REVIEW OF SOUTH AFRICA'S APPLIANCE ENERGY CLASSES AND IDENTIFICATION OF THE NEXT SET OF ELECTRICAL EQUIPMENT FOR INCLUSION IN THE NATIONAL STANDARDS AND LABELLING PROJECT: EXISTING ELECTRICAL APPLIANCES

DRAFT REPORT VER 1

Urban Econ Development Economists | Energy Efficient Strategies | Kevin Lane Oxford

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ACRONYMS AND ABBREVIATIONS

%:	percent
<:	smaller than
>:	greater than
°C:	Degrees Celsius
AMPS:	All Media and Products Study
btu/h:	British thermal unit per hour
Btu:	British thermal unit
CAGR:	compounded annual growth rate
COP:	Coefficient of Performance
DoE:	Department of Energy
DVD:	Digital versatile disc
EE:	energy efficiency
EEC:	European Economic Community (directive)
EEI:	Energy Efficiency Index
EER:	Energy Efficiency Ratio
EN:	European Standard
EU:	European Union
FRIDGE:	Fund for Research into Industrial Development, Growth and Equity
GWh:	Gigawatt hour
GWP:	Global warming potential
IEC:	International Electrotechnical Commission
ISO:	International Standards Organisation
kg:	kilogramme
kWh:	kilowatt hour
L:	litres
LCD:	Liquid Crystal Display
LOA:	Letter of Authority
LSM:	Living Standard Measure
MEPS:	Minimum Energy Performance Standard
MVE:	Monitoring, Verification and Enforcement

N/A:	Not applicable
NRCS:	National Regulator for Compulsory Specifications
p.a.:	per annum
PDP:	Plasma Display Panel
R:	Rand (South African currency)
S&L:	Standard and Labelling
SAARF:	South African Audience Research Foundation
SAEc:	Standard Annual Energy Consumption
SANS:	South African National Standard
SEER:	Seasonal energy efficiency ratio
SSTB:	Simple set top box
STB:	Set top box
TV:	television
TWh:	Terawatt hour
UEC:	unit energy consumption
UK:	United Kingdom
UNDP:	United Nations Development Programme
US:	United states
VC:	Compulsory Specification
W:	watt
ZAR:	South African Rand

DEFINITION OF KEY TERMS

Living Standards Measure (LSM)

The Living Standard Measure (LSM) (also known as the multivariate market segmentation index, developed by the South African Audience Research Foundation (SAARF)) has become one of the extensively used market segmentation tools in South Africa. It divides the population into 10 groups, 1 being the lowest bound and 10 being the highest in terms of wealth. The index considers the degree of urbanization (whether the household resides in a metropolitan area, small city or village), ownership of electronics, appliances and other assets (such as vehicles). Essentially, the LSM approach differentiates the market based on wealth rather than current disposable income of the household.

The following income group categories are associated with each LSM:

Table A: LSM groups

LSM	1	2	3	4	5	6	7	8	9	10
Income category	**Low-income**					**Middle-income**		**High-income**		
Monthly av. income	1 909	2 504	2 792	3 785	4 550	6 895	11 193 (L) 13 626 (H)	15 796 (L) 17 433 (H)	21 829 (L) 25 692 (H)	34 332 (L) 42 170 (H)

Stock, ownership, and penetration rate

For the purpose of this study, stock refers to the number of products in use across all households. The penetration rate gives a percentage of households with at least one product in use. Ownership is the ratio of stock to the number of households (usually a decimal number). In more extreme cases, an ownership ratio of 2 or 3 would mean an average of 2 or 3 appliances per household.

Minimum Energy Performance Standard (MEPS)

MEPS are regulatory measures which define the minimum level of energy performance rating that an appliance must meet or exceed before it can be sold. MEPS have been set for consumer protection by banning less energy efficient products from the market – which consume more electricity. Therefore, overall electricity costs incurred by an average consumer for operating such an appliance are reduced in the long-term. In addition, MEPS serve as an incentive to manufacturers to supply more energy efficient appliances, resulting in improved energy savings in our economy (DoE, 2016).

