also state that servicing or repairing an equipment or product that contains or uses a controlled substance is prohibited, unless the person doing the job is issued with a permit in accordance to the regulations. The regulations exclusively state that no person shall sell, import, retrofit refrigeration or air conditioning equipment with any HCFC's. Below is a list of controlled substances in accordance with the regulations:

- a) Chlorofluorocarbons;
- b) Bromochlorofluorocarbons
- c) Halons;
- d) Carbon Tetrachloride;
- e) 1,1,1 Trichloroethane;
- f) Hydrobromofluorocarbons;
- g) Bromochloromethane.
- h) Methylbromide

The refrigerant gases commonly found in Botswana include, R410, R22, R404, R407, R134, and R600a.

6.2.2 The Kingdom of Eswatini

The Kingdom of Eswatini is a landlocked country located in the southern part of Africa and is covering a total area of 17,364 km². The northeast is bordered by Mozambique and the north, west, and south by South Africa, as depicted in Figure 64. Due to variations in altitude, the weather varies a lot depending on the location. The highveld has temperatures ranging from 5 °C to 25 °C. The Middleveld has temperatures ranging from 10 °C to 35 °C and the lowveld has temperatures ranging from 20 °C to 40 °C. Eswatini has a total population of 1.1 million of which 76% is found in rural areas and 24% in urban areas (Eswatini-CSO, 2017). In 2018 the total GDP current was reported to be USD4.7 billion and a GDP per Capita of USD4,145.97 (World Bank, 2018).

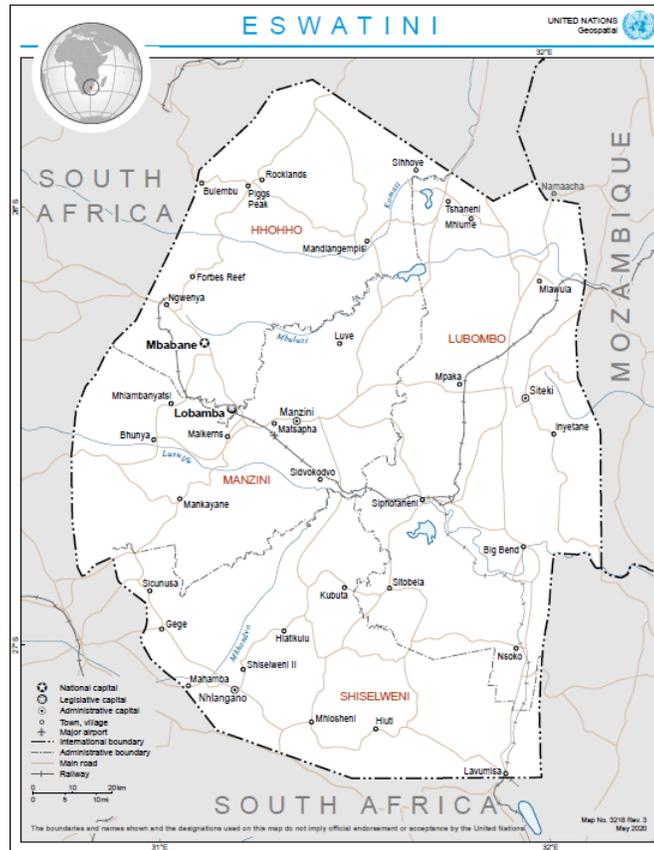


Figure 64 Map of Eswatini

Table 36 Overall energy and economic indicators for Eswatini (2018)

Indicators	Data
Population in 2018 (million)	1.1 Million
GDP in 2018 (current) Billion USD	4.71 Billion USD
GDP per Capita in 2018 (current USD)	4,146 USD
Access to electricity, total in 2018 (% population)	80%
Access to electricity, urban in 2018 (% of urban population)	89%
Access to electricity, rural in 2018 (% of rural population)	78%
System Maximum Demand	238 MW
Installed capacity in 2018	188 MW
Annual electricity consumption in 2018	1,406 GWh
Electricity imports (2018)	942 GWh
Total Electricity Units Generated (2018)	624 GWh

Sources: EEC Annual Report 2019, World Bank data, National Census 2017

Eswatini’s electricity sector broadly comprises three sub-sectors, generation, transmission, and distribution. The state utility, Eswatini Electricity Company is responsible for the generation,

transmission, and distribution of electricity in the country. In terms of energy security, Eswatini generated most electricity using its hydro (326.7 GWh) and biomass cogeneration (296.8 GWh) power stations. Approximately 924 GWh was imported from South Africa, Mozambique and the Southern Africa Power Pool’s Day Ahead Market. In terms of electricity consumption, approximately 1406 GWh (MNRE, 2018) was consumed by the different sectors, as illustrated in Figure 65. The electrification rate of Eswatini currently stands at 80% (MNRE, 2018), making Eswatini to be one of the most electrified countries in SADC. Through its rural electrification program, Eswatini has a target to ensure universal access to electricity by the year 2030. The average electricity tariff for the residential sector is USD0.11. Eswatini’s electricity tariff structure is still dominated by cross subsidies, with the residential being subsidised by the industrial sector.

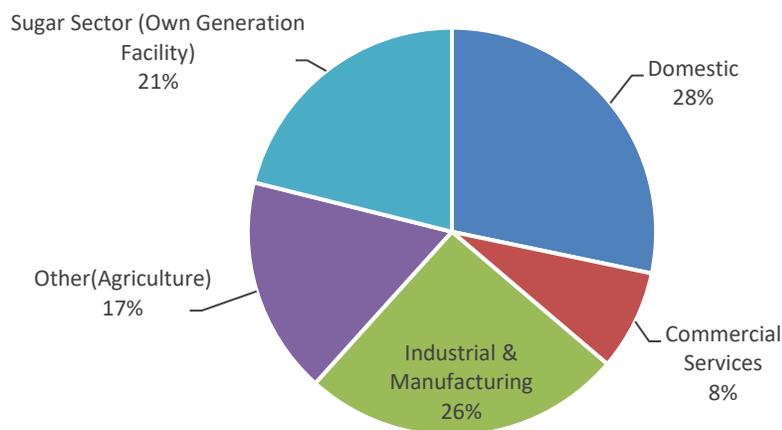


Figure 65 Electricity consumption by sector in Eswatini (2018)

6.2.2.1 Policy Context

Eswatini has put in place the Energy Efficiency and Conservation Policy (2019) with a goal to stimulate sustainable energy efficiency and conservation programmes in all economic sectors. Through this policy, the Government has committed to adopt and enforce mandatory MEPS and labelling for household appliances in line with regional and international practices. The National Energy Policy, 2003, which was updated in 2018, has been the pillar of the energy sector development.

Further, Eswatini has put in place the National Energy Efficiency Strategy and Action Plan, 2020 focusing mainly on the electricity sector due to the enormous potential for energy efficiency achievements, especially among residential consumers. The National Energy Efficiency Strategy and Action Plan contains sectoral targets that were calculated by means of the baseline information provided in Eswatini’s Energy Master Plan 2034. This Energy Master Plan 2034 was formulated to provide national decision makers with the quantitative base for planning future energy sector projects/initiatives. The National Energy Efficiency Strategy and Action Plan aims to achieve the following (Energy-Department, 2020):

- 20% Reduction in the overall electricity consumption of the residential sector by 2034.

- 10% Reduction in the overall electricity consumption of the industrial sector by 2034.
- 15% Reduction in the overall electricity consumption of the Sugar sector by 2034.
- 10% Reduction in the overall electricity consumption of the Commerce and Government by 2034.
- 10% Reduction in the overall electricity consumption of other sectors (Agriculture) by 2034.

In 2007, Eswatini promulgated the following pieces of legislation, Electricity Act of 2007, Swaziland Electricity Company Act of 2007, Energy Regulatory Authority Act of 2007 which are essential in the liberalisation process of the energy supply industry, aimed at improving services offered to consumers and encouraging private sector investment.

6.2.2.2 Institutional Mapping

The key institutions that play a major role in promoting energy efficiency in residential refrigerators and room air conditioners are summarized in Table 37.

Table 37 Key institutions in Eswatini

Main Organization	Description/Role
Ministry of Natural Resources and Energy through the Department of Energy (DoE)	The Department of Energy under the Ministry of Natural Resources and Energy (MNRE) oversees the development and implementation of the energy policies, energy legislation, energy strategies, and overall management of energy resources in Eswatini.
Ministry of Tourism and Environmental Affairs through the Climate Change Unit	The Ministry of Tourism and Environmental Affairs oversees the development and implementation of environmental policies and laws of the country.
Department of Regulatory and Quality Infrastructure Development under the Ministry of Commerce, Industry and Trade	The Department is mandated with the development of the legal and institutional framework and infrastructure for standardization, technical, regulations, quality, assurance, accreditation and metrology to achieve its mission.
Eswatini Energy Regulatory Authority (ESERA)	Eswatini Energy Regulatory Authority established through the Energy Regulatory Act, 2007 mandated with the administration of Electricity Act, 2007, regulation of generation, transmission, distribution, supply, use, import and export of electricity in Eswatini.
Eswatini Standards Authority (SWASA)	The Eswatini Standards Authority (SWASA) was established through the Quality and Standard Act (2003). SWASA is the sole custodian of all issues regarding standards and quality in Eswatini and its mandate is to develop, maintain and promote the implementation of standards and performing conformity assessments.

Eswatini Electricity Company	Eswatini Electricity Company was established through the Electricity Act 2007 to ensure sustainable generation, transmission and distribution of electricity in the Kingdom of Eswatini.
Eswatini Environment Authority	Established through the Environment Management Act, 2002 to ensure that Eswatini's development is environmentally, economically and socially sustainable, by means of promoting sound environmental policies, practices and development, which meets appropriate national and international standards.
Eswatini Revenue Authority	Established through the Revenue Authority Act, 2008, Eswatini Revenue Authority is mandated with the customs declarations at points of entry and control of imports and exports in Eswatini.
University of Eswatini's Centre for Sustainable Energy Research	The UNESWA-CSER is a semi-autonomous centre based in the University of Eswatini, focusing on energy research, training and consultancy, implementation of Energy efficiency and conservation measures, and Energy system analysis and modelling.

6.2.2.3 Overview of Residential Refrigerators and Freezers in Eswatini

Despite having introduced policies and strategies promoting implementation of energy efficiency measures, Eswatini currently does not have regulations that require refrigeration appliances to comply with a set of MEPS. Unavailability of information/data regarding the potential savings as a result of MEPS and inadequate funding for energy efficiency programmes are some of the key barriers to the implementation of MEPS for refrigerators. Eswatini imports the bulk of refrigerators and freezers to meet the country's demand, mostly from South Africa. The imported refrigeration products carry the South African energy efficiency label. Through awareness campaigns, the public is being sensitized about the energy efficiency of residential refrigerators and freezers and the importance of the South Africa energy efficiency label.

6.2.2.3.1 Stock in Use

According to the Population Census, 2017, 143,827 households were found to have a refrigerator and/or Freezer (Eswatini-CSO, 2017). Approximately 65.4% of households in urban areas own/use a refrigerator and/or freezer, whilst 51.5% of households in rural areas were found to own a refrigerator and/or freezer. It is becoming very common for most households to have more than one refrigerator. The lower income homes or rented facilities are more likely to have one refrigerator, with the middle to high income households having several units per home with some owning more than one dwelling. As previously mentioned, Eswatini is heavily reliant on imports to meet the consumer demand for refrigerators and freezers. The quantities of refrigerator/freezer units imported into the Kingdom of Eswatini from 2017 to 2020 are illustrated in Figure 66 (SRA, 2020). Unfortunately, the data does not provide the description by brands and types of refrigerators and freezers.

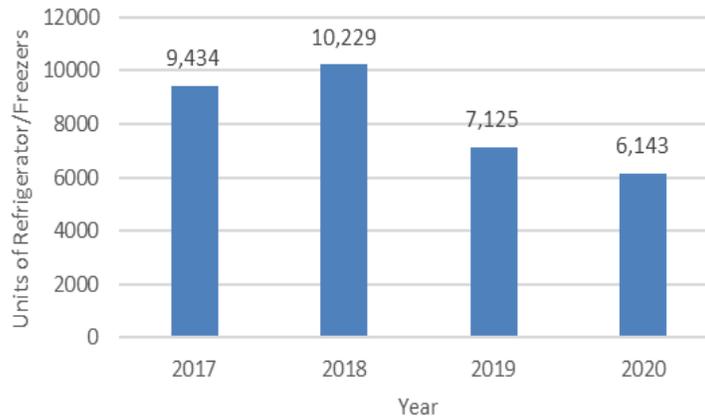


Figure 66 Refrigerators and freezers imported into Eswatini

The Country Saving Assessment modelled by the U4E estimated that the stock of residential refrigerators in Eswatini will increase to approximately 240,000 units by 2030, as illustrated in Figure 67. The average unit sales per annum by 2030 is forecasted to reach around 22,000 units (UNEP-U4E, 2020).

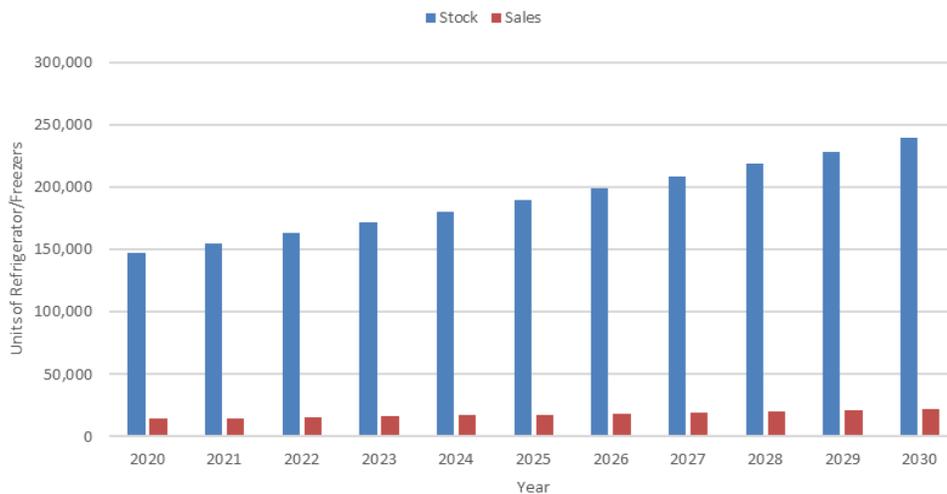


Figure 67 Projected stock and sales of residential refrigerators in Eswatini

6.2.2.3.2 Manufacturing of Residential Refrigerators and Freezers

The Fridge Factory, also known as Palfridge, is the only manufacturer of refrigerators and freezers in Eswatini. The company specialises in production of commercial and household refrigerators and freezers. In terms of residential refrigerators, the company produces chest freezers, combined double door refrigerators and solar powered freezers. In 2019 the company produced 38,432 refrigerators, dominated by chest freezers and followed by small bar refrigerators (Fridge-Factory, 2020). Large double door refrigerators accounted for only 13% of the production, as illustrated in Figure 68. The estimated lifespan of the refrigerators produced locally is 10 years. The company produces two brands,

namely Univa and Fridge Star, which are mainly exported to South Africa, Mozambique and Zimbabwe. The company produces refrigerators that comply with South Africa’s MEPS and Labelling system. The energy efficiency ratings of freezers and refrigerators produced locally are rated as in Class B ($55 \leq EEl < 75$) and Class A ($42 \leq EEl < 55$), respectively. The majority of refrigerators produced locally are exported. Only 4% was distributed to the local market, as shown in Figure 69.

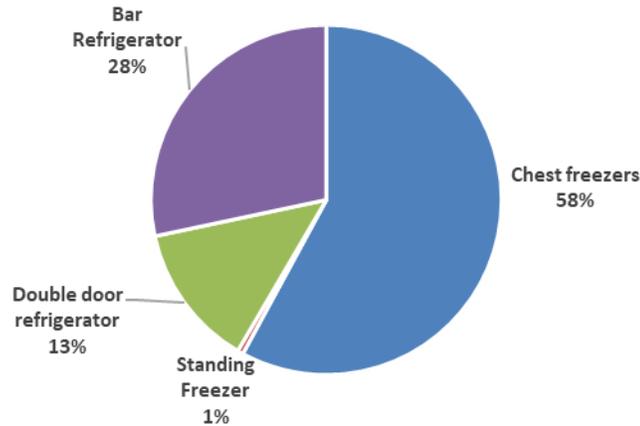


Figure 68 Production of refrigerators by type in Eswatini by type 2019



Figure 69 Share of Exports and local distribution for refrigerators 2019

6.2.2.3.3 Distribution of Residential Refrigerators and Freezers

The market is supplied with different types and sizes of residential refrigeration systems, including chest freezers, upright freezers/refrigerators, double door fridge (combi fridge), side by side door fridges, French door fridges, and bar fridges. The most popular brands offered to the market include Defy, Hisense, Kelvinator, Samsung, KIC, LG, Fridge Star, Zero, and Russel Hobbs. The market is supplied with

both frost free and direct cool designs. The frost-free refrigerators are expensive when compared to the direct cool units³⁹.

Residential refrigerators and freezers are mainly sold in furniture stores, supermarkets, electrical and electronic shops, predominantly of South African origin. In essence, this means the refrigeration products come with the South African energy efficiency label displaying the energy efficiency rating, annual energy consumption, volume, etc. Very few agencies distributing the refrigerators on behalf of big brands were found to be active in the local market. The importers and retailers of refrigerators are presented in Table 38. Most of these companies originate from South Africa, and some are companies of Eswatini.

Table 38 Key players in the distribution of residential refrigerators in Eswatini

Type	Company
Furniture Shops	Russells Furniture Bradlows OK Furnishers Bears Lewis Furniture Warehouse
Supermarkets	Spar Pick n Pay
Electrical and Electronics Shop	HiFi Corporation, Hoageys Swaziland Supply Centre Defy Distributor Best Electric

According to interviews with the floor attendants in the shops, it was noted that the energy consumption information, or the label is not a priority to most customers, in contrast the customers are more concerned with the brand, aesthetics and size of the refrigerator. The resale of second hand or refurbished refrigeration appliances is occurring in Eswatini, yet there are no regulations to control this activity. The supply chain of residential refrigerators in Eswatini summarised in Figure 70.

³⁹ Data obtained from the questionnaire in October 2020.

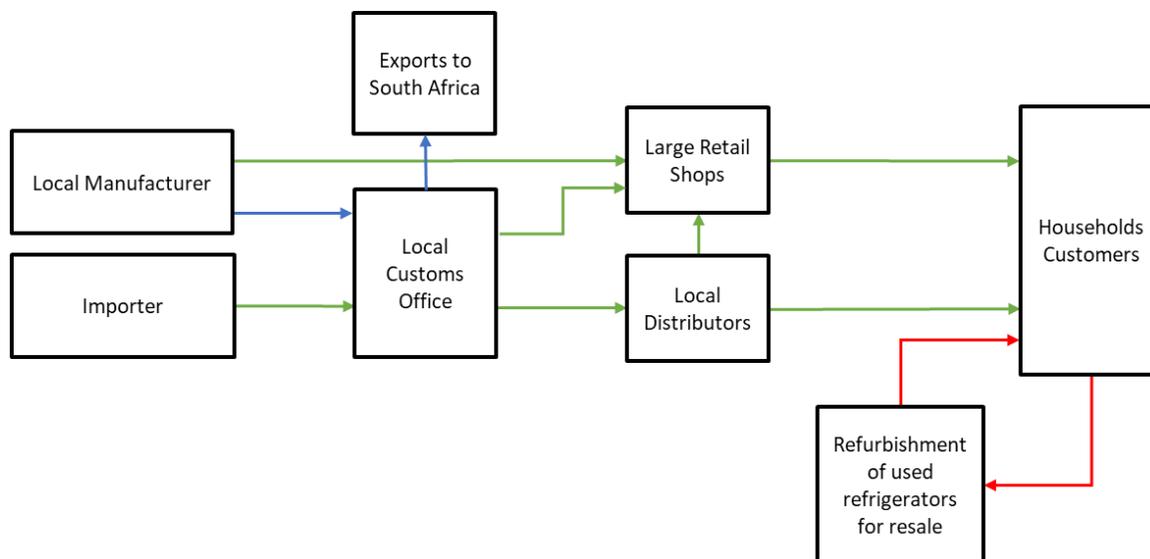


Figure 70 Supply chain of residential refrigerators in Eswatini

6.2.2.3.4 Energy Efficiency of Residential Refrigerators and Freezers

Most residential refrigerators distributed in Eswatini market have the South African energy efficiency label. It was established the bulk of refrigerators and freezers supplied to the market have energy ratings Class A ($55 \leq EEI < 75$) or better and Class B ($42 \leq EEI < 55$) or better, respectively and are in accordance with the South African MEPS and labelling system. Residential refrigerators produced locally have an annual energy consumption ranging between 328 to 1500 kWh for chest freezer and ranges between 255 – 470 kWh for the double door refrigerator, as shown in Table 39 (Fridge-Factory, 2020).

Table 39 Energy efficiency of residential refrigerators produced in Eswatini

Type of Refrigeration Technologies	Volume (Range / Most Popular in litres)	Energy Consumption (Range / Most Popular in kWh/year)	Energy Efficiency Performance Class
Chest freezers	199 – 520 L	328 – 1500	B
Double door refrigerator-freezer	176 – 273 L	255 – 470	A

Applying the U4E Country Saving Assessments to estimate the impact of MEPS for refrigerators at two levels of ambition (minimum and high), Figure 71 provides an illustration of the electricity savings potential for both scenarios up to 2040 (UNEP-U4E, 2020). Implementation of MEPS under the minimum and high ambition scenarios has potential to reduce electricity consumption by 30 GWh and 70 GWh in 2040 respectively as compared to the Business-as-Usual scenario (UNEP-U4E, 2020).

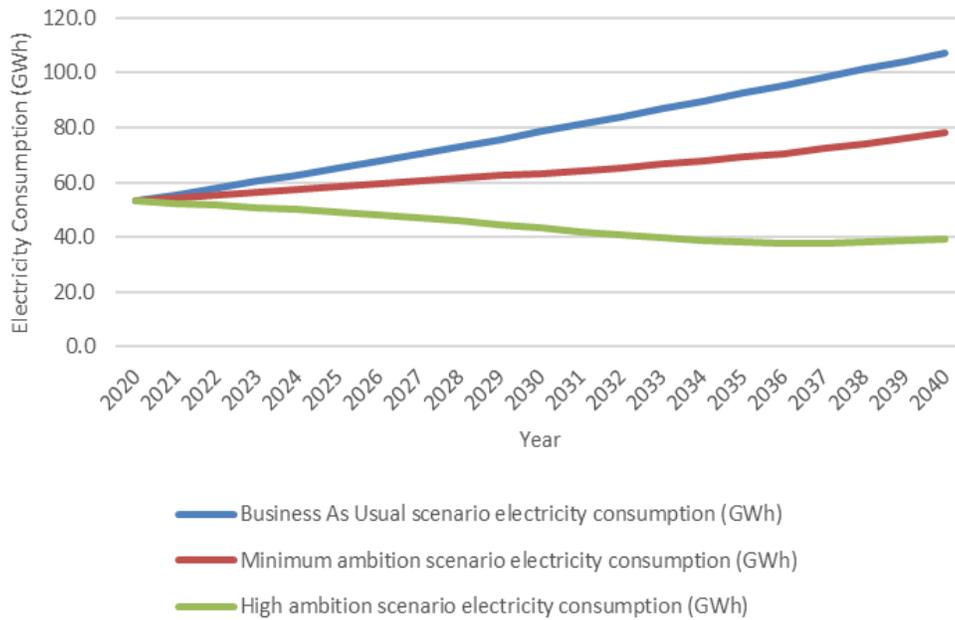


Figure 71 Projected electricity consumption for residential refrigerators in Eswatini

6.2.2.4 Overview of Room Air Conditioning Appliances

Eswatini currently does not have regulations that require air conditioners to comply with a set of MEPS. Eswatini imports all room air conditioning systems to meet the country’s demand, mostly from South Africa.

6.2.2.4.1 Stock in Use

The penetration of room air conditioners in the household sector is very low. In 2013, about 5% (8% Urban and 2% Rural) of households had installed room air conditioners (MNRE, 2013). Room air-conditioners in Eswatini are mostly used for cooling in commercial buildings, such as offices, hotels, hospitals and entertainment areas. With the increased availability of basic infrastructure (road, electricity and water) in rural areas, Eswatini is experiencing a migration of households from urban areas to rural areas near towns and cities. This has resulted in an upsurge in demand for air conditioners in the residential sector, including houses located in rural areas. However, most households especially the lower to middle-income brackets find cooling fans as an affordable alternative to air conditioners. The Country Saving Assessment modelled by U4E estimated that the stock of room air conditioners in Eswatini will increase to approximately 89,000 units by 2030, as illustrated in Figure 72. The average unit sales per annum by 2030 is forecasted to reach around 7,000 units (UNEP-U4E, 2020).

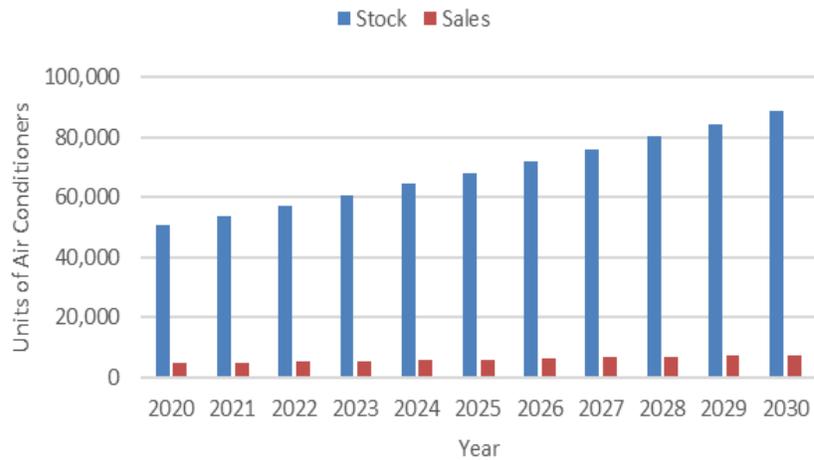


Figure 72 Projected stock and sales of air conditioners in Eswatini

6.2.2.4.2 Manufacturing of Room Air Conditioners

Eswatini does not have manufacturing facilities for air conditioning equipment.

6.2.2.4.3 Distribution and Sales of Room Air Conditioners

The different types of room air conditioners supplied to the Eswatini market include the split type, portable and window units. Air conditioning units are generally not “off-the shelf” items as such require the services of an agency or service provider that can provide after sales services, such as maintenance services. The key stakeholders involved in the distribution of room air conditioners include importers, distributors and installers. Some household appliance stores are also selling room air conditioning equipment. There are various service providers available in the Eswatini market providing sales, installation and maintenance of conditioners, as presented in Table 40. The supply chain of air conditioners is summarised in Figure 73.

Table 40 Key stakeholders in the distribution of room air conditioners in Eswatini

Type	Company
Furniture Shops	OK Furnishers
Electrical and Electronics Shop	HiFi Corporation, Hoageys Swaziland Supply Centre Defy Distributor
Air conditioning Contractors	Viva Air-conditioning, Gree Air Conditioners National Refrigeration & Scale (PTY) Ltd Ecozone Swaziland Damnics Air Conditioners Airconditioning & Refrigeration Services Macnab's Refrigeration (PTY) Ltd

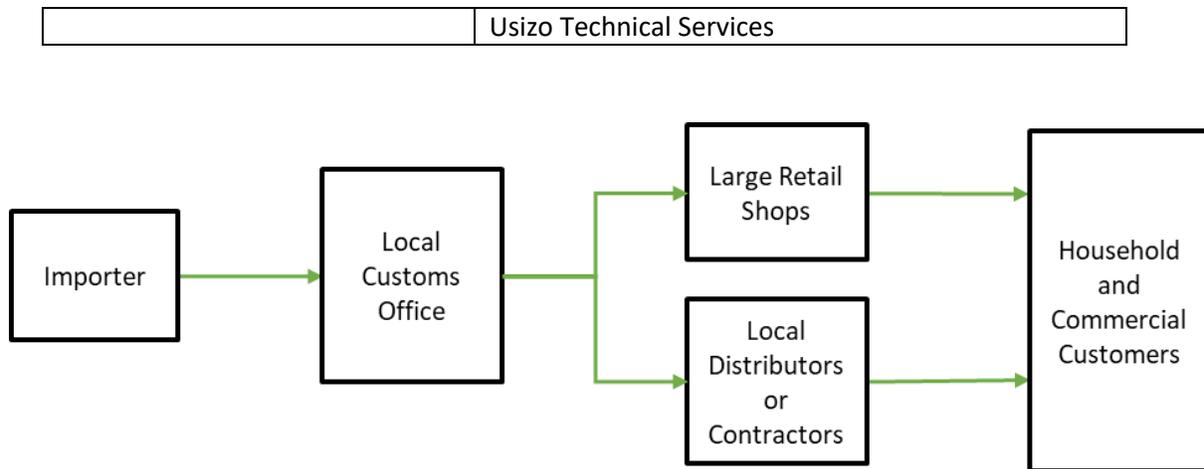


Figure 73 Supply chain of room air conditioners in Eswatini

6.2.2.4.4 Energy Efficiency of Room Air Conditioners

Most room air conditioning equipment available in the market have the South Africa energy efficiency label, displaying the energy efficiency ratio, annual energy consumption in cooling, cooling output, and the energy efficiency classes. A variety of efficiencies ranging from MEPS (Class B) to best available option (predominantly Class A) were found in the market⁴⁰. The inverter type air conditioning system is the common technology supplied to the market. The use of non-inverter type air conditioners exists but is no longer popular amongst consumers.

Applying the U4E Country Saving Assessments to estimate the impact of MEPS for air conditioners at two levels of ambition (minimum and high), Figure 74 demonstrates the potential electricity savings for both scenarios up to 2040 (UNEP-U4E, 2020). Implementation of MEPS under the minimum and high ambition scenarios has potential to reduce electricity consumption by 23 GWh and 40 GWh in 2040 respectively as compared to the Business as Usual (BAU) scenario (UNEP-U4E, 2020).

⁴⁰ Data obtained from the questionnaire in October 2020.

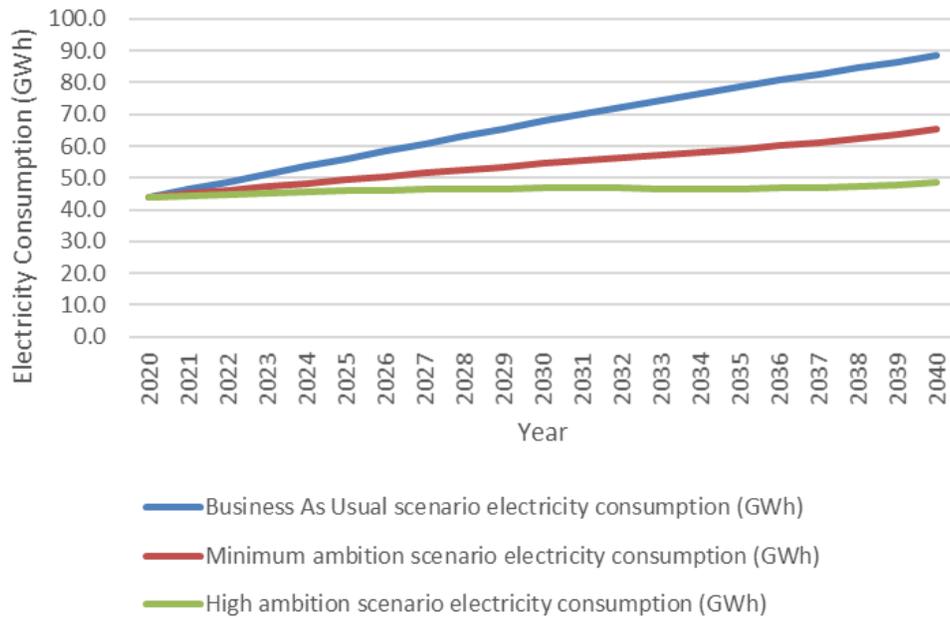


Figure 74 Projected electricity consumption of room air conditioners in Eswatini

6.2.2.4.5 Product Registration

Eswatini does not have a product registration system for air conditioners and refrigerators.

6.2.2.5 Refrigerant Gases and Emissions

Eswatini enacted the Ozone Depleting Substance Regulations of 2003 (EEA, 2014) read together with the Ozone Depleting Substance (Amendment) Regulations, 2014 to:

- Regulate the production, trade and use of controlled substances and Products;
- provide a system of data collection that will facilitate compliance with relevant reporting requirements under the Protocol;
- promote the use of ozone friendly substances, products, equipment and technology;
- ensure the elimination of substances and products that deplete the ozone layer.

These regulations include the mandatory registration of importers and exporters of controlled substances or controlled products as well as issued quota allocations for importers and exporters. Following the Montreal Protocol Eswatini has started with the phase out of HCFC gases, such as the R122 and R141B. The phase out of HFCs, such as R134a, has not commenced hence such gases are still used in refrigerators. The Ozone Depleting Substance Regulations requires an import permit for HCFCs and HFCs refrigerant gases. The Department of Customs and Excise under the Eswatini Revenue Authority with assistance of Eswatini Environment Authority is also mandated to conduct inspections at all entry points of the country to ensure that these regulations are complied with.

Table 41 Overall energy and economic indicators for Namibia (2018)

Indicators	Data
Population in 2018 (million)	2.5 Million
GDP in 2018 (current) Billion USD	13.45 Billion USD
GDP per Capita in 2018 (current USD)	5,495 USD
Access to electricity, total in 2018 (% population)	55%
Access to electricity, urban in 2018 (% of urban population)	72%
Access to electricity, rural in 2018 (% of rural population)	36%
System Maximum Demand	684 MW
Installed capacity in 2018	576 MW
Annual electricity consumption in 2018	4,159 GWh
Electricity imports (2018)	3,161 GWh
Electricity exports (2018)	119 GWh
Total Electricity Units Generated (2018)	1,274 GWh

Sources: World Bank data, Nampower Annual Report 2018

In 2018, the state Utility (Nampower) and Independent Power Producers (IPPs) generated about 1274 GWh. In order to meet the country's demand, a total of 3,161 GWh was imported from South Africa, Zambia, Zimbabwe and the SAPP, which is a transboundary interconnection agency (NamPower, 2019). Namibia's electricity sector is characterised by generation, transmission, and distribution. Nampower, the state utility, is active mainly in generation and transmission of electricity. Figure 76 shows IPPs generated about 6% of the electricity supply. Worth noting is the participation of regional electricity distributors that are supplied by Nampower and in turn redistribute electricity to customers, mainly the commercial and domestic sector, within their jurisdictions. Namibia's electricity tariffs are the highest in the region, at 0.142 USD per kWh for residential consumers and 0.145 USD for industrial consumers (CTCN, 2018b). Namibia's electrification is around 55% and the country is experiencing significant growth in electricity demand which presents opportunities for energy efficiency market transformation.

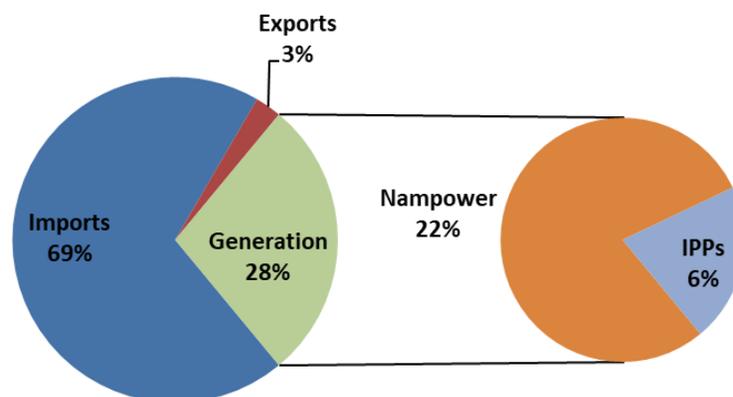


Figure 76 Electricity supply in Namibia (2018)

6.2.3.1 Policy Context

The White Paper on Energy Policy published in 1998, developed by the Ministry of Mines and Energy, is fundamental in the implementation of energy efficiency programs. The policy identifies energy efficiency in households as one of the key areas to develop in order to improve the country's energy intensity. Specifically, the policy targets the introduction of a household appliance labelling programme with the aim to promote the use of energy efficient appliances in the sector. In 2017, Namibia published the National Energy Policy, 2017 which emphasizes on the need to develop the legislative instruments, monitoring and evaluation programs supporting the implementation of energy efficiency measures and programs in Namibia. However, the new policy does not provide details on the introduction of MEPS and labelling programs for household appliances. Namibia currently does not have an implementation strategy which focuses on energy efficiency. The Electricity Act, 2007 is the legal instrument used mainly for the administration and regulation of Namibia's electricity sector.

6.2.3.2 Institutional Mapping

Table 42 summarises the key institutions that play a major role in promoting energy efficiency in Namibia.

Table 42 Key Institutions in Namibia

Main Organization	Description/Role
Directorate of Energy, Ministry of Mines and Energy	The Ministry of Mines and Energy is the ministry responsible for energy matters in the country, and it is the custodian of the National Energy Policy, 2017.
Electricity Control Board	The Electricity Control Board is the statutory regulator for the electricity sector, established in 2000 under the Electricity Act of 2000, the 2000 Electricity Act was repealed by the Electricity Act of 2007 and the Namibia Energy Regulatory Authority (NERA) Bill is currently being drafted. Under the NERA Bill, the ECB will be transformed into the Namibia Energy Regulatory Authority (NERA). The new Electricity Bill will introduce the required changes to give

	effect to the establishment of the NERA. There is no indication when this bill will be passed.
Namibia Power Corporation (NamPower)	The Namibia Power Corporation (NamPower) is the country's major state-owned power utility and is responsible for generation, transmission, trading, and import and export of electricity.
Namibia Energy Institute	The Namibia Energy Institute is a national government institute and is housed at the Namibia University of Science and Technology. Its mission is to undertake research, development, enhancement of energy policy and regulatory frameworks, stakeholder engagement, and project implementation on behalf of the Ministry of Mines and Energy.
Namibian Standards Institution (NSI)	The Namibian Standards Institution (NSI) is the national standards body of Namibia responsible for the promotion of standardization and quality assurance in the industry, commerce and the public sector.
Namibia Revenue Authority (Customs and Excise division)	The mandate of the Namibia Revenue Authority is to facilitate and control the movement of all goods involved in international trade.
Namibian Institute of Refrigeration and Air Conditioning	The Namibian Institute of Refrigeration and Air Conditioning was initially formulated to strengthen and protect the industry of refrigeration, air conditioning and the allied arts of sciences; to encourage and persevere with the scientific research and the study of principles and methods in the fields of refrigeration and air conditioning.

6.2.3.3 Overview of Residential Refrigerators and Freezers

Namibia currently does not have regulations to enforce MEPS for refrigerators. The National Energy Policy supports the implementation of energy efficiency initiatives and there is no mention of standards and labelling for residential refrigerators suggesting that it may not be a high priority at present. There are no financial mechanisms to support the adoption of energy efficient refrigerators in Namibia.

6.2.3.3.1 Stock in Use

Namibia's Household Income and Expenditure Survey Report (2016) reported 37.8% (206,000 households) and 17.8% (96,000 households) of the households had refrigerators and freezers, respectively, in their homes (NSA, 2016). Most households have an average of two refrigerators per home. The lower income homes or rented facilities are more likely to have one refrigerator, with middle to high income households having several units per home with some owning more than one dwelling. The projected increased access to grid electricity, especially in rural areas, is more likely to result in a significant increase in the use of residential refrigerators in Namibia. The average life expectancy of residential refrigerators ranges between 10-15 years.

The Country Saving Assessment modelled by the U4E estimated that the stock of residential refrigerators in Namibia will increase to approximately 320,000 units by 2030, as illustrated in Figure 77. The average unit sales per annum by 2030 is forecasted to reach around 31,000 units (UNEP-U4E, 2020).