1 INTRODUCTION

1.1 S&L programme overview

Some four years ago, the South African government in collaboration with the United Nations Development Programme (UNDP) implemented the S&L Project in South Africa (i.e. *Market Transformation through the Introduction of Energy Efficiency Standards and the Labelling of Household Appliances in South Africa*). As part of the first phase of the project, around 12 household electrical appliances were selected for the Minimum Energy Performance Standards (MEPS) Programme - a regulatory tool aimed at reducing electricity consumption within the residential and commercial sectors as set out in Table 1-1.

Table 1-1: The S&L Framework

Electrical Appliance	Regulatory Instrument	Applicable National Standard
Air Conditioners	*VC 9008*	SANS 941
Audio and Video Equipment		
Large Electric Ovens		
Small/Medium Electric Ovens		
Refrigerators		
Freezers		
Dishwashers		
Washing Machines		
Washer-dryer Combinations		
Tumble Dryers		
Fridge-Freezer Combinations		
Electric Water Heaters (Geysers)	*VC 9006*	SANS 151
Electric Lamps	*VC 8043; VC 9091*	*SANS 60901*

MEPS for the 12 electrical appliances (excluding electric lamps and geysers) are guided by SANS 941 (Labelling of Electrical and Electronic Apparatus). These have been made mandatory through the Compulsory Specifications for Energy Efficiency and Labelling of Electrical and Electronic Apparatus (VC 9008), published in 2014. The VC 9008 introduced a phased-in approach towards the enforcement of the MEPS, as specified in SANS 941.

With respect to electric geysers, there have been some efforts to include electric geysers under SANS 941, but this has not yet materialised. The MEPS for electric geysers are currently specified in SANS 151. These were made mandatory through the Compulsory Specification for Hot Water Storage Tanks for Domestic Use (VC 9006), also promulgated in 2014 but amended in August 2016.

While the local S&L project has been in full operation for more three years now, it should be noted that the project, like any other project, has had its own share of highlights and lowlights. These relate to issues around implementation; stakeholder buy-in, compliance, funding, and technical infrastructure – amongst others. The following are some of the notable highlights and lowlights that have characterised the S&L project in South Africa:

Programme highlights

- Stakeholder buy-in has been quite commendable as evidenced by the manner in which the S&L Steering Committee is constituted. The committee is currently comprised of representatives from diverse organs of state, industry associations, and private labs.

- The S&L programme in South Africa can be sustained in theory considering the full cost recovery approach followed by the regulator. The regulator's Monitoring, Verification and Enforcement (MVE) programme, which is the bedrock of the S&L programme, is supported through industry payment of product registration fees (LOA fees) and levies. Through these LOA fees and levies, the regulator can recoup all the programme related costs it incurs while regulating the industry.
- There have been notable investments towards the establishment of local technical infrastructure, which is a pre-requisite for a successful S&L programme. Government- and privately-owned commercial labs to assist with the testing of some of the regulated electric appliances have been also been established.
- Industry compliance is also quite notable as evidenced by the number of product registration applications being received from the industry. Between June 2016 and 2017, around 989 energy efficiency LOA applications were made for VC 9008 alone.

Programme lowlights

- Delayed implementation: The enforcement of certain regulations (e.g. VC9008 and the amended VC9006) was delayed due to the lack of readiness on the part of other S&L stakeholders – i.e. the MVE organisations.
- The S&L programme has often been criticised by the industry due to the long LOA turnaround time.
- The lack of adequate accredited local testing infrastructure inhibits the regulator's sampling and verification testing activities. Furthermore, the complete lack of local testing infrastructure as is the case with air-conditioners also affects the regulator's testing of such appliances.
- Under declaration and limited monitoring and verification capacity limits the ability of the regulator to derive substantial income to sustain its activities over a long-term and ensure adequate enforcement of its regulations.

The S&L project implementers do acknowledge the severity of the aforementioned lowlights and the threat they cause towards the success of the S&L programme hence they are currently instituting some remedial action to address such programme-related challenges.