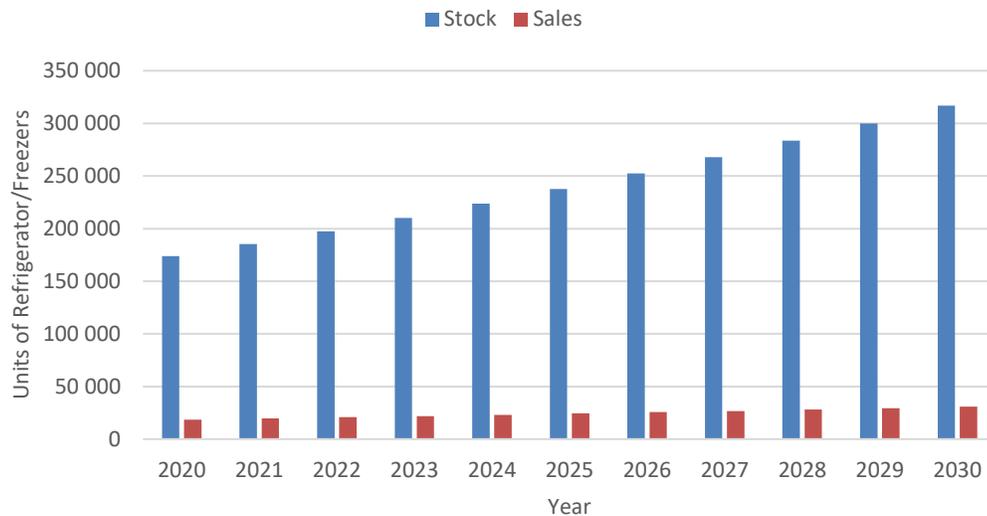


Figure 77 Projected stock and sales of residential refrigerators in Namibia

6.2.3.3.2 Manufacturing of Residential Refrigerators and Freezers

There is no manufacturing of refrigerators and freezers taking place in Namibia.

6.2.3.3.3 Distribution of Residential Refrigerators and Freezers

The supply of residential refrigerators in Namibia is purely from imports, mainly from South Africa. The market is supplied with different types and sizes of residential refrigerators, including chest freezer, single door refrigerator, combined double door refrigerator, side by side door refrigerator, 3 door fridges, and bar fridges. The most popular brands offered in the market include Defy KIC, HiSense, Samsung, Panasonic, Kelvinator, and LG. Residential refrigerators are sold mainly at furniture stores or household appliance stores. Some of the large retailers include GAME, BEARS, Furniture City, Morkels, Russel's, House & Home and HiFi Corporation⁴¹. There are also distribution agencies that were found active in the market, such as Atlantic Distributors, supplying Defy products.

The typical retail prices for the different types of residential refrigerators is summarised in Table 43⁴². The price range for a new freezer starts from USD180 – USD450, whilst a combined refrigerator can cost between USD220-USD900 depending on the type and volume-size. Importation of used refrigerators for the purpose of selling to the public is not allowed in Namibia.

Table 43 Typical prices of residential refrigerators in Namibia

Type of Refrigerator	Volume	New products Price Range (USD)
Freezer only	100L – 530l	USD180-USD450
Refrigerator only	400L	USD700
Freezer-refrigerator	170L -500L	USD220-USD900

⁴¹ Data obtained from the questionnaire in October 2020.

⁴² Data obtained from the questionnaire in October 2020.

The overview of the supply chain of residential refrigerators in Namibia is summarised in Figure 78.

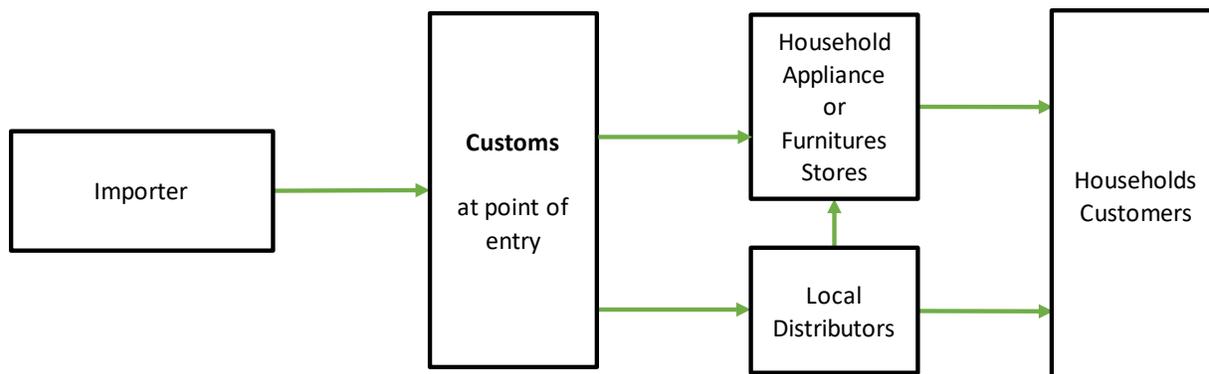


Figure 78 Supply chain of residential refrigerators in Namibia

6.2.3.3.4 Product Registration

Namibia does not have a product registration system for refrigeration products.

6.2.3.3.5 Energy Efficiency of Residential Refrigerators and Freezers

Most residential refrigerators sold in the Namibia market have the South Africa energy efficiency label displayed on the outside front and a variety of efficiencies are available ranging from MEPS (Class B) to best available option (Class A to A+++)⁴³. The labels provide information pertaining to annual energy consumption, volume, and the energy efficiency class of the refrigerator.

Applying the U4E Country Saving Assessments to estimate the impact of MEPS for residential refrigerators at two levels of ambition (minimum and high), Figure 79 illustrates the electricity savings potential for both scenarios up to 2040 (UNEP-U4E, 2020). Implementation of MEPS under the minimum and high ambition scenarios has potential to reduce electricity consumption by 42 GWh and 100 GWh in 2040 respectively as compared to the Business-as-Usual scenario.

⁴³ Data obtained from the Ministry of Mines and Energy, Namibia in October 2020.

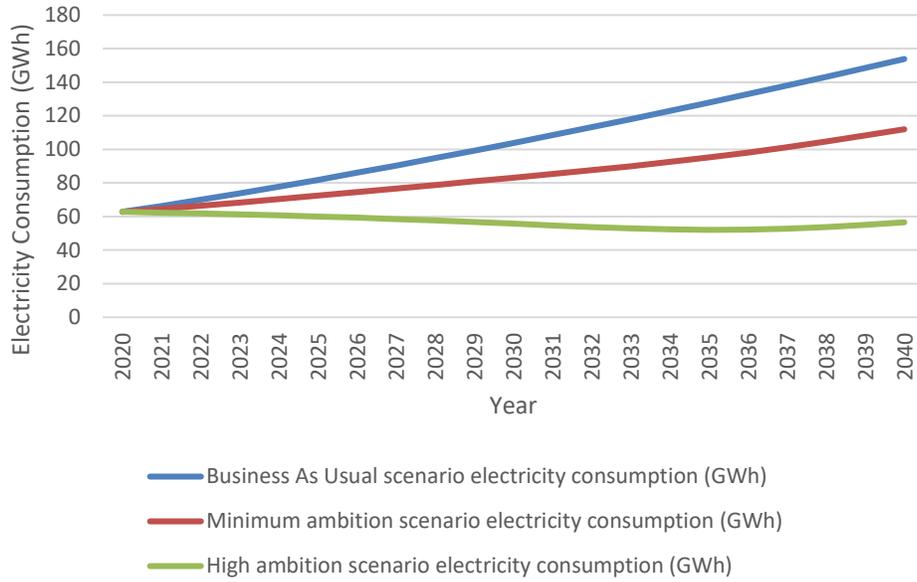


Figure 79 Projected electricity consumption of residential refrigerators in Namibia

6.2.3.4 Overview of Room Air Conditioning

In some parts of Namibia, especially the areas covered by the Namib Desert, where temperatures can go up to 35 °C or even higher, depending on the time of the year, room air conditioning is a necessity. Currently, there are no regulations, standards, and financing schemes to promote the adoption of energy efficient air conditioners. The use of room air conditioning is common in the residential sector and commercial sector which includes office buildings, hotels and shops.

6.2.3.4.1 Stock in Use

The availability of information regarding installed room air conditioners and sales in Namibia is very scarce. Room air conditioners are widely used in the residential and commercial sectors. Nonetheless, the Country Saving Assessment modelled by the U4E estimated that the stock of room air conditioners in Namibia will increase to approximately 185,000 units by 2030, as illustrated in Figure 80. The average unit sales per annum by 2030 is forecasted to reach around 15,000 units (UNEP-U4E, 2020).



Figure 80 Projected stock and sales of room air conditioners in Namibia

6.2.3.4.2 Manufacturing of Room Air Conditioners

There is no manufacturing of air conditioners taking place in Namibia.

6.2.3.4.3 Distribution and Sales of Room Air Conditioners

The supply of room air conditioners is mainly characterised by imports, mainly from South Africa and China. The different types of air conditioners supplied to the Namibian market include the split type, portable and window units. Air conditioning units are generally not “off-the shelf” items and as such require the services of an agency that can provide after sales services, such as maintenance services. The key stakeholders involved in the distribution of room air conditioners include importers, distributors and installers. Some household appliance stores are also selling room air conditioning equipment. There are various service providers available in the Namibia market providing sales, installation and maintenance of conditioners. These include Seasonair, Samsung, Starke, to name a few. The list of agencies/companies distributing room air conditioners can be obtained from the Namibian Institute of Refrigeration and Air Conditioning⁴⁴.

The most popular brands offered to the market include Daikin, Defy, Hisense, Samsung, Panasonic, Mitsubishi, Carrier, Gree, LG, Chigo Siemens Toshiba and Midea⁴⁵. Figure 81 summarises the supply chain of room air conditioners in Namibia.

⁴⁴ Access [here](#) for the list of agencies/companies.

⁴⁵ Data obtained from the questionnaire in October 2020.

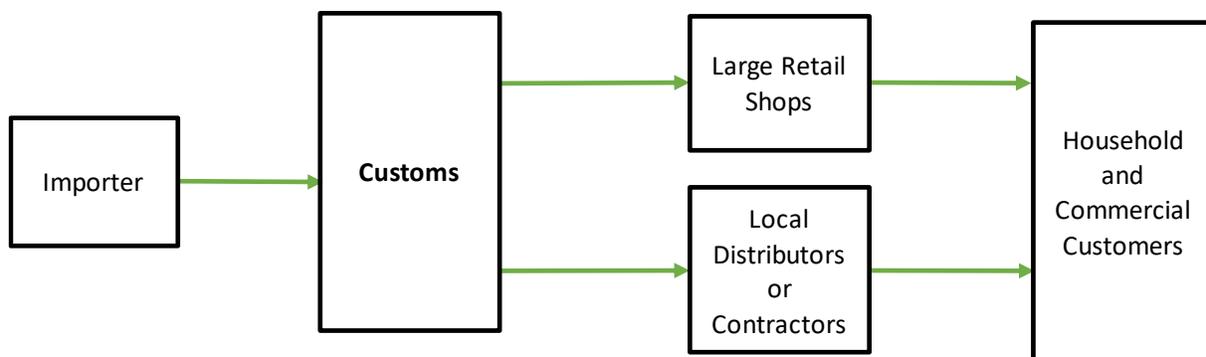


Figure 81 Supply chain of room air conditioners in Namibia

Table 44 provides a summary of the average retail prices for the different sizes of room air conditioners sold in Namibia. The prices for new room air conditioners range between USD700 – USD2000⁴⁶, depending on the size. Importation of used room air conditioners for the purpose of selling to the public is not happening in Namibia.

Table 44 Retail prices for the different sizes of room air conditioners in Namibia

Size of Air Conditioner	Average Retail Price USD
9000 Btu/h = 2.64 kW	USD700.00
12000 Btu/h = 3.52 kW	USD750.00
18000 Btu/h = 5.28 kW	USD1000
24000 Btu/h = 7.03 kW	USD2000

6.2.3.4.4 Product Registration

Namibia does not have a product registration system for air conditioning equipment.

6.2.3.4.5 Energy Efficiency of Room Air Conditioners

Most room air conditioning equipment supplied to the market have energy efficiency labels from South Africa, display the energy efficiency ratio, annual energy consumption in cooling, cooling output, and the energy efficiency classes. A variety of efficiencies ranging from MEPS (Class B) to best available option (predominantly Class A) were found in the market. The room air conditioning systems supplied to the market are designed to be the inverter type or non-inverter type.

Applying the U4E Country Saving Assessments to estimate the impact of MEPS for room air conditioners at two levels of ambition (minimum and high), Figure 82 demonstrates the potential electricity savings for both scenarios up to 2040. Implementation of MEPS under the minimum and high ambition scenarios has potential to reduce electricity consumption by 140 GWh and 250 GWh in 2040 respectively as compared to the Business as Usual (BAU) scenario (UNEP-U4E, 2020).

⁴⁶ Data obtained from the questionnaire in October 2020.

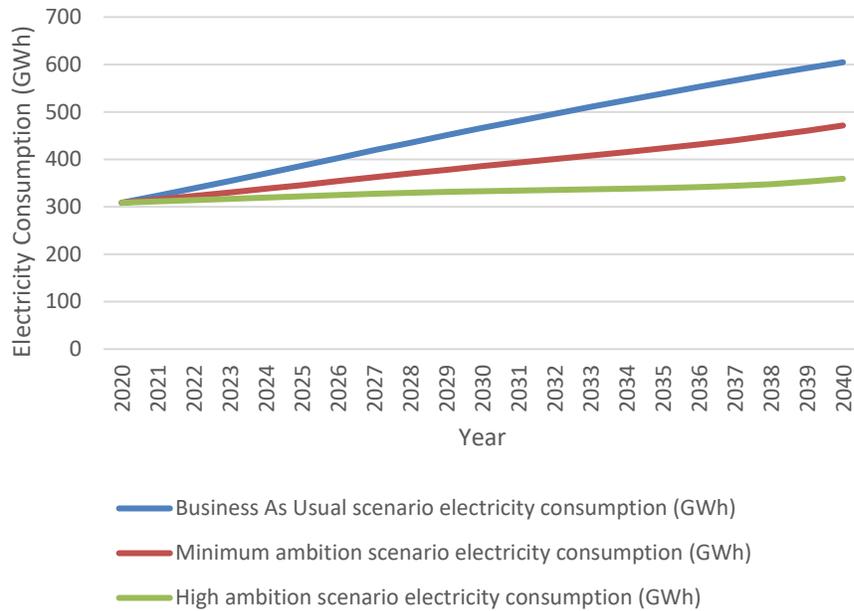


Figure 82 Projected electricity consumption for room air conditioners in Namibia

6.2.3.5 Refrigerant Gases and Emissions

Namibia is one of the countries that ratified the Kigali amendment to the Montreal Protocol on substances that deplete the ozone layer. In the fight against greenhouse gas emissions, Namibia enacted the Ozone Depleting Substances Regulations, 2004 read together with the amendment of prohibition of import into Namibia of ozone depleting substances, 2010.

The production or manufacture of the below-listed controlled substances or products containing, as stated in the Regulations is prohibited. Importation or exportation of controlled substances or products containing a controlled substance, including residential refrigerators and room air conditioners, is prohibited. Below is a list of controlled substances in accordance with the regulations:

- i) Chlorofluorocarbons;
- j) Halons;
- k) Carbon Tetrachloride;
- l) Methyl Chloroform;
- m) Hydrobromofluorocarbons;
- n) HCFC's;
- o) Bromochloromethane;
- p) Methyl bromide.

6.2.4 Republic of Seychelles

The Republic of Seychelles is an island country located in the western Indian ocean and consisting of 115 small islands covering a total area of 455 km², as shown in Figure 83. Seychelles has a tropical

climate which is warm and humid with strong oceanic influences. The temperature is consistently between 24-32°C and there is always some humidity throughout the year. Seychelles has a total population of 97 thousand of which 43% is found in rural areas and 57% in urban areas (World Bank, 2018). Most of the population is found in Mahe, the largest Island. Owing to its topography, Seychelles is a destination to many tourists, making tourism a very important part of the country's economy. In 2018 the total GDP current was reported to be USD1.60 billion and the GDP per Capita (current) of USD16,300.00 (World Bank, 2018).

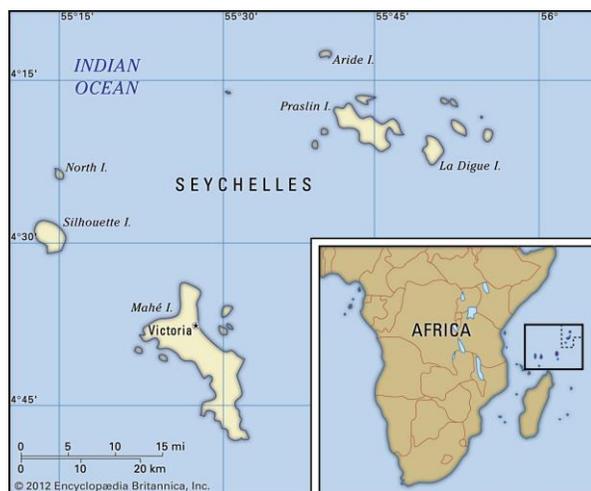


Figure 83 Map of Seychelles

Table 45 Overall energy and economic indicators for Seychelles (2018)

Indicators	Data
Population in 2018 (million)	0.097 Million
GDP in 2018 (current) Billion USD	1.59 Billion USD
GDP per Capita in 2018 (current USD)	16,391USD
Access to electricity, total in 2018 (% population)	100%
Access to electricity, urban in 2018 (% of urban population)	100%
Access to electricity, rural in 2018 (% of rural population)	100%
System Maximum Demand	67 MW
Installed capacity in 2018	125 MW
Annual electricity consumption in 2018	386 GWh
Electricity imports (2018)	0 GWh
Electricity exports (2018)	0 GWh
Total Electricity Units Generated (2018)	428 GWh

Sources: World Bank data, Irena, PUC Annual Report 2018

In 2018 Seychelles generated about 428 GWh which was dominated by fossil fuels, as depicted in Figure 84 (PUC, 2018). The state utility, Public Utilities Corporation, is responsible for the generation, transmission, and distribution of electricity in all islands of Seychelles. The commercial sector (55%)

dominated electricity consumption in 2018, as illustrated in Figure 84, and the residential sector consumed about 33% (PUC, 2018). Seychelles remains the only country in the SADC Region to have universal access to electricity. The average electricity tariff for the residential sector is around USD0.10 (PUC, 2018).

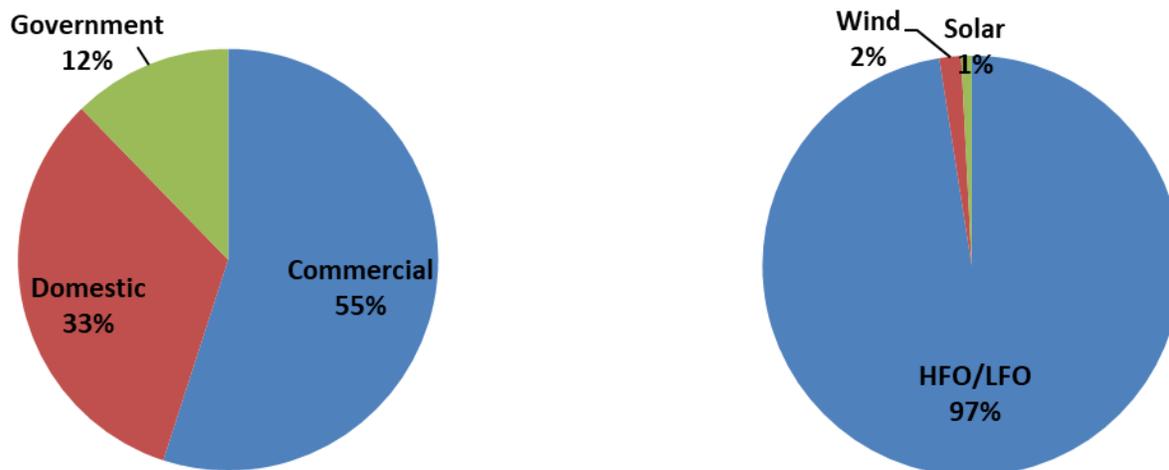


Figure 84 Electricity consumption by sector and electricity generation in Seychelles

6.2.4.1 Policy Context

The Seychelles Energy Policy (2010-2030) is fundamental to the implementation of energy efficiency initiatives in the island nation. Reduction in electricity consumption is one of the core strategic elements identified and prioritised in the energy policy. In the 20-year horizon, the policy anticipates a rapid growth in electricity consumption. Room air conditioning and residential refrigeration are some of the main contributors to this growth. Introduction of financing incentives for energy conservation, standards and labelling for room air conditioners, residential refrigerators and freezers are some of the strategic interventions identified in the policy. Further, Seychelles has put in place the Seychelles Sustainable Development Strategy (2012-2020) which recommends strategies for all environment-related programs. This strategy seeks to promote energy efficiency in all sectors of the economy, including household appliances. Moreover, the strategy supports the development of a detailed energy efficiency policy and an energy efficiency act.

Seychelles promulgated the Energy Act in 2012 which established the Seychelles Energy Commission with a mandate to promote energy efficiency in all sectors. The Act categorically states that the commission must prescribe regulations on energy efficiency and energy conservation, develop standards and labelling procedures for selected products, including household appliances (Seychelles-Government, Energy Act, 2012).

Further, Seychelles promulgated the Value Added Tax Act of 2010 read together with Value Added Tax (Amendment of Schedules) Regulations, 2014 which provide for exemption from Value Added Tax for

energy efficient air conditioners and refrigerators imported into Seychelles. The prevailing standard rate for the value added tax is 15% (Seychelles-Government, Seychelles Value Added Tax Act, 2010).

6.2.4.2 Institutional Mapping

The key institutions that play a major role in promoting energy efficiency in refrigerators and air conditioners are summarized in Table 46.

Table 46 Key institutions in Seychelles

Main Organization	Description/Role
The Energy and Climate change Department under the Ministry of Agriculture, Environment, and Climate Change	The Department is responsible for the formulation of energy policies, strategies and action plans, including promotion of energy efficiency. The Department is also responsible for water and climate change.
Seychelles Bureau of Standards	The Seychelles Bureau of Standards was established under the SBS Act 1987 mandated with the adoption of national standards, inspection, testing and certification authority.
Seychelles Energy Commission	Seychelles Energy Commission, established through the Energy Act of 2009, is the regulator mandated to regulate the electricity sector. The Energy Act mandates the SEC to promote energy efficiency in all sectors. The commission is also responsible for planning and coordination of the government’s approach on the National Energy Policy.
Seychelles Revenue Commission	Seychelles Revenue Commission is an authority that was established through the Seychelles Revenue Commission Act 2009 responsible for the administration of revenue laws, including customs.
The Public Utilities Corporation (PUC)	Public Utilities Corporation was established through the Public Utilities Corporation Act (1985) and mandated to be the sole utility company providing electricity, water, and sewerage services in Seychelles.

6.2.4.3 Overview of Residential Refrigerators and Freezers in Seychelles

In an effort to reduce energy use of residential freezers and refrigerators, Seychelles introduced MEPS. However, Seychelles has not yet developed regulations to make the standards mandatory. Seychelles has a long-term goal to have only energy-efficient refrigeration equipment used in the country.

6.2.4.3.1 Stock in Use

The Household Budget Survey of 2006 reported approximately 97% of households owned a refrigerator (NBS, 2006). Almost the same figure was reported in the Household Budget Survey 2013. Due to the high humid temperatures in Seychelles, a refrigerator unit is a necessary item to own. It is estimated

that about 100% of households possess 1 or 2 refrigerators (NBS, 2006). The Country Saving Assessment modelled by the U4E estimated that the stock of residential refrigerators in Seychelles will increase to approximately 37,000 units by 2030, as illustrated in Figure 85. The average unit sales per annum by 2030 is forecasted to reach around 2,500 units (UNEP-U4E, 2020).



Figure 85 Projected stock and sales of residential refrigerators in Seychelles

6.2.4.3.2 Manufacturing of Residential Refrigerators and Freezers

There is no manufacturing of refrigerators and freezers taking place in Seychelles.

6.2.4.3.3 Distribution of Residential Refrigerators and Freezers

The supply of refrigeration equipment in Seychelles is purely coming from imports. The majority of the residential refrigerators are imported from the United Arab Emirates, China, Thailand, Italy, India and small portions from South Africa and Kenya. The market is supplied with different types and sizes of household refrigerators including chest freezers, single door refrigerators, combined double door refrigerators, side by side door refrigerators, 3 door fridges, and bar fridges. The most popular brands offered in the market include Samsung, Panasonic, LG, West point, Sharp, Super General, Hitachi and Ocean⁴⁷. The market is supplied with both frost free and direct cool designs. The frost-free refrigerators are expensive when compared to the direct cool units.

Refrigerators and freezers are made available to consumers through home appliance stores shown in Table 47.

Table 47 Home appliance stores (distributors) of residential refrigerators.

1. Abhaye Valabhji	7. KS Enterprise Ltd Pty
2. Visally Trade Centre Pty Ltd	8. Arc Ventures Pty Ltd
3. Lifestyle Co Pty Ltd	9. Refrigeration Services Seychelles

⁴⁷ Data was obtained from the questionnaire in October 2020.

4. TMKR PTY LTD	10. PNJ supplies
5. Laxmi trading	11. Home Electronice
6. Providence Supplies PTY Ltd	

The typical retail prices for the different types of residential refrigerators are summarised in Table 48⁴⁸. The price for a new freezer ranges between USD130–USD350 and a combined refrigerator can cost between USD210-USD620 depending on the type and volume-size. The large side by side and 3 door refrigerators can cost above USD750 a unit. The popular residential refrigerator sizes range between 250L and 300L. Importation of used refrigerators for the purpose of selling to the public is not allowed in Seychelles. However, there are terms and conditions which allow the importation of second hand/used products for personal use.

Table 48 Typical prices of residential refrigerators in Seychelles

Type of Refrigerator	New products Price Range (USD)
Freezer only	USD130-USD350
Refrigerator	USD210-USD620
Freezer-refrigerator	Above USD750.00

The overview of the supply chain of residential refrigerators summarised in Figure 86. All refrigeration products entering Seychelles must be examined to ascertain the energy efficiency of the product, mainly for VAT exemption purposes.

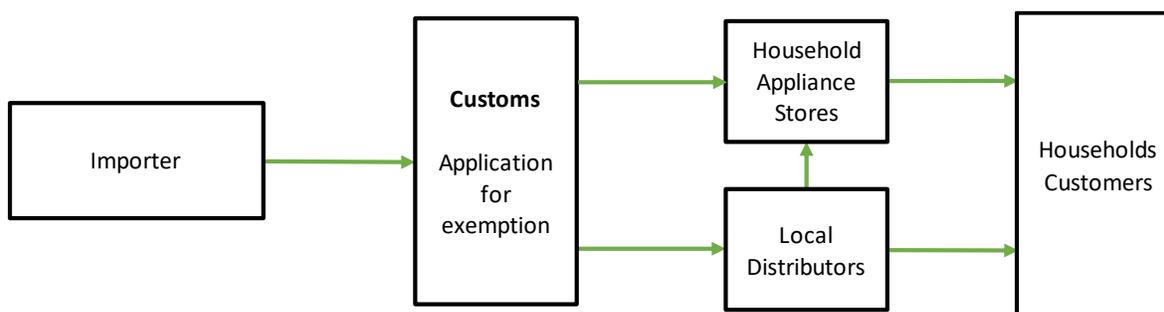


Figure 86 Supply chain of refrigerators in Seychelles

6.2.4.3.4 Energy Efficiency of Residential Refrigerators and Freezers

A bulk of residential refrigerators and freezers sold to the household sector have energy efficiency labels from various countries including, South Africa, European Union, Kenya, United Arab Emirates,

⁴⁸ Data was obtained from the questionnaire in October 2020.

India and China⁴⁹. The labels provide information pertaining to annual energy consumption, volume, and the energy efficiency class of the refrigerator.

The Seychelles Energy Commission recognises that the quantification of energy efficiency for refrigerators depends on many factors, including the energy consumption under standard testing conditions and other parameters that affect the performance of refrigerators. Due to absence of mandatory standards and labelling, Seychelles introduced an interim process which relies on existing energy efficiency labels of other countries/regions. Since refrigerators are imported from various parts of the world, the Seychelles Energy Commission has approved the following requirements, as explained in Table 49 (SEC, 2015), which provides the approved scale for different types of energy efficiency labelling system for refrigerators. These requirements are used as the eligibility criterion for the VAT exemption.

Table 49 Classification of energy efficiency classes for refrigerators

Number of Energy Efficiency Classes or Categories	Eligible Classes or Categories
4 or less bars or stars	The best energy efficiency class or category only
5 bars or stars	Best 2 classes or categories
6 bars or stars	Best 2 classes or categories
7 bars or stars	Best 3 classes or categories
8 or more bars or stars	Best 3 classes or categories

Applying the U4E Country Saving Assessments to estimate the impact of MEPS for residential refrigerators at two levels of ambition (minimum and high), Figure 87 illustrates the electricity savings potential for both scenarios up to 2040 (UNEP-U4E, 2020). The Seychelles case is unique when compared to other SADC countries. Since the country is 100% electrified and almost all households own a refrigerator, the electricity consumption for residential refrigerators does not rapidly increase when looking at the business-as-usual trend. However, the implementation of MEPS under the minimum and high ambition scenarios have potential to reduce electricity consumption by 3 GWh and 8 GWh in 2040 respectively as compared to the Business-as-Usual scenario.

⁴⁹ Data was obtained from the questionnaire in October 2020.

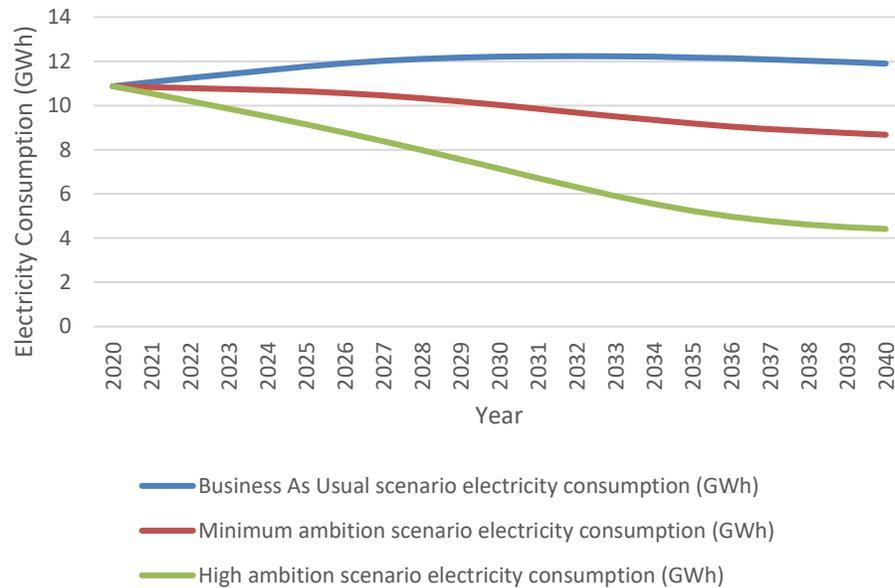


Figure 87 Projected electricity consumption of residential refrigerators in Seychelles

6.2.4.4 Overview of Room Air Conditioning

In a country like Seychelles having high humid temperature (around 30 °C) conditions throughout the year, a room air conditioning unit cannot be regarded as a luxury item but a necessity. In an effort to reduce energy use and control the quality of room air conditioners, Seychelles introduced voluntary MEPS. These standards shall remain voluntary up to the time enforcing regulations are introduced. The Seychelles Energy Commission has prioritised the development of the required regulations.

6.2.4.4.1 Stock in Use

Room air conditioners are mainly used in residential buildings, office buildings, hotels and shops. The wall mounted split type room air conditioner is extensively used in Seychelles. The penetration of room air conditioners is estimated to be around 45% for households, 95% for office buildings, and 100% for hotels and other commercial establishments (Seychelles Nation, 2020).

The Country Saving Assessment modelled by U4E estimated that the stock of room air conditioners in Seychelles will increase to approximately 46,000 units by 2030, as illustrated in Figure 88. The average unit sales per annum by 2030 is forecasted to reach around 3,300 units (UNEP-U4E, 2020).



Figure 88 Projected stock and sales of room air conditioners in Seychelles

6.2.4.4.2 Manufacturing of Room Air Conditioners

There is no manufacturing of air conditioning equipment taking place in Seychelles.

6.2.4.4.3 Distribution and Sales of Room Air Conditioners

The supply of room air conditioners is completely characterised by imports from the United Arab Emirates, China, Thailand, Italy, India, South Africa, Kenya and China. Air conditioning units are generally not “off-the shelf” items as such require the services of an agency that can provide after sales services such as maintenance services and Table 50 provides a list of service providers or agencies found in Seychelles that also provide after sales services, such as maintenance⁵⁰.

Table 50 List of distributors for room air conditioners

1. Abhaye Valabhji	9. Refrigeration Services Seychelles
2. Visally Trade Centre Pty Ltd	10. PNJ supplies
3. Lifestyle Co Pty Ltd	11. Home Electronic
4. TMKR PTY LTD	12. Cooling Plus
5. Laxmi trading	13. HJ Cool
6. Providence Supplies PTY Ltd	14. Unique Trading
7. KS Enterprise Ltd Pty	15. Machinery and Equipment
8. Arc Ventures Pty Ltd	

⁵⁰ Data was obtained from the questionnaire in October 2020.

The most popular brands offered in the market include Samsung, Panasonic, LG, West point, Sharp, Carrier, Aux and Ocean. The overview of the supply chain of room air conditioners is summarised in Figure 89.

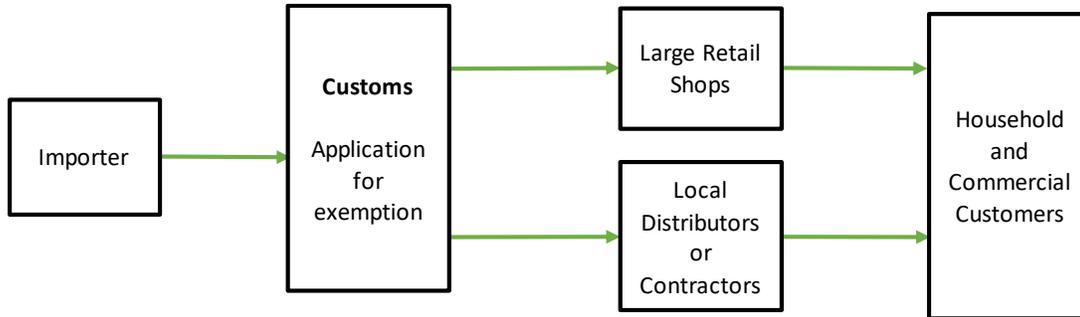


Figure 89 Supply chain of room air conditioners in Seychelles

The typical retail prices for the different sizes of split air conditioners sold in Seychelles range between USD260 – USD700⁵¹ as shown in Table 51⁵². Importation of used residential refrigerators for the purpose of selling to the public is not allowed in Seychelles.

Table 51 Retail prices for the different sizes of split air conditioners in Seychelles

Size of Air Conditioner	Retail Price USD
9000 Btu/h = 2.64 kW	USD260 - USD650
12000 Btu/h = 3.52 kW	USD360 - USD550
18000 Btu/h = 5.28 kW	USD460 - USD650
24000 Btu/h = 7.03 kW	USD470 - USD700

6.2.4.4.4 Energy Efficiency of Room Air Conditioners

The room air conditioning equipment supplied to the market has energy efficiency labels from South Africa, European Union, Kenya, United Arab Emirates, India and China⁵³. The energy efficiency label displays information pertaining to energy efficiency ratio, annual energy consumption in cooling, cooling output, and the energy efficiency class. Most room air conditioners (wall mounted split type) have an energy efficiency ratio of 3⁵⁴. The average lifetime for these room air conditioners is 10 years. The room air conditioning systems supplied to the market are designed to be the inverter type or non-inverter type, the former being the popular technology.

Currently the regulations to enforce MEPS for air conditioners are pending, hence the Seychelles Energy Commission introduced an interim eligibility criterion for the VAT exemption, used as a financing mechanism to support the deployment of energy efficient air conditioners. The Energy Efficiency Ratio

⁵¹ Data was obtained from the questionnaire in October 2020.

⁵² Data was obtained from the questionnaire in October 2020.

⁵³ Data was obtained from the questionnaire in October 2020.

⁵⁴ Data was obtained from the questionnaire in October 2020.

(kW/kW) is used to classify the efficiency of the product. The minimum energy requirements for split air conditioning systems to qualify for the exemption is illustrated in Table 52(SEC, 2015). The EER requirements for Seychelles are equivalent to Class B ($3.2 \geq \text{EER} > 3.0$) of the South African minimum energy efficiency requirements. The Commission depends on the label information packaged with the product or provided by the importer as reliable information and basis for decision making for VAT exemption. This presents an opportunity for importers to provide counterfeit labels so as to benefit from the VAT exemption.

Table 52 EER requirements for different capacities of air conditioners in Seychelles

Size (Cooling) Capacity	Minimum EER (kW/kW)	Comparison to South African MEPS (Minimum EER) (Spilt)
Upto 12000 Btu/h (up to 3.52kW)	3.1	Class B $3.2 \geq \text{EER} > 3.0$
12001 Btu/h to 24000Btu/h 3.52kW - 7.03 kW	3	Class B $3.2 \geq \text{EER} > 3.0$
Above 7.03 kW Min	4.2	

Applying the U4E Country Saving Assessments to estimate the impact of MEPS for room air conditioners at two levels of ambition (minimum and high), Figure 90 demonstrates the potential electricity savings for both scenarios up to 2040 (UNEP-U4E, 2020). Implementation of MEPS under the minimum and high ambition scenarios has potential to reduce electricity consumption by 65 GWh and 107 GWh in 2040 respectively as compared to the Business as Usual scenario (UNEP-U4E, 2020).

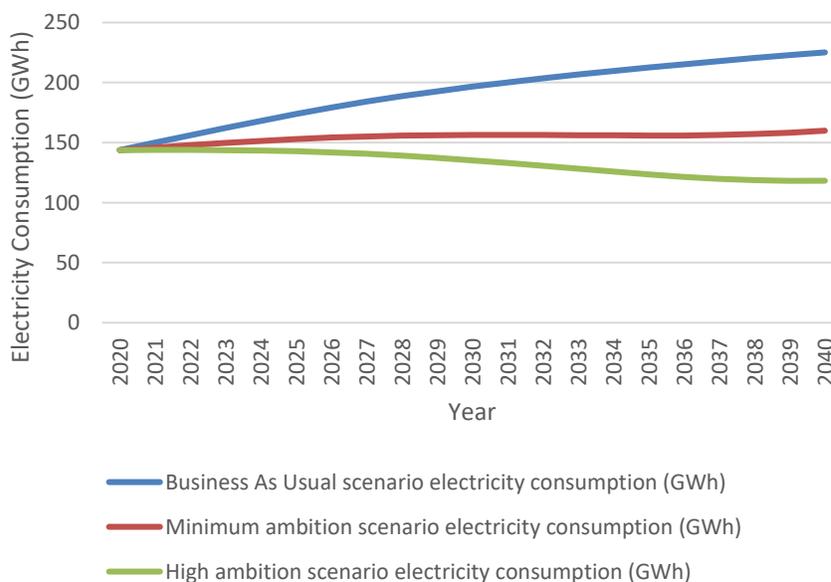


Figure 90 Projected electricity consumption for room air conditioners in Seychelles

6.2.4.4.5 Product Registration

A product registration system for air conditioners and refrigerators was established and it is under the administration of the Seychelles Energy Commission. Currently importers of air conditioners and refrigerators compliant to the minimum energy requirements explained above are exempted from paying VAT. There is a product registration system established for products, including refrigerators, that qualify for VAT exemption. If a product is non-compliant, the importer, irrespective of their status (VAT registered and non-VAT registered businesses as well as private individuals) and irrespective of the purpose of the import (for commercial and private/personal use), must pay VAT with the Customs department at the point of entry (Seychelles-Government, 2010).

6.2.4.5 Refrigerant Gases and Emissions

In the fight against climate change, Seychelles enacted the Environment Protection (Ozone) Regulations, 2000 with the aim to minimize the use of ozone depleting refrigerants. The production or manufacture of the below-listed controlled substance or products containing, as stated in the Regulations is prohibited. Importation or exportation of controlled substances or product, including residential refrigerators and room air conditioners, containing a controlled substance is prohibited. The regulations restrict the sale of the controlled substances. The Regulations exclusively states no person shall use controlled products for any purpose including the purpose of installing, servicing, or operating any such products, except under, and otherwise than in accordance with the conditions of, a permit issued under these Regulations (Seychelles-Government, 2000). Below is a list of controlled substances in accordance with the regulations:

- q) Chlorofluorocarbons;
- r) Halons;
- s) Carbon Tetrachloride;
- t) Methyl Chloroform;
- u) Hydrobromofluorocarbons;
- v) HCFC's;
- w) Bromochloromethane;
- x) Methyl bromide.