1.2 Scope

Urban-Econ Development Economists supported by Energy Efficient Strategies (Australia) and Dr Kevin Lane (UK) was appointed by the United Nations Development Programme (UNDP) to conduct a review of the existing Minimum Energy Performance Standards (MEPS) and identify a next set of electrical appliances and equipment for inclusion in South Africa's national Standards and Labelling (S&L) Project.

The scope of the project is twofold:

1. *Improved MEPS*: Assessing the existing MEPS for the twelve appliances and determine whether there is scope (through technological advances, market changes, or for any other reason) to improve them (this report)
2. *New MEPS*: Identifying a new additional set of electrical equipment (not limited to residential appliances) that could be considered for the project (i.e. the new appliances report)

This report covers the **first component of the study, i.e. assessing the existing MEPS and determining whether there is scope to improve them.** Based on the engagement with the UNDP during the beginning of the study, the focus of the assessment of the existing MEPS was further refined as follows:

- **Geysers**: exclude from the analysis as the MEPS have been recently updated to Class B
- **Audio/visual equipment**: review MEPS levels adopted in the other countries and comment on a reasonable level that could be introduced
- **Lighting:** exclude form the study since this electric equipment does not yet have an approved national standard
- **Refrigerators and freezers:** include in the analysis and assess whether the existing MEPS levels could be improved further; engage with the industry participants to gather information to substantiate the argument and any proposal
- **Tumble Dryers:** include in the analysis and assess whether the existing Class D could be improved further to Class C and even Class B; engage with the industry participants to gather information to substantiate the argument and any proposal
- **Dishwasher:** include in the analysis and review the arguments that were made with respect to the proposed and then approved Class A MEPS; assess whether these arguments still stand; and advise on whether any action needs to be taken
- **Washing machines;** similar to dishwashers, review the arguments made with respect to the proposed and then approved Class A MEPS in the original study; assess whether these arguments still stand; and advise on whether any action needs to be taken
- **Washer-dryer:** include in the analysis and assess whether the existing MEPS level could be improved further; engage with the industry participants to gather information to substantiate the argument and any proposal
- **Electric Ovens:** include in the analysis and assess whether the existing Class B for large ovens could be improved further to Class A, and if Class A in the case of small and medium ovens should remain; engage with the industry participants to gather information to substantiate the argument and any proposal
- **Air conditioners and heat pumps**: undertake a detailed assessment of the split air-conditioning units sold and distributed in South Africa inclusive of brands, models, efficiency levels, sales volumes, application purpose (cooling or heating), the difference between a residential and a commercial unit; determine the potential MEPS level that could be introduced to improve the current levels; engage with the local distributors and manufacturers to determine the barriers and other challenges that may be faced by industry participants and critically assess their reasoning and grounds on the basis of which these issues are highlighted; conduct an impact assessment

1.3 Data sources

The primary and secondary data sources listed in Table 1-2 were utilised to inform the study.

Table 1-2: Primary and Secondary Data Sources

Primary sources	• *Meetings with two representatives from the air-conditioning industry* • *A meeting with a representative from the electro-technical industry association* • *Shop visits (Game Brooklyn; Metro Home City)*
Secondary sources	***Data***

	• *Review of online shopping platforms* • *Review of supplier websites and product manuals* • *EuroMonitor Consumer Appliances data (2017)* • *NRCS Levies data (2017/18)* • *AMPS data from Eighty20 (2010-2016)* • *Database from previous S&L study* • *NRCS Approved LOAs database* ***Reports*** • *BigEE reports* • *FRIDGE report (2012) -i.e. initial S&L study* • *CLASP reports* • *WOWEB reports* • *Topten reports* • *Other S&L related literature* ***Standards and regulations*** • *Relevant national (i.e. VCs) and international (e.g. EU) MEPS regulations* • *National (i.e. SANS) and international (i.e. IEC; EN) standards*