A summary of refrigerants gases used in cooling products is provided in table 49⁵⁵.

⁵⁵ Data was obtained from the questionnaire in October 2020.

Table 53 Summary of refrigerant gases in Seychelles

Equipment type	Average cooling capacity (kW)	Average realistic Lifetime (based on stock) [years]	Main refrigerants	Initial charge [kg]	EER (2019)	Leakage rate per year [%]
Split residential AC	3.4	10	R410A, R22	0.7	3	12
Duct split residential AC	9.2	10	R410A	2.6	3.3	15
Rooftop ducted	43	10	R407C	24.3	2.9	10.0*
Multi-splits, VRF/VRVs	36	10	R410A, R22, R417	11.7	3.1	4.4
Air conditioning chillers	454	12	R410A, R717, R134a	123.3	3.5	5
Car air conditioning	5	15	R134a	0.68	1.7	20.0*
Domestic refrigeration	0.2	12	R134a, R600a	0.11	2.3	12
Stand-alone equipment	3.5	10	R134a, R600a	0.58	2.6	
Condensing units	6.2	10	R404A, R410A, R134a	4	2.7	30.0*
Centralised systems for supermarkets	334.1	10	R410A	70	3.5	38.0*
Industrial condensing units	16.5	10	R404A, R507	5*	2.7	10

6.2.5 The Republic of South Africa

The Republic of South Africa occupies most of the southern part of the African continent covering a total area of 1,219,090 km². South Africa shares borders with Namibia, Botswana and Zimbabwe in the north, with Eswatini and Mozambique in the north east, and surrounds Lesotho, as shown in

Figure 91. South Africa has a total population of 57,5 million, 34% is found in rural areas and 66% in urban areas (World Bank, 2018). In 2018 the total GDP was reported to be USD 368 billion and a GDP per capita (current) of USD6,400 (World Bank, 2018).

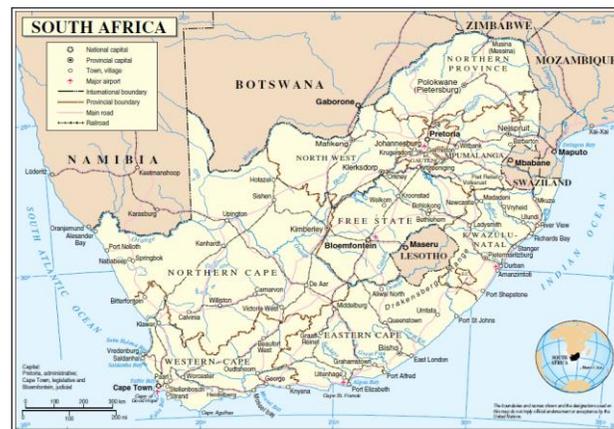


Figure 91 Map of South Africa

Table 54 Overall energy and economic indicators for South Africa (2018)

Indicators	Data
Population in 2018 (million)	57.5 Million
GDP in 2018 (current) Billion USD	368.29 Billion USD
GDP per Capita in 2018 (current USD)	6,374 USD
Access to electricity, total in 2018 (% population)	91%
Access to electricity, urban in 2018 (% of urban population)	92%
Access to electricity, rural in 2018 (% of rural population)	90%
System Maximum Demand	34,242 MW
Installed capacity in 2018	47,334 MW
Annual electricity consumption in 2018	208,319 GWh
Electricity imports (2018)	7,355 GWh
Electricity exports (2018)	12,461 GWh
Total Electricity Units Generated (2018)	224,902 GWh

Sources: Eskom 2019 Integrated Report, World Bank data, Statistics South Africa

South Africa's electricity sector broadly comprises the three sub-sectors, namely: Generation, transmission and distribution. In terms of generation, Eskom, the national utility, is the key player in the production of electricity, with most of its power generation infrastructure being dominated by coal fired power stations. In 2018 South Africa's electricity supply is dominated by ESKOM which contributed about 92% and the remainder was sourced from local independent power producers and imports, as illustrated in Figure 94 (ESKOM, 2019). Eskom supplies electricity mainly to industrial (23%), mining (14%), commercial (5%), agricultural (3%), rail transport (1%), municipalities (42%) and a small portion of residential (6%) customers. Most residential customers are supplied through municipalities who also supply to business establishments within their jurisdictions.

Eskom has established electricity generation facilities outside the borders of South Africa and approximately 3% was imported in 2018, as illustrated in Figure 92. In the same year Eskom exported about 5% of its generated electricity to neighbouring countries. Electricity generation by municipalities and auto generators (industries which generate electricity for their own use) is becoming common in South Africa.

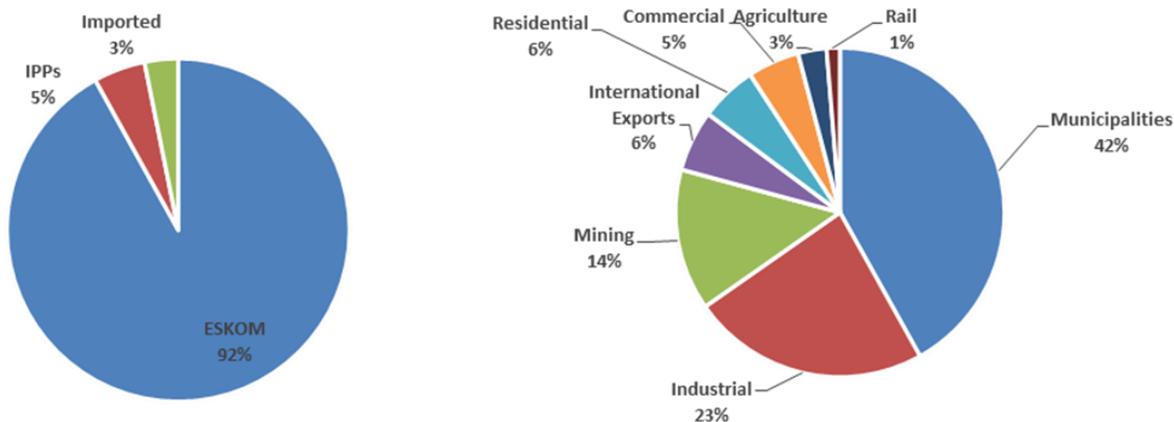


Figure 92 Electricity supply and consumption by sector in South Africa (2018)

South Africa is one of the countries in the SADC region reportedly to have high electrification rates. The World Bank reported approximately 91% of the population has access to electricity in South Africa. The average electricity tariff for the residential sector is around USD0.13 (GPP, 2020).

6.2.5.1 Policy Context

The Ministry of Mineral Resources and Energy developed a White Paper on the Energy Policy (1998) which recognises the significant potential for energy efficiency improvements in South Africa. For this purpose, the South African government adopted the National Energy Efficiency Strategy in 2005 to promote energy efficiency and thus minimize energy consumption. The National Energy Efficiency Strategy (2005) set out a national target of 12 % for energy efficiency improvement by 2015, compared to 2000 as a base year. The strategy also defined sector-specific targets, including the residential with a set target of 10% reduction on the final energy demand. In order to achieve this target, the National Energy Efficiency Strategy (2005) outlined several energy efficiency interventions including mandatory standards and appliance labelling of household appliances. Following the successful implementation of the National Energy Efficiency Strategy (2005), South Africa is in the process of adopting the Post 2015 National Energy Efficiency Strategy which aims to build on the previous achievements and further stimulate energy efficiency improvements through a combination of fiscal and financial incentives, a robust legal and regulatory framework. The Post 2015 National Energy Efficiency Strategy has set more ambitious targets as presented in Table 55 (DMRE, 2015).

Table 55 Sectoral targets from South Africa’s Post 2015 National Energy Efficiency Strategy

Sector	Target
Residential	<ol style="list-style-type: none"> 33% reduction in the average specific energy consumption (annual energy consumption per m²) of new household appliances purchased in South Africa by 2030 relative to a baseline of 2015. 20% improvement in the average energy performance of the residential building stock by 2030 relative to a baseline, as

	measured by the energy consumption (excluding plug load) per square of habitable space.
The industry and mining sector	1. 16% reduction in weighted mean specific energy consumption in Manufacturing by 2030 relative to a 2015 baseline. A cumulative total annual energy saving of 40 PJ arising from specific energy saving interventions undertaken by mining companies.
Agriculture Sector	1. Total electricity saving of 1 PJ from officially supported energy saving projects by 2030.
Commercial Services	1. 37% reduction in the specific energy consumption of lettable /habitable floor area across the sector by 2030 relative to a 2015 baseline.
Municipal Sector	1. 20% reduction in the energy intensity (measures as energy consumption per head of population served) in the provision of electricity-intensive municipal services (namely, street lighting, traffic lights, water supply and wastewater treatment). 2. 30% reduction in the fossil fuel intensity of municipal vehicle fleets (measures as total fossil fuel consumption per head of population served).
Public Buildings	1. 50% reduction in the specific energy consumption (measured as GJ annual energy consumption per square meter of occupied floor area) by 2030 relative to a 2015 baseline.
Transport	1. 20% reduction in the average vehicle energy intensity (measured in MJ/km) of the South African road vehicle fleet (determined from the vehicle energy consumption per km as specified on the fuel economy label) to a 2015 baseline.
Electricity Utility	1. 10 PJ of electricity derived from grid-connected cogeneration and waste heat recovery plants by 2030. 2. An average total electricity distribution losses below 8% by 2030 and average non-technical losses below 0.5%.

The energy sector in South Africa is regulated by the National Energy Act, 2008 and it is the same act that established the South African National Energy Development Institute (SANEDI) mandated to direct, monitor and conduct energy research and development, promote energy research and technology innovation as well as undertake measures to promote energy efficiency throughout the economy (SANEDI, 2020).

All these initiatives led to the implementation of the energy efficiency standards and labelling (S&L) program, dating back to 2007, where it was first introduced to industry as a voluntary program. The scope of the S&L Program has been extended to cover household appliances. The S&L project gets its legal mandate from Sections 19 (i),(l) of the National Energy Act, 2008, which states that the Minister of Mineral Resources and Energy may make regulations regarding labelling for energy efficiency

purposes of household appliances, and energy efficiency standards for specific appliances (DMRE, 2008). South Africa has put in place the Compulsory Specification for Energy Efficiency and Labelling of Electrical And Electronic Apparatus (VC9008) which require several household appliances, including room air conditioners, and residential refrigerators and freezers to comply with the country's set of MEPS. The requirements of the MEPS and product labelling are guided by the South African National Standard (SANS 941 Labelling of Electrical and Electronic Apparatus) developed by the South African Bureau of Standards (SABS).

In addition, South Africa promulgated the NRCS Act, (Act no.5 of 2008) which established the National Regulator for Compulsory Specifications, an independent entity, mandated with the administration of compulsory specifications and other technical regulations, including the VC9008.

6.2.5.2 Institutional Mapping

Table 56 presents the key institutions that play a major role in promoting energy efficiency of refrigerators and air conditioners.

Table 56 Key institutions in South Africa

Main Organization	Description/Role
Department of Mineral Resources and the Department of Energy (DMRE)	Under the Department, Energy Efficiency (EE) Directorate is mandated to (a) Promote and develop EE practices, norms and standards in different energy sectors, including industries, commercial buildings, households, transport and agriculture; (b) Develop energy efficiency policies, strategy and guidelines.
The Department of Trade Industry and Competition	The department is mandated to oversee the development of trade and industry and is responsible for the development of policy and legislative framework. The department relies on a group of specialised, regulatory and financial development agencies and institutions in supporting its mandate. Under the guidance of this department, there are two agencies that are key in the implementation of the MEPS for household appliances. These are South African Bureau of Standards (SABS) and NRCS.
The South African National Energy Development Institute (SANEDI)	The SANEDI was established in 2011 under the National Energy Act, 2008 (Act No. 34 of 2008). The Act provides for SANEDI to direct, monitor and conduct energy research and development, promote energy research and technology innovation as well as undertake measures to promote EE throughout the economy.
The National Energy Regulator of South Africa (NERSA)	The National Energy Regulator of South Africa (NERSA) is the country's energy regulator established through the National Energy Regulator Act, 2004 (Act No. 40 of 2004). NERSA's mandate is to regulate the electricity, piped-gas and petroleum pipelines industries in terms of the Electricity Regulation Act, 2006 (Act No. 4 of 2006), Gas Act, 2001 (Act No. 48 of 2001) and Petroleum Pipelines Act, 2003 (Act No. 60 of 2003).
The South African Bureau of Standards (SABS)	The SABS was established in terms of the Standards Act, 1945 (Act No. 24 of 1945) and continues to operate in terms of the latest edition of the Standards Act, 2008 (Act No. 8 of 2008) as the

	national standardisation institution in South Africa, and is mandated to (a) Develop, promote and maintain South African National Standards (SANS); (b) Promote quality in connection with commodities, products and services; and (c) Render conformity assessment services and assist in matters connected therewith.
The National Regulator for Compulsory Specifications (NRCS)	The NRCS was established in accordance with the provisions of the NRCS Act, (Act no.5 of 2008) (NRCS Act) and falls within the area of responsibility of the Department of Trade, Industry and Competition. The NRCS was established to administer compulsory specifications and other technical regulations and maximise compliance of regulated products and services in accordance with government policies and guidelines.
The Department of Environmental Affairs	The Department of Environmental Affairs is mandated to give effect to the right of citizens to an environment that is not harmful to their health or wellbeing, and to have the environment protected for the benefit of present and future generations.
South African Revenue Service (Customs division)	The South African Revenue Service (SARS) was established in terms of the South African Revenue Service Act 34 of 1997. SARS's Customs division plays an integral role in facilitating the movement of goods and people entering or exiting the borders of South Africa.
South African Domestic Appliance Association (SADAA)	SADAA is a local trade association that provides a single, consensual voice for the home appliance industry, promoting industry's mission to advance the lifestyles of South Africans. Its membership is composed of manufacturers and distributors of a wide variety of home appliances, including; <ul style="list-style-type: none"> ● Large appliances such as refrigerators, freezers, ovens and stoves, dishwashers, washing machines and tumble dryers, ● Small appliances such as vacuum cleaners, irons, toasters and toothbrushes.

6.2.5.3 Overview of Residential Refrigerators and Freezers in South Africa

Since the introduction of the S&L project in South Africa, the quality and efficiency of residential refrigerators continues to improve with more companies now focusing on continuous improvement. VC9008 Regulation, read together with SANS 941 for compliance, is the legal instrument used to regulate residential refrigerators and freezers in South Africa (DTI, 2014). According to VC9008 regulation, refrigerators-freezers and freezers are expected to have a minimum energy efficiency rating Class B and Class C, respectively. The official test method for the performance of refrigerators is cited

in SANS 62552/IEC 62552 - Household Refrigerating Appliances - Characteristics and Test Methods (DMRE, 2017).

The Annex of SANS 62552 defines 10 types of refrigerators and freezers available in the South African market. The following definitions are similar to the ones used in European Regulations (DMRE, 2017):

- a) category 1: Household refrigerators, without low temperature compartments
- b) category 2: Household refrigerators/chillers, with compartments at 5°C or 10°C, or both
- c) category 3: Household refrigerators, with no star low temperature compartments
- d) category 4: Household refrigerators, with low temperature compartments *
- e) category 5: Household refrigerators, with low temperature compartments **
- f) category 6: Household refrigerators, with low temperature compartments ***
- g) category 7: Household refrigerators/freezers, with low temperature compartments *(***)
- h) category 8: Household food freezers, upright
- i) category 9: Household food freezers, chest
- j) category 10: Household refrigerators and freezers with more than two doors, or other appliances not covered above.

Note: The symbols *, **, *** and *(***) relate to the frozen compartment temperature of operation and, in the case of *(***) , the freezing capacity of the freezer.

6.2.5.3.1 Stock in Use

The Department of Mineral Resources and Energy conducted an impact assessment of the standards and labelling program. It was established that the stock of residential refrigerators owned and operated by South African households increased from almost 11 million in 2010 to about 14 million units in 2016 with a Compound Annual Growth Rate of 4.6%, as presented in

Figure 93 (DMRE, 2017). Based on the historical trend, it is estimated that the stock of residential refrigerators will increase to approximately 28.7 million residential refrigerators by the year 2032. The stock of freezers increased from about 2.8 million in 2010 to approximately 3.5 million units in 2016. It is projected that the stock of freezers will increase to approximately 6 million by 2032, as shown in Figure 94 (DMRE, 2017). The lower income homes or rented facilities are more likely to have one refrigerator, with middle to high income households having several units per home, including both residential refrigerator and freezer.

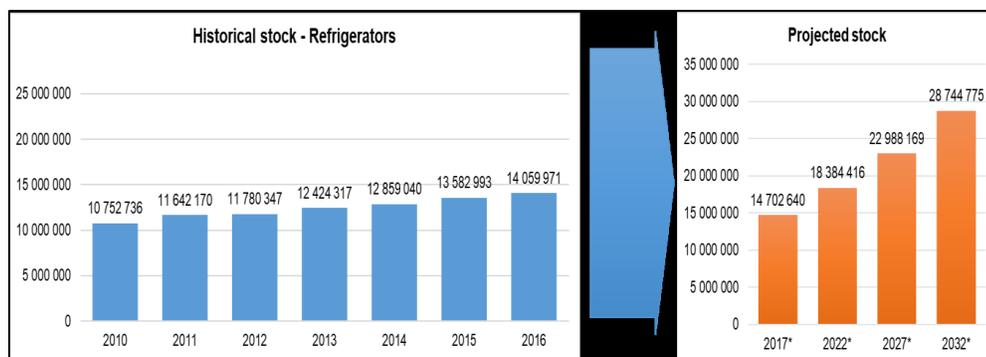


Figure 93 Stock of refrigerators in South Africa

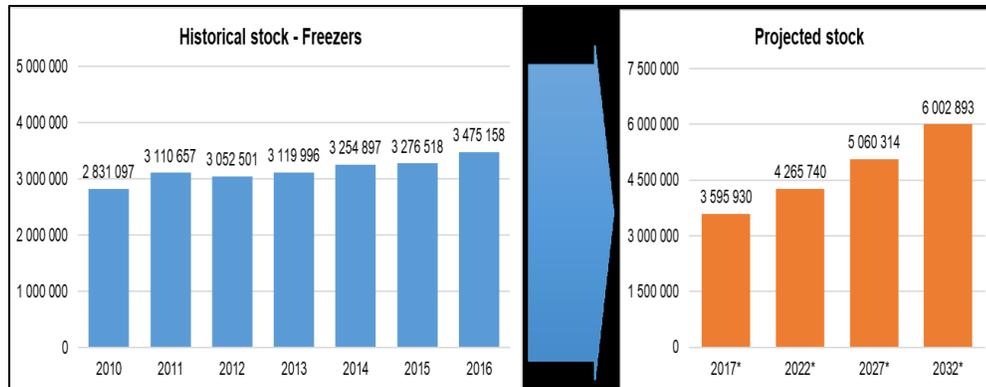


Figure 94 Stock of freezers in South Africa

6.2.5.3.2 Manufacturing of Residential Refrigerators and Freezers

There is manufacturing of residential refrigerators and freezers in South Africa. The manufacturing of refrigerators and freezers is dominated by international manufacturers which have established local manufacturing and component assembly plants. These include Defy, KIC, Whirlpool and Hisense which is mostly an assembly plant⁵⁶. The other popular brands, such as LG, Samsung, AEG, Sansui, Bosch, to name a few, are imported into South Africa from various international production facilities. In the year 2017, South Africa manufactured about 911,100 units of refrigerators and freezers. In the same year, 481,600 units were imported. A total of 1,631,200 units were sold to household consumers, as shown in Table 57 (DMRE, 2017).

Table 57 Manufacturing and imports for refrigerators and freezers (2017)

	Refrigerators	Freezers	Total
Manufactured	708,500	202,600	911,100
Imported	450,000	31,600	481,600
Total Units sold per annum	1,301,300	329,900	1,631,200

According to the VC9008, regulations, manufacturers and importers must secure a Letter of Authority (LOA) from the NRCS for the refrigeration appliance to be sold in South Africa indicating that the appliance meets the MEPS and conforms to SANS 941. Further, manufacturers and importers are expected to supply the South African energy efficiency label, as shown in Figure 95, of the refrigeration appliance to retailers for display in showrooms and online stores.

⁵⁶ Data was obtained from the questionnaire in October 2020.

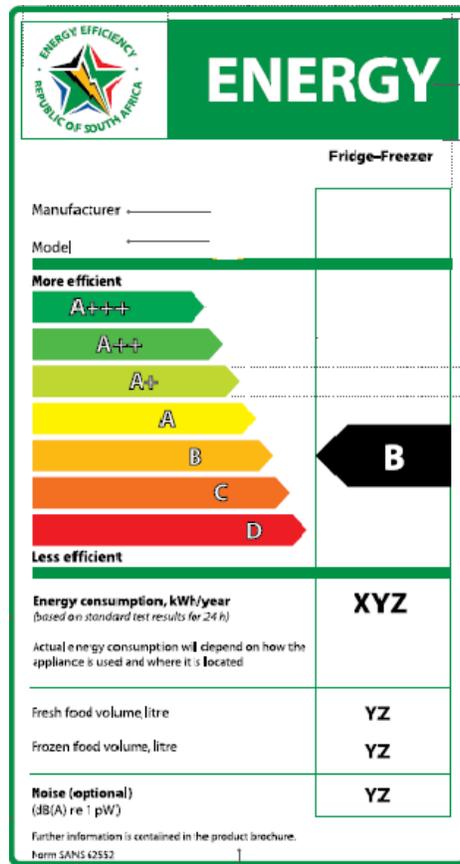


Figure 95 South Africa energy efficiency label for residential refrigerators

6.2.5.3.3 Distribution of Residential Refrigerators and Freezers

Table 58 provides a summary of the different shopping platforms for residential refrigerators and freezers which include furniture shops, supermarkets, electrical and electronic shops, and online shopping platforms which are becoming very common in South Africa. Some of these stores are operating in other SADC countries and thus increasing export opportunities to those countries. Worth noting are the new developments made by most stores to include online shopping platforms in addition to physical stores. According to the VC9008 regulations retailers must ensure all appliances sold in-store or online have the South African Energy Efficiency label displayed on the front door of the refrigerator. The label should be supplied by the manufacturer or distributor of the appliance and it must clearly display the energy performance class, as well as additional energy performance information about the appliance. Retailers are not expected to sell appliances that do not meet the specified MEPS.

Table 58 Types of retail stores for residential refrigerators in the South Africa market

Type of retail	Retail Stores (Popular)
Furniture Shops	Russells Furniture Bradlows OK Furnishers Bears

	Lewis House & Home Homechoice
Supermarkets	Spar Pick n Pay Makro Game Checkers
Electrical and Electronics Shop	HiFi Corporation, Best Home and Electric Smeg Appliance Warehouse Hirsch's Metro Home Centre Euro Appliances
Online Shops	takealot.com Loot.co.za thebrandstore.co.za Jumia

Figure 96 illustrates the supply chain of residential refrigerators in South Africa. Importers and manufacturers are required by law to ensure their products are compliant with MEPS requirements before being sold in the market. Upon issuance of the LOA by the NRSC, locally manufactured and imported products can be distributed to retail stores.

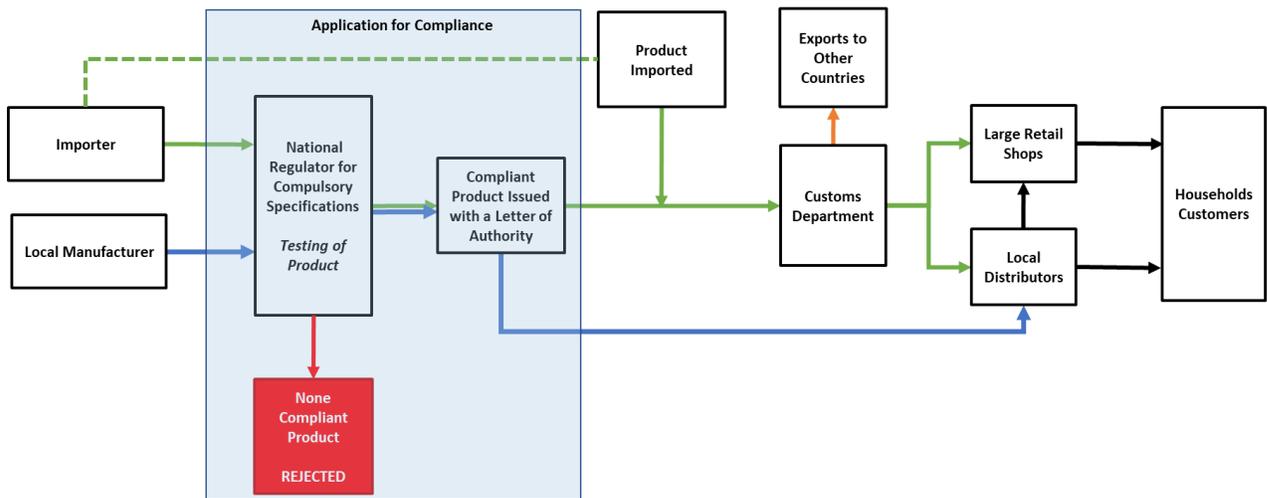


Figure 96 Supply chain for residential refrigerators in South Africa

South African consumers have a wide selection of models to choose from. The South African market is reported to have at least 784 refrigerator models and 110 models for freezers (DMRE, 2017). The designs include chest freezers, upright freezer/refrigerator only, combined refrigerator, French door refrigerator, and side by side refrigerator. The market is supplied with both frost free and direct cool

designs. The frost free refrigerators are expensive when compared to the direct cool units. The rate of penetration for refrigerators and freezers is estimated to be around 70% and 30%, respectively⁵⁷.

6.2.5.3.4 Sales of Residential Refrigerators

Refrigerators sold in the South African market are differentiated among three size types – small (<340 litres), medium (341 – 595 litres), and large (>595 litres) (DMRE, 2017).

(i) Single Door Refrigerator

The single door type of refrigerators is becoming more and more common in the South African market, though still having a rather low market share. In terms of sales in the year 2017, 41,400 units were sold including small, medium and large single door refrigerators, as illustrated in Figure 99. According to the Existing MEPS Status Quo Report, Defy and Whirlpool/KIC received the most sales of single door refrigerators in 2017, as shown in Figure 97.

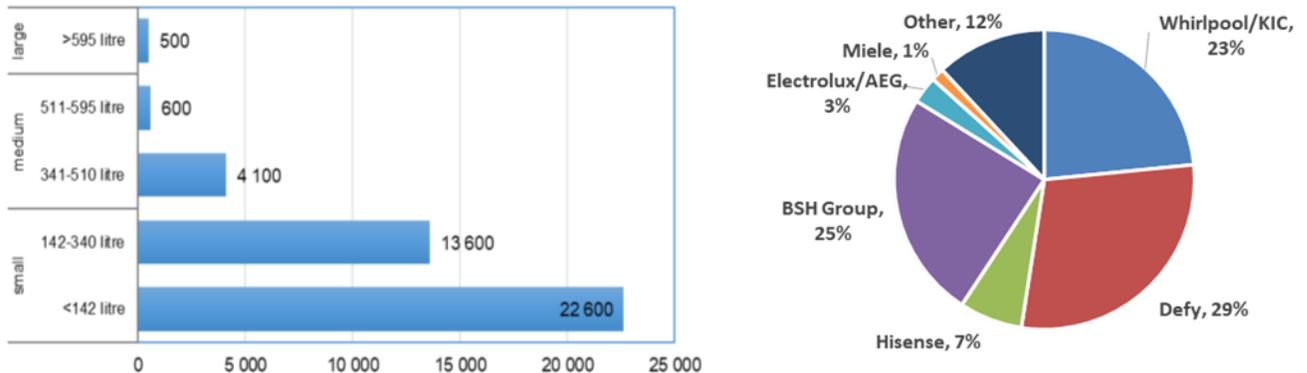


Figure 97 Sales of single door refrigerators in South Africa (2017)

(ii) Multiple Door Fridge

Besides the single door fridge, the South African market is also supplied with the combined double door, Side by Side Door, and 3 or 4-Door refrigerators. In terms of sales, 1,301,300 (DMRE, 2017) units were sold including small, medium and large single door refrigerators, as illustrated in Figure 98. Figure 98 depicts the double door fridge and small sized refrigerator were the most popular in the year 2017 (DMRE, 2017).

⁵⁷ Data was obtained from the questionnaire in October 2020.

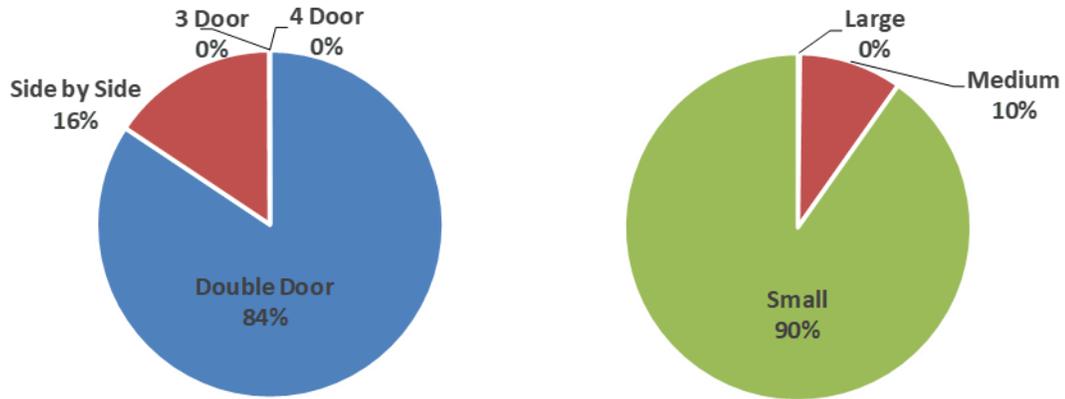


Figure 98 Share of refrigerator sales by design and size in South Africa (2017)

In terms of brand mix in the sale of refrigerator freezer, Figure 99 depicts HiSense (30%) having the greatest market share, followed by Defy appliances and then Whirlpool/KIC and LG with an equal units sold.

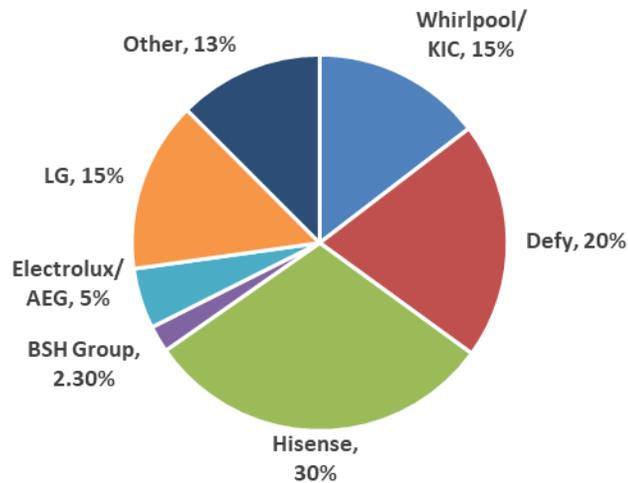


Figure 99 Brand share for refrigerators in the South African market (2017)

(iii) Freezers

The market in South Africa is supplied with three types of freezers, namely the chest freezer, upright freezer and table top freezer. In terms of sales, 329,900 units were sold, including small, medium and large sizes, as depicted in Figure 100 (DMRE, 2017). In terms of design, the chest freezer was popular amongst consumers. The upright freezers accounted for 33% of sales which shows the popularity of this type. In term size, the small was popular amongst consumers. Small freezers accounted for 87% in the total sales in 2017. Medium and large freezers had a very low demand.

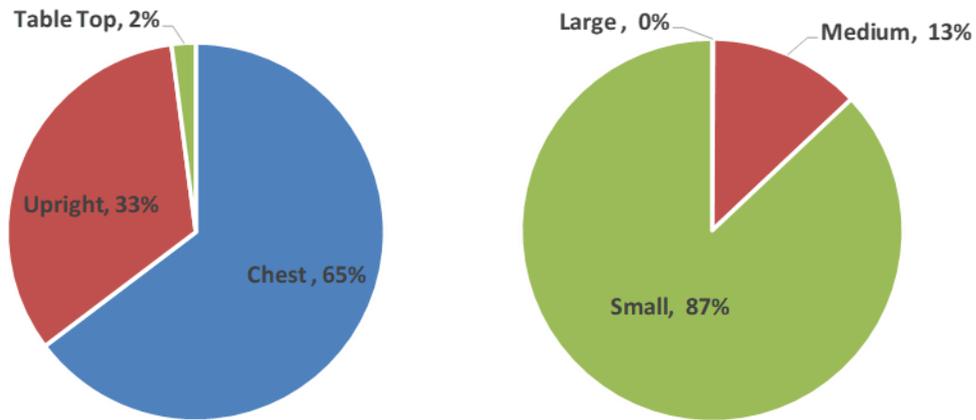


Figure 100 Sale of freezers by design and size in South Africa (2017)

In terms of the brand mix for freezer sales, Figure 101 depicts Defy and Whirlpool/KIC equally dominated the sales of refrigerators in 2017. Hisense accounted for 10 % of the sales and other brands make up the difference.

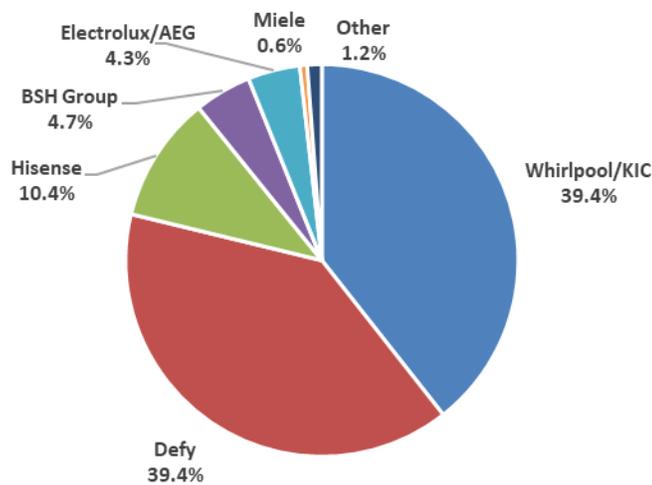


Figure 101 Brand mix for freezers in the market of South Africa (2017)

The retail prices for residential refrigerators and freezers vary with design, size or volume, brand and energy efficiency rating. Table 59 presents a price range of refrigerators⁵⁸

Table 59 Typical prices for residential refrigerators in South Africa

	Size (litres)	Price Range (USD)
Freezer only	236L – 453L	USD160 – USD800
Refrigerator only		USD450
Refrigerator-freezer	308 – 555 litres	USD300 to USD1100

⁵⁸ Data was obtained from the Department of Minerals Resources and Energy, South Africa in October 2020.

6.2.5.3.5 Energy Efficiency of Residential Refrigerators and Freezers

The VC9008 Regulation sets the minimum energy efficiency rating Class B ($55 \leq \text{EEI} < 75$) and Class C ($75 \leq \text{EEI} < 90$) for refrigerators-freezer and freezer, respectively, as detailed in Table 60 (DMRE, 2017). In the South African context, Energy Efficiency Index (EEI) is used to determine the energy label class for refrigerators and freezers. The EEI is defined as the ratio of the energy consumption for an individual product as measured in accordance with the test method over the reference for the product size and category. The DMRE conducted a comparison of energy label classes for refrigerators in South Africa and Europe. Table 60 shows the energy label classes applied in the South African market are mostly similar to those used in the European market.

Table 60 Comparison of label classes in South Africa and Europe for refrigeration appliances

Label Class	SANS EEI	Original EU 94/2/EC	Current EU 1060/2010
A+++	N/A	N/A	$\text{EEI} < 22$
A++	$\text{EEI} < 30$	N/A	$22 \leq \text{EEI} < 33$
A+	$30 \leq \text{EEI} < 42$	N/A	$33 \leq \text{EEI} < 42^*$
A	$42 \leq \text{EEI} < 55$	$\text{EEI} < 55$	$*42 \leq \text{EEI} < 55$
B	$55 \leq \text{EEI} < 75$	$55 \leq \text{EEI} < 75$	$55 \leq \text{EEI} < 75$
C	$75 \leq \text{EEI} < 90$	$75 \leq \text{EEI} < 90$	$75 \leq \text{EEI} < 95$
D	$90 \leq \text{EEI} < 100$	$90 \leq \text{EEI} < 100$	$95 \leq \text{EEI} < 110$
E	$100 \leq \text{EEI} < 110$	$100 \leq \text{EEI} < 110$	$110 \leq \text{EEI} < 125$
F	$110 \leq \text{EEI} < 125$	$110 \leq \text{EEI} < 125$	$125 \leq \text{EEI} < 150$
G	$125 \leq \text{EEI}$	$125 \leq \text{EEI}$	$150 \leq \text{EEI}$

The bulk of the refrigeration appliances available to consumers have a higher energy efficiency class ('A' or best available option) than the current MEPS level. This shows the commitment of manufacturers in continuous improvement of products thus ensuring the market is supplied with energy efficient products.

The existing MEPS are currently under revision. The outcome of this revision will result in an introduction of new classes. The proposed new minimum classes for refrigerators are Class A and A+ expected to start in 2020 and 2026 respectively. The proposed new classes for freezers are Class B and A+ expected to start in 2020 and 2024, respectively (DMRE, 2020).

Applying the U4E Country Saving Assessments to estimate the impact of MEPS for residential refrigerators at two levels of ambition (minimum and high), Figure 102 (UNEP-U4E, 2020) demonstrates the potential electricity savings for both scenarios up to 2040. Implementation of MEPS under the minimum and high ambition scenarios has potential to reduce electricity consumption by 1,500 GWh and 3,000 GWh in 2040 respectively as compared to the Business as Usual (BAU) scenario (UNEP-U4E, 2020).

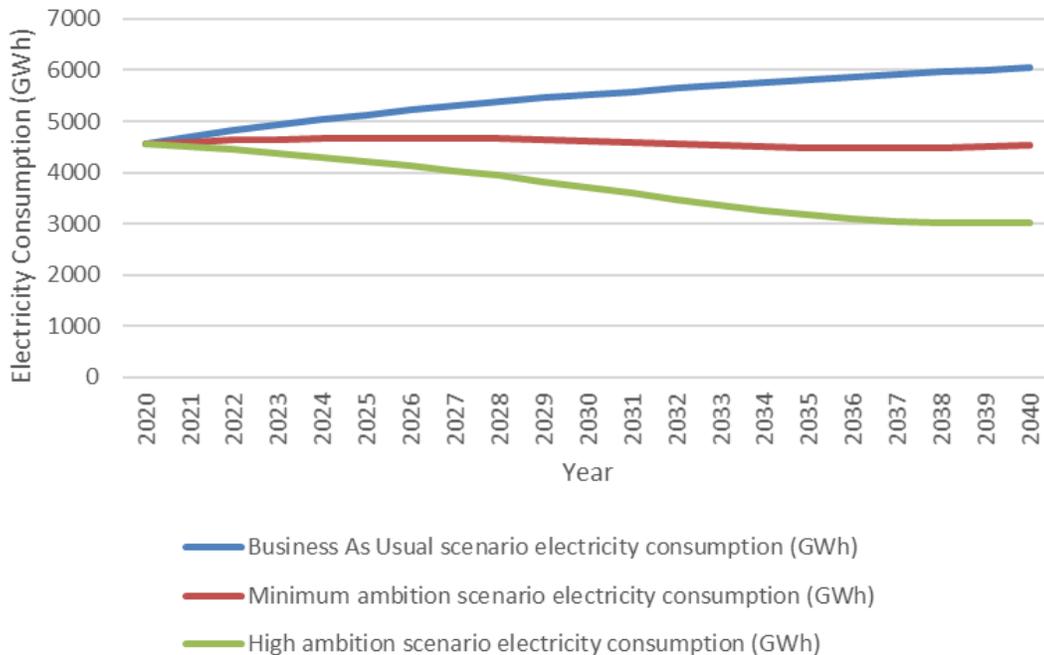


Figure 102 Projection of electricity consumption for residential refrigerators in South Africa

6.2.5.4 Overview of Room Air Conditioning Appliances

In South Africa, room air conditioning appliances are regulated by the VC9008 regulation which requires air conditioners to comply to SANS 941. This regulation requires air conditioning appliances to comply with the minimum energy efficiency rating of Class B (DMRE, 2017) for the following regulated items:

- Wall mounted split air conditioners,
- Window air conditioners, and
- Portable air conditioners.