1.4 Key assumptions

- Electricity price increase
- Annual electricity consumption calculations

Electricity price	• *Base price (residential): 127.3 c/kWh* • *Annual increase: 7.3% pa*
Tumble dryers annual usage	• *160 cycles a year (based on information presented for some Bosch models)[1], which translates into 3 cycles per week throughout the year or 6 cycles per week over six months*
Refrigerators annual electricity consumption	• *Average of the different estimated annual electricity consumption figures presented on the respective refrigerator labels:* ○ *for Class 'B' – 3 models* ○ *for Class 'A' – 2 models* ○ *for Class 'A+' – 1 model*
Freezers annual electricity consumption	• *Average of the different estimated annual electricity consumption figures presented on the respective freezer labels:* ○ *for Class 'C' – none* ○ *for Class 'B' – 2 models* ○ *for Class 'A' – 2 models*
Electric ovens annual energy consumption	• *Based on the estimated energy consumption (kW/h) per cycle info presented on the respective oven labels* • *Assuming usage of four hours a week and a 52 week-year[2]*
Air conditioners annual usage	• *519 hours (guided by the 500 hour annual usage figure put forth as a labelling standard – and also based on own computation using one product on the market)[3]*

[1] https://www.bosch-home.com/za/products-list/washersanddryers/tumbledryers/condensertumbledryers/WTM8326SZA#/Tabs=section-technicalspecs/Togglebox=-981012385/
[2] https://www.savingenergy.org.za/asl/consumers/electric-ovens/
[3] https://www.savingenergy.org.za/asl/consumers/air-conditioners/

2 AUDIO-VISUAL APPLIANCES (AND OTHER PRODUCTS)

2.1 Context and background

Item	Comment	
Applicable standards and regulations	EE standard	• SANS 941: Covers energy efficiency requirements, measurement methods and energy efficiency of electrical and electronic apparatus, including audio and visual equipment. • Clause 4.2.2 (audio and video equipment) states *when tested in accordance with SANS 62087, audio and video equipment in passive standby mode shall have a power consumption of not exceeding 1 W. For the set top box the power consumption in passive standby mode shall not exceed 3 W*.
	Regulation	• VC 9008: Audio and video equipment shall comply with SANS 941.
	Performance measurement standard	• SANS 62087:2010/IEC 62087:2008: Methods of measurement for the power consumption of audio, video and related equipment
Items regulated	• VC9008 specifies the scope of audio and video equipment as follows: *television sets, video recording equipment, simple set top boxes (SSTBs), audio equipment and multi-function equipment for consumer use; television sets include, but are not limited to, those with cathode ray tube (CRT), liquid crystal display (LCD), plasma display panel (PDP), or projection technologies*.	
Other electronic apparatus subjected to standby power regulations	• SANS 941 Clause 4.1.2 (standby power) states *when tested in accordance with SANS 62301 (except as indicated in 4.2.2), the standby power of apparatus shall be not more than 1 W. Air conditioners are excluded from this requirement*. The scope of SANS 941 applies to the specified equipment, called apparatus, including: Air conditioners, Dishwashers, Ovens, Refrigerators and Freezers, Tumble Dryers, Washer-dryer combinations, Washing machines **NOTE:** Air conditioners are explicitly excluded from the scope of standby power in Clause 4.1.2 while refrigerators and freezers are naturally excluded since they do not have a passive standby mode.	
Test method used and origins	• SANS 941 references *SANS 862, Set-top box decoder for free-to-air digital terrestrial television* as the official test method for set top boxes and *SANS 62301/IEC 62301, Household electrical appliances – Measurement of standby power*. • SANS 62301:2012 is and identical adoption of IEC 62301:2011 (Edition 2). SANS 862 is a local South African standard that covers a range of technical requirements for operation such as frequencies, coding, decoding and other capabilities. It also defines standby operation.	

2.2 Market description

Market description

There are at least 22 brands and over 350 models of televisions in the market[4]. A 2015 BigEE report also estimated that there were just over 31 brands of radios and 44 brands of video players in the market.

[4] Refer to the compiled excel database

Market composition

Sales of home video equipment alone, in 2017 were about 1.22 million units (Figure 2-1), showing an absolute growth in sales volumes by 18.3% from 2012 – the lowest sales period since 2003 (Euromonitor, 2017b). The sales of home video equipment largely follow the trajectory of household expenditure observed in the past decade, which was directly linked to the economic conditions: in 2005-2006, consumer expenditure has been on a rise, while the global and domestic financial and economic crises of 2008-2009 dampened consumer spending significantly leading to the sharp decline in sales of home video appliances. Nonetheless, Euromonitor (2017b) predicts, that the sale volumes will increase in the next five years in South Africa reaching approximately 1.9 million units in the year 2022.