The regulated air conditioners in South Africa shall have a maximum cooling capacity of 7.1kW (24000btu/h) as stipulated in VC9008 regulation. According to the wording used in the VC9008 regulation, ceiling mounted split-type air-conditioners (also known as Cassette) that fall within the set cooling capacity threshold are exempted.

The official test method for the performance of air conditioning appliances is cited in SANS 54511-3:2016/EN 14511-3:2013: Air conditioners, liquid chilling packages and heat pumps with electricity driven compressors for space heating and cooling. Part 3: Test methods.

6.2.5.4.1 Stock in Use

In South Africa room air conditioning is mostly used in the commercial sector and residential sector. In terms of total room air conditioners installed in South Africa, the Country Saving Assessment modelled by U4E estimated that the stock of room air conditioners in South Africa will increase to approximately

4.5 million units by 2030, as illustrated in Figure 103. The average unit sales per annum by 2030 is forecasted to reach around 340,000 units (UNEP-U4E, 2020).

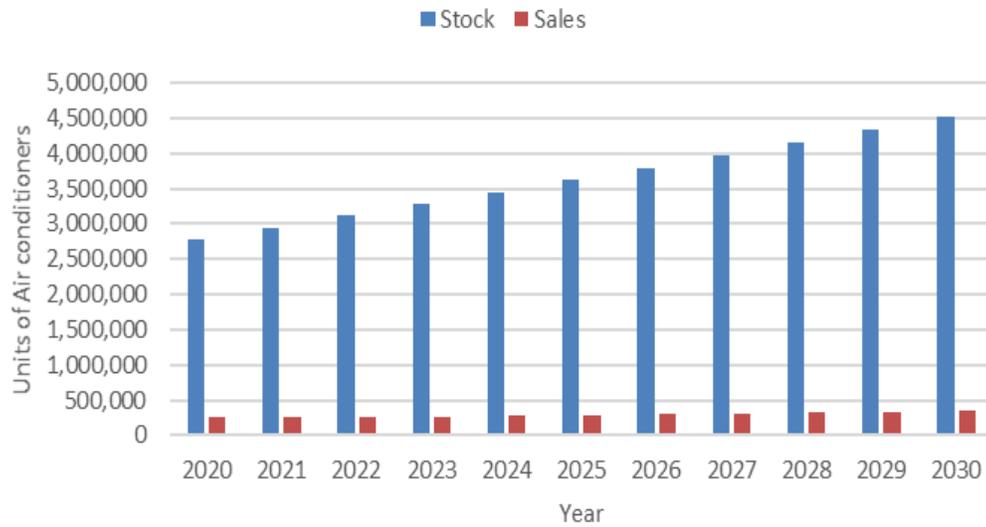


Figure 103 Projection for stock of room air conditioners in South Africa

In the residential sector air conditioners are mostly installed in the upper-middle to high-income households. Low income households still find electric cooling fans as a solution for cooling purposes. It was established that the stock of air conditioners installed in the residential sector increased from almost 510 thousand in 2010 to about 750 thousand in 2016 with a Compound Annual Growth Rate of 6.4%, as presented in Figure 104 (DMRE, 2017). Based on previous trends it is estimated that the installed number of air conditioners in the household sector will increase by almost 60% between 2016 and 2032.

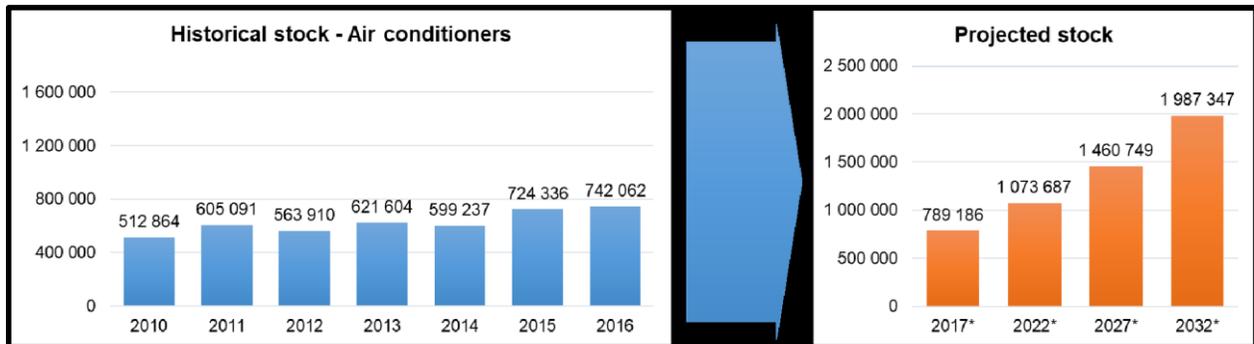


Figure 104 Historical stock and projections for air conditioners

The utilisation of air-conditioners by the residential sector is relatively high in coastal areas especially those along the coast of the Indian ocean, where there is a high demand for air cooling and dehumidification due to the long periods of humid conditions. In terms of penetration rate by province, as depicted in Figure 105, the KwaZulu Natal Province is leading with 12% and the Eastern Cape has least penetration (DMRE, 2017).

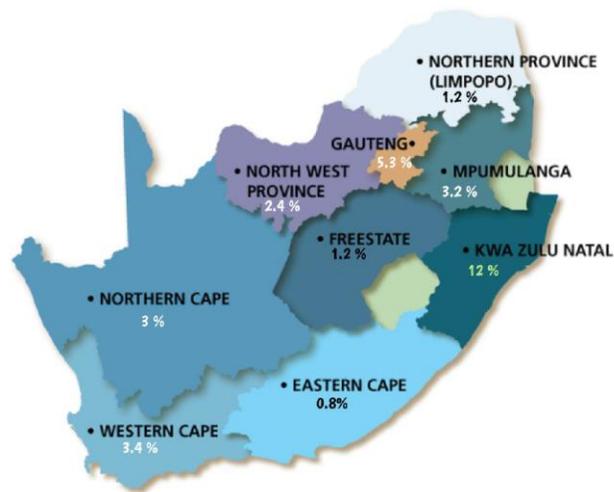


Figure 105 Penetration of air conditioners by province in South Africa (2016)

6.2.5.4.2 Manufacturing of Room Air Conditioners

South Africa does not have manufacturing facilities for air conditioners sized up to 24000 BTU/h (7.1kW). There are very few manufacturing plants that are producing commercial air-conditioners, which have a minimum capacity of 50 kW.

6.2.5.4.3 Distribution of Room Air Conditioners

The supply of room air conditioners is characterised by imports. In 2017, 294 thousand of the regulated room air conditioners were sold, and the wall mounted split type dominated the sales, as illustrated in Figure 106 (DMRE, 2017). The split units are used in both residential and commercial application. The demand for portable room air conditioners is still low. However, some household owners/flat residents find this option more affordable compared to split type and where there are restrictions for installation of wall or window air-conditioners, mainly in apartments/flats. The window units are not very common in the residential sector. These units are mainly sold to the commercial sector, mainly mobile/site container offices or houses and remote base stations such as the telecommunications (DMRE, 2017).

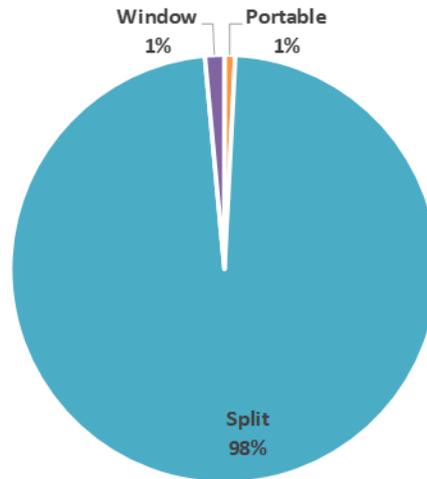


Figure 106 Types of room air conditioners sold in the South Africa (2017)

Air conditioning units are generally not “off-the shelf” items as such they require the services of an agency that can also provide after sales services, such as maintenance services. The key stakeholders involved in the distribution of room air conditioners in South Africa can be categorised as follows:

- International brands with direct subsidiaries in the local market
- Representatives or agencies, distributing on behalf of international companies
- Independent distributors who sell air conditioners under their own brands.

Independent distributors are very common in the supply of room air conditioners in South Africa. In most cases, air-conditioning systems for household owners, even big companies, are supplied and installed by independent distributors. Representatives or agencies, distributing on behalf of international companies are also very common.

According to the VC 9008 regulations, distributors of room air conditioners must ensure all appliances sold in-store or online have the South African Energy Efficiency label, shown in Figure 107, and must be displayed on the outside of the air conditioner. The label is supplied by the manufacturer or distributor of the appliance and it must clearly display the energy performance class, as well as additional energy performance information about the appliance. Retailers are not expected to sell appliances that do not meet the specified MEPS.

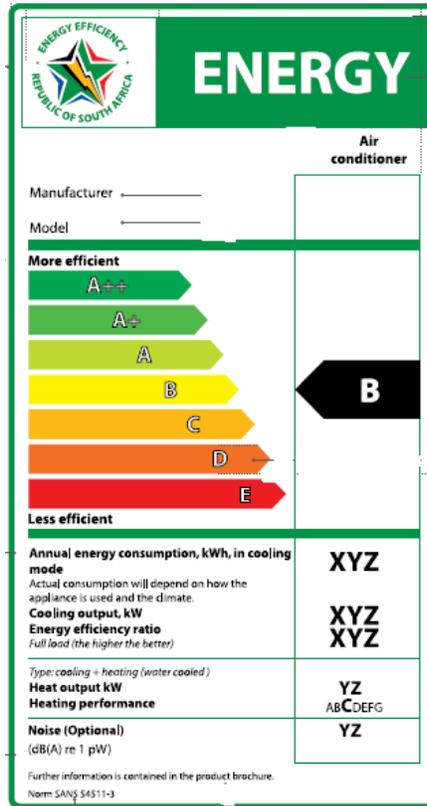


Figure 107 South Africa's energy efficiency label for air conditioners

Figure 108 provides an illustration of the supply chain for room air conditioners in South Africa. Importers are required by law to ensure their products are compliant to MEPS before importation of the product. The importer shall receive the letter of authority from NRCS permitting importation and selling of the product in South Africa. The imported product must meet the customs' requirements at the point of entry.

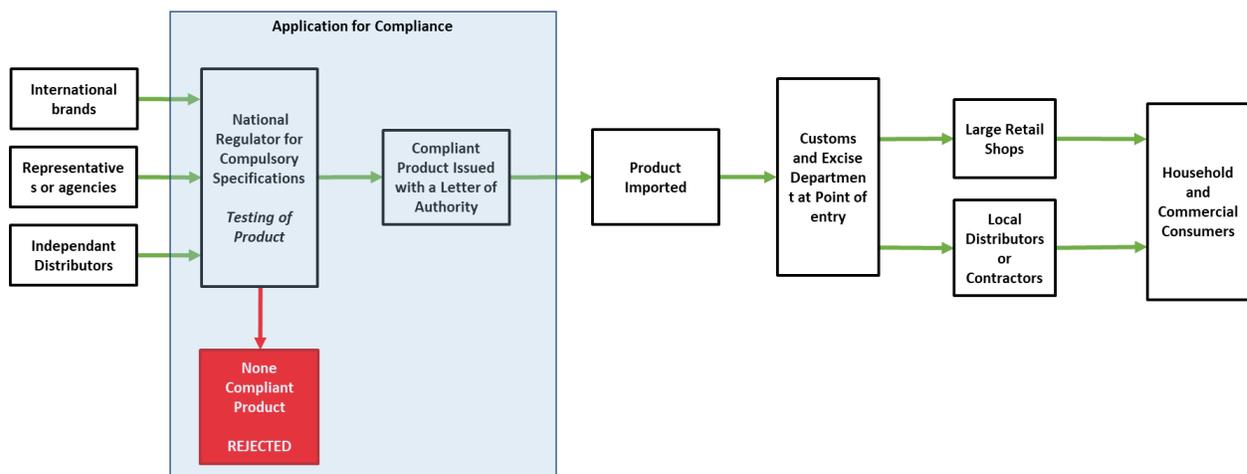


Figure 108 Supply chain of room air conditioners in South Africa

In terms of brand share in the overall market, the LG brand accounted for 31% of air conditioners sold to the household sector in South Africa, as illustrated in Figure 109 (DMRE, 2017). Samsung also had a significant contribution in this market, supplying about 20% of the units sold. The other, which accounted for 28%, include no-name and private brands distributed by independent distributors.

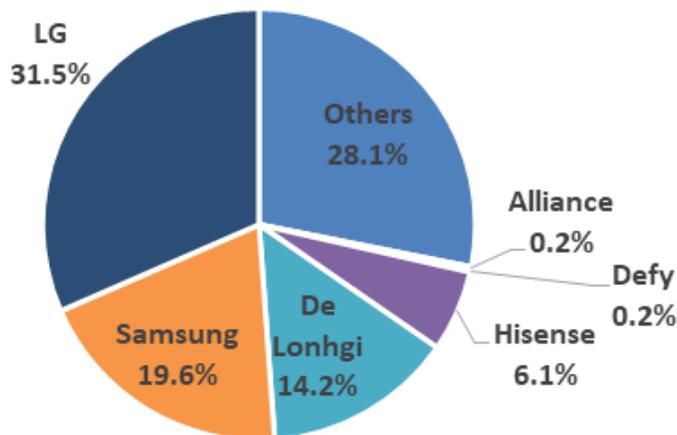


Figure 109 Brand shares for air conditioners in South Africa (2017)

The distribution of no name products and those distributed by independent distributors presents a risk of dumping energy inefficient models labelled with a higher energy rating, yet the actual energy rating is low.

6.2.5.4.4 Energy Efficiency of Room Air Conditioners

The VC9008 regulation stipulates that air conditioners must have a minimum energy efficiency rating Class B. In the South African context, the measured Energy Efficiency Ratio (EER - kW/kW), also known as cooling efficiency, is used as a measure for the energy efficiency grading for the different types of air conditioners. The EER used is measured at rated capacity rather than a seasonal rating. Table 61 illustrates the measured different EER according to the energy label class for the three regulated air conditioners in South Africa. The classes marked in red are not permitted in the South African MEPS according to VC9008. It was established that the energy ratings of most air conditioners available in the market have energy efficiency rating of Class A or best available option. The technology of the room air conditioning systems supplied to the market is designed to be the inverter type or non-inverter type, with the former being the most popular technology.

The existing MEPS are currently under revision. The outcome of this revision will result in the introduction of new classes for air conditioners. The proposed new classes are Class A and expected to start in 2020 and 2026 respectively (DMRE, 2020).

Table 61 Comparison of efficiency level by label class for the three air conditioners in South Africa

Efficiency level	Split	Portable	Window
$EER > 3.6$	A++	A	A
$3.6 \geq EER > 3.4$	A+	A	A
$3.4 \geq EER > 3.2$	A	A	A
$3.2 \geq EER > 3.0$	B	A	A
$3.0 \geq EER > 2.8$	C	A	B
$2.8 \geq EER > 2.6$	D	A	C
$2.6 \geq EER > 2.4$	E	B	D
$2.4 \geq EER > 2.2$	E	C	E
$2.2 \geq EER > 2.0$	E	D	F
$2.0 \geq EER > 1.8$	E	E	G
$1.8 \geq EER > 1.6$	E	F	G
$1.6 \geq EER$	E	G	G

Applying the United for Efficiency (U4E) Country Saving Assessments to estimate the impact of MEPS for room air conditioners at two levels of ambition (minimum and high), Figure 110 demonstrates the potential electricity savings for both scenarios up to 2040. Implementation of MEPS under the minimum and high ambition scenarios has potential to reduce electricity consumption by 600 GWh and 900GWh in 2040 respectively as compared to the Business-as-Usual scenario (UNEP-U4E, 2020).

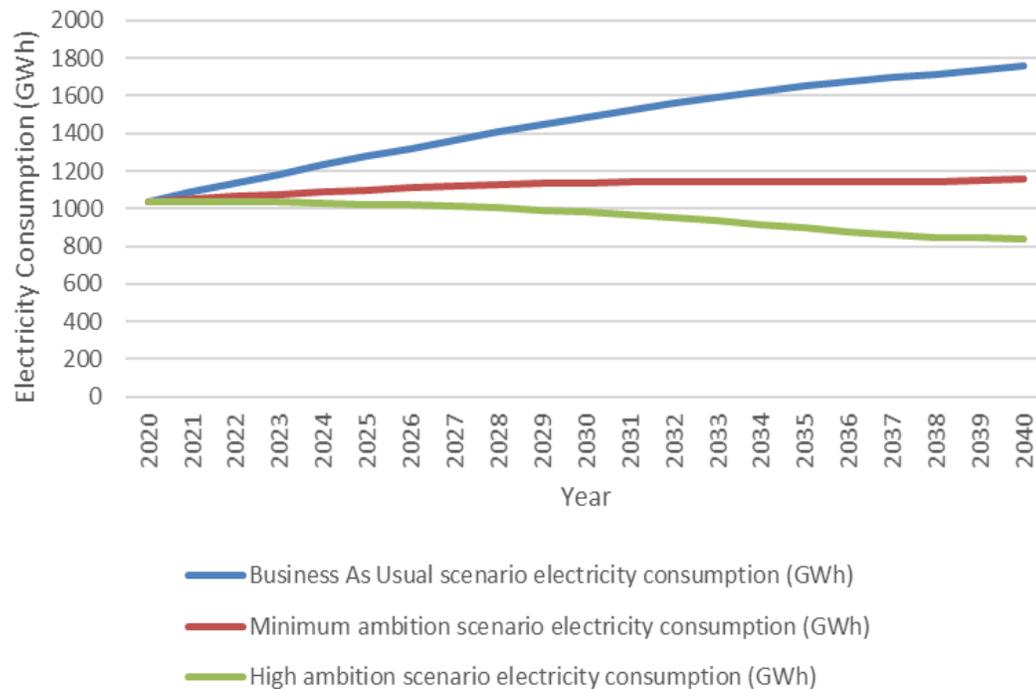


Figure 110 Projected electricity consumption of room air conditioners in South Africa

6.2.5.4.5 Product Registration

All regulated room air conditioners and refrigerators sold in South Africa must be registered with the NRCS after issuance of the Letter of Agreement which confirms compliance to requirements of the technical regulation (NRCS, 2008). South Africa is developing a new product registration system which is currently being tested. It is expected to become mandatory in 2021 (DMRE, 2020).

6.2.5.5 Refrigerant Gases and Emissions

In response to the universal fight against climate change, South Africa promulgated the National Environmental Management: Air Quality Act, 2004 (Act No. 39 Of 2004) which was fundamental to the enactment of the Regulations Regarding the Phasing-out and Management of Ozone Depleting Substances. According to the regulations production, importation, exportation, use or placing on the market of the following ozone-depleting substances and equipment, including residential refrigerators and room air conditioners, is prohibited in South Africa.

- a) Chlorofluorocarbons;
- b) Bromochlorofluorocarbons
- c) Halons;
- d) Carbon Tetrachloride;
- e) 1,1,1 Trichloroethane;
- f) Hydrobromofluorocarbons; And
- g) Bromochloromethane.

The regulations also provide the phase out schedule for hydrochlorofluorocarbons (HCFCs), HCFC-141b and equipment charged with HCFC R22. South Africa intends to completely phase out the use of HCFCs in the South African market. Importation of any new or used residential refrigeration and room air-conditioning systems or equipment containing HCFC-R22 or any refrigerant or refrigerant blend containing any HCFC is prohibited since 1 July 2014. Further, using HCFC-R22, or any other refrigerant containing HCFCs, either in pure form or as a component of blended refrigerants, in the construction, assembly or installation of any new residential refrigeration or room air-conditioning system or equipment is prohibited since 1 January 2015 (DWEA, 2014). South Africa is one of the 76 countries that have ratified the Kigali Amendment to the Montreal Protocol, which commits South Africa to start the phase down of HFCs in 2024 (HVAR, 2019).

South Africa has introduced several refrigerants with low GWP. For example, the R600a is becoming a very common refrigerant gas in refrigerators.

7. Conclusions and Recommendations

The market assessment found that in many countries inefficient and high GWP room air conditioners and residential refrigerators are currently on the market. MEPS and energy labels, if well-designed and implemented, are some of the fastest and most effective approaches to improve efficiency. It is in this context key for the countries of the regions to implement these policy measures. Currently, about half of the countries have MEPS in place which are mostly not harmonized among the countries which have implemented them. Even less countries have implemented labels, namely three countries that have all a mandatory and comparative energy label regulation. In addition to the standards and labelling context the market assessment also found that while most of the countries have a standards body in place, many of the countries lack of energy efficiency entities. Also, product registration systems and financial incentives for energy efficient cooling appliances are scarce.