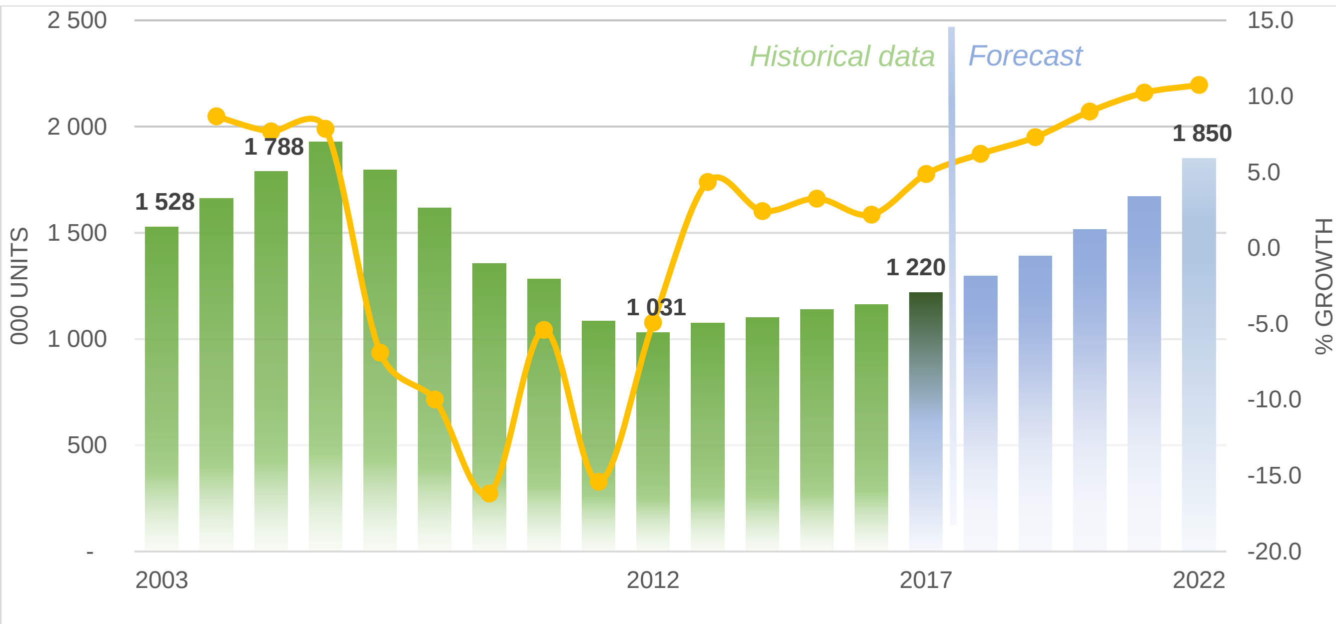


Figure 2-1: Trend in Sales of Home Video Equipment (Euromonitor, 2017b)

Figure 2-2 depicts the breakdown of the sales by category. It shows that televisions are the main driver of the volume of retail sales for home video equipment, as they account for over 95% of the market share and has shown a positive growth over the past few years. Further, LCD TVs is the only type of televisions cold on the market in 2017, with sales of plasma and analogue TVs being discontinued in 2016 and 2015 respectively. The sales of LCD TVs is also expected to grow in the next five years at the compounded annual growth rate (CAGR) of 9.4% - significantly higher than that observed in the past few years.

On the other hand, the demand for video and DVD players is projected to decline over the next few years, given the forecasted decay rate of 4.2% and 7.5% respectively (Euromonitor, 2017b). Although Blu-Ray players have seen a positive CAGR over the past five years, the decline in their sales volume since 2015 shows that their popularity in the market has already started to drop. This could largely be attributed to a growing market of television content over Internet Protocol (IP) and increasing access to pay-per-view services and other streaming media, which is enabled through the growing access to internet among South African households though wireless and fibre networks.