The findings underpin technical notes on each of the products which include detailed recommendations.

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Annexes

Annex 1: Questionnaire for Government Officials

Stakeholder Questionnaire

Market Assessment for room air conditioners and refrigerators.

UNEP's United for Efficiency initiative (U4E) is supporting regional harmonization efforts in the East African Community (EAC) and the Southern African Development Community (SADC) regions to leverage the large potential of energy-efficient and climate-friendly cooling. Responses to this questionnaire are of critical importance to properly understand the market for residential refrigerators and room air conditioners (and having a cooling capacity of <12 kW) in the country and the region.

The results will be used by the United Nations Environment Programme (UNEP), United Nations Industrial Development Organization, the East African Centre of Excellence for Renewable Energy and Efficiency (EACREEE) and the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) to help inform recommendations on policies and programs to increase adoption of energy-efficient products.

We, therefore, kindly request you, as an important stakeholder, to take a few minutes and provide your inputs to this questionnaire.

UNEP, UNIDO, EACREEE and SACREEE will treat questionnaire responses as business-sensitive information. The findings will be aggregated across the pool of organizations that participate to avoid attribution to any particular entity.

NB: Some of the questions have been asked in previous EELA surveys, however you are kindly requested to respond to all the questions.

Country	
----------------	--

Point of Contact

Organisation	
Title/Position	
Name and Surname	
Email	
Tel.	
Fax.	

1. Policies and Programs for Refrigerators and Air Conditioners

- a) Are there any national policies or programs to promote the energy efficiency of refrigerators and air conditioners? (e.g., national policy, regulation, tax incentives / subsidy/financing, import duties, or other information programme.)

YES	NO
<input type="checkbox"/>	<input type="checkbox"/>

Please tick (☑) or cross (X)

If **YES**, Please provide details or a link.

- b) Have minimum energy performance standards been adopted for the refrigerators.

YES	NO
<input type="checkbox"/>	<input type="checkbox"/>

Please tick (☑) or cross (X)

If **YES**, kindly share the standards document and indicate the enforcement level below:

Mandatory	<input type="checkbox"/>
Voluntary	<input type="checkbox"/>

Please tick(☑) or cross (X)

- c) Have minimum energy performance standards been adopted for the Air Conditioners.

YES	NO
<input type="checkbox"/>	<input type="checkbox"/>

Please tick (☑) or cross (X)

If **YES**, kindly share the standards document and indicate the enforcement level below:

Mandatory	<input type="checkbox"/>
Voluntary	<input type="checkbox"/>

Please tick (☑) or cross (X)

- d) Are there any national policies or programmes to guide the use of refrigerant gases in refrigerators and air conditioners?

YES	NO

Please tick (☑) or cross (X)

If **YES**, Please provide details or a link.

- e) Which institution/s is/are responsible for development of standards and testing of refrigerators and air conditioners in your country?

Development of Standards	Testing of appliances

- f) Are there any associations, municipality, utility or other entity offering programmes to promote energy efficient refrigerators and air conditioners?

YES	NO

Please tick (☑) or cross (X)

If **YES**, Please provide details or a link.

2. Supply Chain of Refrigerators and Air conditioners

- a) Are there any manufacturers of refrigerators and air conditioners in your country?

YES	NO

Please tick (☑) or cross (X)

If **YES**, Please provide manufacturer details and type of product/or a link.

	Manufacturer	Type of Product (model) (e.g. AC, Freezer, Fridge etc)
1		
2		
3		

b) Are there any importers of refrigerators and air conditioners in your country?

YES	NO

Please tick (☑) or cross (X)

If **YES**, Please provide details of the importer and type of product and/or a link.

	Type of Product (e.g. AC, Freezer, Fridge etc)	Details of the Importer (Name, address, website, etc)
1		
2		
3		

c) Are there any energy performance labels on the imported products?

Type of product	YES	NO
Refrigerators		
Air conditioner		

Please tick (☑) or cross (X)

If **YES**, Please provide details (e.g. *European Union Energy Label, South African Energy Efficiency Label etc*).

d) Are there any exporters of refrigerators and air conditioners in your country?

YES	NO

Please tick (☑) or cross (X)

If **YES**, Please provide details of the exporter and type of product and/or a link.

	Type of Product (e.g. AC, Freezer, Fridge etc)	Details of the Exporter (Name, address, website, etc)
1		
2		
3		

e) Do you have a product registration system for refrigerators and air conditioners in your country?

YES	NO

Please tick (☑) or cross (X)

If **YES**, Please provide details or a link.

f) Is there importation of **second hand** refrigeration and air conditioning products into your country?

Type of product	YES	NO	% of imported market that is second had
Refrigerators			
Air conditioner			

Please tick (☑) or cross (X)

If **YES**, Please provide details of the appliance and country or region of origin.

	Type of Second Hand Product (e.g. AC, Freezer, Fridge etc)	Area of Origin (Country or Region) e.g. France or Europe
1		
2		
3		

g) Are there regulations in your country to prohibit the importation of **second hand** electronic products, including refrigeration and air conditioning products?

YES	NO

Please tick (☑) or cross (X)

If **YES**, please provide details on the level of enforcement.

h) Is there a database that manufacturer/suppliers/importers/exporters register their refrigeration and air conditioning products, including second hand products, that are/will be sold in your country?

YES	NO

Please tick (☑) or cross (X)

If **YES**, Please provide details or a link.

3. Air Conditioner and Refrigerator Technologies and Volumes

a) Which type of refrigerator is offered in your national market?

- | | |
|----------------------|--|
| Freezer only | Please tick
<input type="checkbox"/> |
| Refrigerator only | <input type="checkbox"/> |
| Freezer-refrigerator | <input type="checkbox"/> |
| Other | <input type="checkbox"/> <i>Please specify</i> |

b) Which type of air conditioner is offered in your national market?

- | | |
|--------------|---|
| Wall Mounted | Please tick
<input type="checkbox"/> |
|--------------|---|

- Split packaged systems
- Portable non-ducted packaged system
- Window units
- Other *Please specify*

c) What is the average unit energy consumption of the most common refrigerators and air conditioners – *cooling component*?

Type of product	Average Volume (L)	Average Unit Power Input (W)	Average Unit Energy Consumption (kWh) - annual
Refrigerators			

Type of product	Average Unit Power Input (kW), or EER (W/W)	Average Cooling Capacity (kW or BTU/h)
Air Conditioner		

d) Does the imported and/or Exported refrigerators and air conditioners have a labelling on Energy Efficiency Ratio?

YES	NO
<input type="checkbox"/>	<input type="checkbox"/>

Please tick (☑) or cross (X)

If **YES**, please provide details or link.

e) What are the common brands of refrigerators and air conditioners?

Refrigerator Brands	Air Conditioner Brands

--	--

- f) Provide a list of permitted refrigerant gases in your country.
- g) Please provide an estimated number of residential refrigerators and air conditioners *in use* in your country, giving the year and source of data.

	Type of Product	Estimated number	Year	Source of information
1	Air conditioner			
2	Refrigerators (including freezers)			

- h) Please provide an estimated number of residential refrigerators and air conditioners in *annual new sales* in your country, giving the year and source of data.

	Type of Product	Estimated number	Year	Source of information
1	Air conditioner			
2	Refrigerators (including freezers)			

- i) How would you describe the rate of penetration of energy efficient refrigerators and air conditioners in the market of your country?

Type of Product	Low <20%	Medium 20%-50%	High >50%	Comments
Air conditioner				
Refrigerators (including freezers)				

Please tick (☑) or cross (X)

4. Customer related issues for Air Conditioner and Refrigerator

- a) What are the typical prices paid for the following types of refrigerators?

Type of Refrigerator	Typical Volume (L)	Price Range (USD)	
		New products	Used Products

Freezer only			
Refrigerator only			
Freezer-refrigerator			
Other			

b) What are the typical prices paid for the following types of Air conditioners?

Air Conditioner Size	Price Range (USD)	
	New products	Used Products
9000 Btu/h = 2.64 kW		
12000 Btu/h = 3.52 kW		
18000 Btu/h = 5.28 kW		
24000 Btu/h = 7.03 kW		
40,950 Btu/h = 12 kW		

c) What are the barriers to more energy-efficient refrigeration and air conditioning products (e.g. availability, awareness, accessibility, affordability, acceptance, etc.) in your country?

5. Provide any other comments that can give insight into the market situation of Air Conditioners and Refrigerators.

Annex 2: Questionnaire for Private Sector

Stakeholder Questionnaire

Market Assessment for room air conditioners and refrigerators.

UNEP's United for Efficiency initiative (U4E) is supporting regional harmonization efforts in the East African Community (EAC) and the Southern African Development Community (SADC) regions to leverage the large potential of energy-efficient and climate-friendly cooling. Responses to this questionnaire are of critical importance to properly understand the market for residential refrigerators and room air conditioners (and having a cooling capacity of <12 kW) in the country and the region.

The results will be used by the United Nations Environment Programme (UNEP), United Nations Industrial Development Organization, the East African Centre of Excellence for Renewable Energy and Efficiency (EACREEE) and the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) to help inform recommendations on policies and programs to increase adoption of energy-efficient products.

We, therefore, kindly request you, as an important stakeholder, to take a few minutes and provide your inputs to this questionnaire. This Questionnaire must be returned on 21st October 2020

UNEP, UNIDO, EACREEE and SACREEE will treat questionnaire responses as business-sensitive information. The findings will be aggregated across the pool of organizations that participate to avoid attribution to any particular entity.

NB: Please note the Questionnaire has two sections; **Section 1** focusing on **Air Conditioning** and **Section 2** focusing on **Refrigeration**. Kindly complete sections relevant to your line of business.

Country	
---------	--

Point of Contact

Organisation	
Title/Position	
Name and Surname	
Email	
Tel.	
Fax.	
Mobile	

SECTION 1 – AIR CONDITIONING TECHNOLOGIES

This section is about the manufacturing and distribution of room air conditioning technologies.

From the list below, please check the box which best describes your organization:

Manufacturer	<input type="checkbox"/>	<i>Answer only Section 1.1 (a – g)</i>
Distributor	<input type="checkbox"/>	<i>Answer only Section 1.2 (a – g)</i>
Retailer	<input type="checkbox"/>	<i>Answer only Section 1.3 (a – d)</i>

1.1 MANUFACTURING SECTION:

j) Which type of air conditioning systems manufactured by your company? Please provide an average of units produced per annum for each type.

Type of Air Conditioner	Please Check Box	Annual unit production
-------------------------	------------------	------------------------

Split packaged systems		
<i>Wall Mounted</i>	<input type="checkbox"/>	
<i>Floor-standing type</i>	<input type="checkbox"/>	
<i>Cassette type</i>	<input type="checkbox"/>	
<i>Under ceiling type</i>	<input type="checkbox"/>	
Portable	<input type="checkbox"/>	
Window (unitary)	<input type="checkbox"/>	
Floor Standing	<input type="checkbox"/>	
Other (Please Specify)	<input type="checkbox"/>	

k) What is the Energy Efficiency Rating (EER, EU SEER, CSPF, etc.) of the Air Conditioning equipment/s manufactured by company? Please also provide the cooling capacity and energy efficiency performance class for the Air Conditioners.

Type of Air Conditioner	Cooling Capacity (Range and most popular)	Efficiency of AC (EER/SEER) (Range)	Energy Efficiency Performance Class (i.e. A+++, A++, A+, B)
<i>e.g.,</i>	<i>2.5 – 7.1 kW / 3.5 kw)</i>	<i>EER 3.0 – 5.0 EU SEER 6.1 – 9.0</i>	<i>EU A+ to A+++</i>
Split packaged systems			
<i>Wall Mounted</i>			
<i>Floor-standing type</i>			
<i>Cassette type</i>			
<i>Under ceiling type</i>			
Portable			
Window (unitary)			
Floor Standing			
Other (Please Specify)			

l) Please estimate the product lifetime in normal residential or commercial use.

Type of Air Conditioner	Estimated Product Lifetime
Split packaged systems	
<i>Wall Mounted</i>	
<i>Floor-standing type</i>	
<i>Cassette type</i>	
<i>Under ceiling type</i>	
Portable	
Window (unitary)	
Floor Standing	
Other (Please Specify)	

m) Please provide the Air Conditioning brands manufactured by your company.

- 1.....
- 2.....
-

n) Please provide a list of the major retailers/distributors of your product.

- 1.....
- 2.....
- 3.....

o) Does your company export its manufactured Air Conditioning products?

- YES**
- NO**

Please Check Box

If **YES**, please provide the details of the countries and percentage share of local distribution and exports:

	Percentage (%)
Local Distribution	
Export	

p) Please provide a list of refrigerant gases used in the Air Conditioners manufactured by your company.

- 1....
- 2....
- 3....

1.2 DISTRIBUTOR SECTION

a) Which type of air conditioning systems distributed by your company? Please provide an average of units distributed per annum for each type.

Type of Air Conditioner	Please Check Box	Annual Unit Distribution
Split packaged systems		
<i>Wall Mounted</i>	<input type="checkbox"/>	
<i>Floor-standing type</i>	<input type="checkbox"/>	
<i>Cassette type</i>	<input type="checkbox"/>	
<i>Under ceiling type</i>	<input type="checkbox"/>	
Portable	<input type="checkbox"/>	
Window (unitary)	<input type="checkbox"/>	
Floor Standing	<input type="checkbox"/>	
Other (Please Specify)	<input type="checkbox"/>	

b) Please provide the Air Conditioning brands distributed by your company.

- 1.....
- 2.....
- 3.....

c) Please provide a list of your major customers.

- 1.....
- 2.....
- 3.....

d) What is the Efficiency Rating (EER/SEER) of the Air Conditioning systems distributed by your company? Please also provide the cooling capacity and energy efficiency performance class for the Air Conditioners.

Type of Air Conditioner	Cooling Capacity (Range / Most Popular)	Efficiency of AC (EER/SEER) (Range / Most Popular)	Energy Efficiency Performance Class (i.e. A+++, A++, A+, B)
e.g.,	2.5 – 7.1 kW / 3.5 kw)	EER 3.0 – 5.0 / 3.4 EU SEER 6.1 – 9.0 /7.0	EU A+ to A+++
Split packaged systems			
<i>Wall Mounted</i>			
<i>Floor-standing type</i>			
<i>Cassette type</i>			
<i>Under ceiling type</i>			
Portable			
Window (unitary)			
Floor Standing			
Other (Please Specify)			

e) Does your company **import** Air conditioning appliances?

YES

NO

Please Check Box

If YES, please list the country/s of source.

1.....

2.....

3.....

f) Does your company **export** Air conditioning appliances?

YES

NO

Please Check Box

If YES, please list the country/s of destination.

1.....

2.....

3.....

g) Please provide a list of refrigerant gases used in Air Conditioners distributed by your company.

1....

2....

3....

1.3 RETAILER SECTION

a) Which type of air conditioning system sold by your company? Please provide an average of units sold per annum for each type.

Type of Air Conditioner	Please Check Box	Average Units Sold per year
Split packaged systems	<input type="checkbox"/>	
<i>Wall Mounted</i>	<input type="checkbox"/>	
<i>Floor-standing type</i>		
<i>Cassette type</i>	<input type="checkbox"/>	
<i>Under ceiling type</i>	<input type="checkbox"/>	
Portable	<input type="checkbox"/>	
Window (unitary)	<input type="checkbox"/>	
Floor Standing	<input type="checkbox"/>	
Other (Please Specify)	<input type="checkbox"/>	

b) Please provide the Air Conditioning brands sold by your company.

1.....

2.....

3.....

.....

c) What is the **average retail price** for the following Air Conditioning systems? Please also provide the cooling capacity, energy efficiency rating and energy efficiency performance class for the Air Conditioners.

Type of Air Conditioner	Cooling Capacity (most popular)	Average Retail Price (USD) (most popular)	Efficiency of AC (EER/SEER) (most popular)	Energy Efficiency Performance Class (i.e. A+++, A++, A+, B)
Split packaged systems				
<i>Wall Mounted</i>				

Bar refrigerator	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Chest refrigerators	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Other (<i>Please Specify</i>)	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	

- a) What is the labelled or estimated annual energy consumption of the household refrigeration equipment and appliances manufactured by company? Please also provide the size and energy efficiency performance class for the type of refrigeration technology.

Type of Refrigeration Technologies	Volume (Range / Most Popular in Litres)	Energy Consumption (Range / Most Popular in kWh/yer)	Energy Efficiency Performance Class (i.e. A+++, A++, A+, B)
Chest freezers			
Standing Freezer only			
Freezer-refrigerator			
Bar Refrigerator			
Chest refrigerators			
Other (<i>Please Specify</i>)			

b) Please estimate the product lifetime in normal household use.

Type of Refrigeration Technologies	Estimated Product Lifetime (Years)
Chest freezers	
Standing Freezer only	
Freezer-refrigerator	
Bar Refrigerator	
Chest refrigerators	
Other (<i>Please Specify</i>)	

c) Please provide the household refrigerator brands manufactured by your company.

- 1.....
- 2.....
- 3.....

d) Please provide a list of the key retailers/distributors of your product.

- 1.....
- 2.....

3.....

e) Does your company export its manufactured household refrigerator products?

YES

NO

Please Check Box

If **YES**, please provide the details of the countries and percentage share of local distribution and exports:

	Percentage (%)
Local Distribution	
Export	

f) Please provide a list of refrigerant gases used in household refrigerators manufactured by your company.

1....

2....

3....

1.2 DISTRIBUTOR SECTION

a) Which type of household refrigeration system distributed by your company? Please provide an average of units distributed per annum for each type.

Type of Refrigeration Technologies	Please Check Box	Average Unit Distribution Per Year
Chest freezers	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Standing Freezer only	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Freezer-refrigerator	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Bar Refrigerator	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Chest refrigerators	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Other (<i>Please Specify</i>)	<input type="checkbox"/> Manual Defrost	

	<input type="checkbox"/> Automatic Defrost	
	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	

b) Please provide the household refrigerator brands distributed by your company.

- 1.....
- 2.....
- 3.....

c) Please provide a list of your major customers.

- 1.....
- 2.....
- 3.....

d) What is the labelled or estimated annual energy consumption of the household refrigeration equipment and appliances distributed by company? Please also provide the size and energy efficiency performance class for the type of refrigeration technology.

Type of Refrigeration Technologies	Volume (Range / Most Popular in Litres)	Annual Energy Consumption (Range / Most Popular in kWh)	Energy Efficiency Performance Class (i.e. A+++, A++, A+, B)
Chest freezers			
Standing Freezer only			
Freezer-refrigerator			
Bar Refrigerator			
Chest refrigerators			
Other (<i>Please Specify</i>)			

e) Does your company **import** refrigeration appliances?

YES

NO

Please Check Box

If YES, please list the country/s of source.

1.....

2.....

3.....

f) Does your company **export** refrigeration appliances?

YES

NO

Please Check Box

If YES, please list the country/s of destinations.

1.....

2.....

3.....

g) Please provide a list of refrigerant gases used in refrigerators distributed by your company.

1....

2....

3....

1.3 RETAILER SECTION

a) Which type of refrigerators sold by your company? Please provide an average of units sold per annum for each type.

Type of Refrigeration Technologies	Please Check Box	Average Unit Distribution Per Year
Chest freezers	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Standing Freezer only	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Freezer-refrigerator	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Bar Refrigerator	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	

Chest refrigerators	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
Other (<i>Please Specify</i>)	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	
	<input type="checkbox"/> Manual Defrost <input type="checkbox"/> Automatic Defrost	

b) Please provide the common household Refrigerator brands sold in your company.

- 1.....
- 2.....
- 3.....
-

c) What is the **average retail price range** for the following refrigerators? Please also provide the volume, energy consumption, and energy efficiency performance class for the refrigeration equipment.

Type of Refrigeration Technologies	Volume (Most Popular in Litres)	Average Retail Price Range (USD)	Annual Energy Consumption (KWh/year)	Energy Efficiency Performance Class (i.e. A+++, A++, A+, B)
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Chest freezers				
Freezer only				
Freezer-refrigerator				
Bar Refrigerator				
Chest refrigerators				
Other (Please Specify)				

- d) What are the common preferences and reasons presented by customers when choosing the type and size of a refrigerator? Do customers consider the energy consumption of the refrigerator when buying?