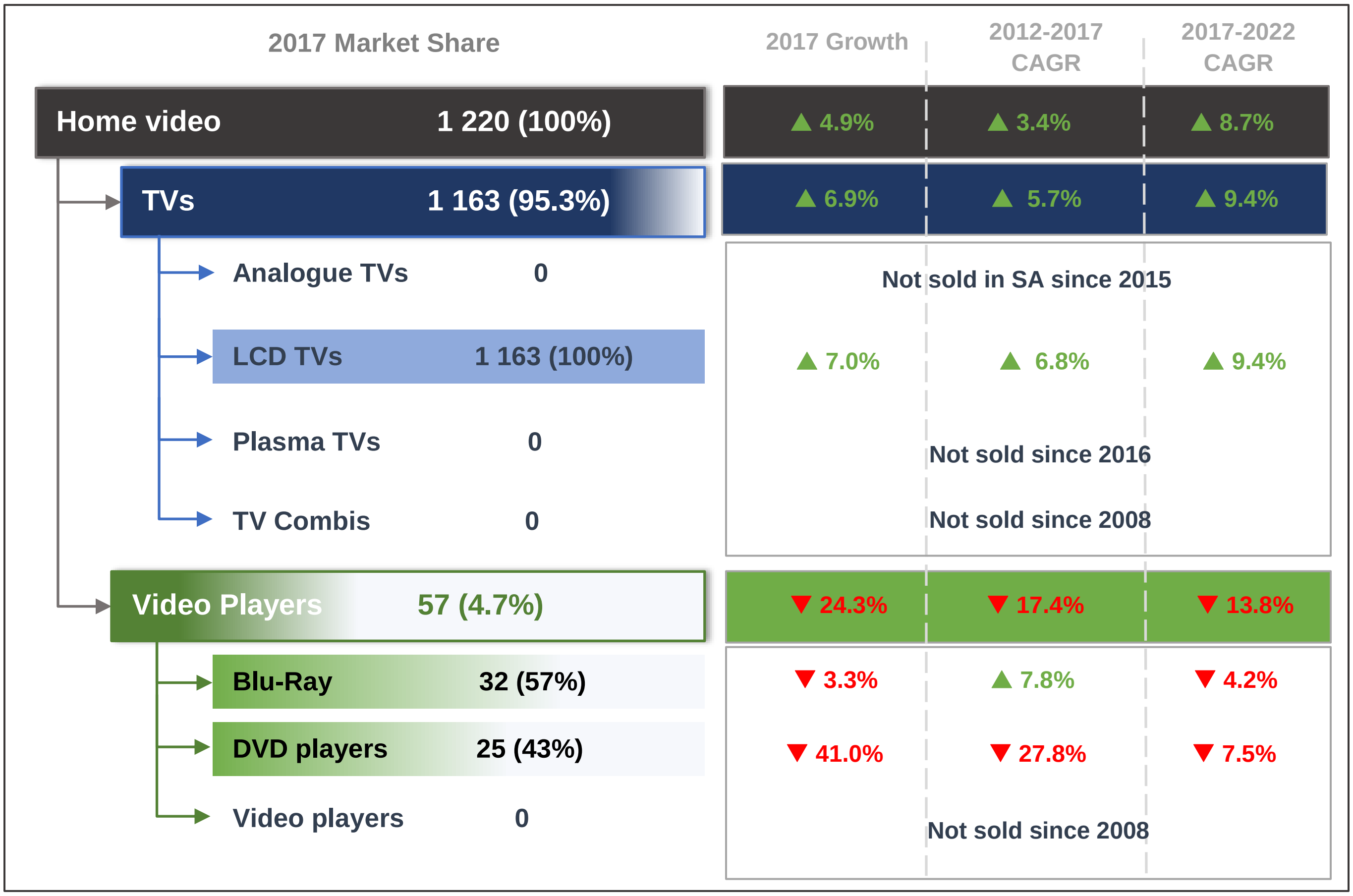


Figure 2-2: Sales of Home Video Equipment by category (Euromonitor, 2017b)

Industry analysis

Figure 2-3 displays an overview of the common brands in the industry home video equipment.

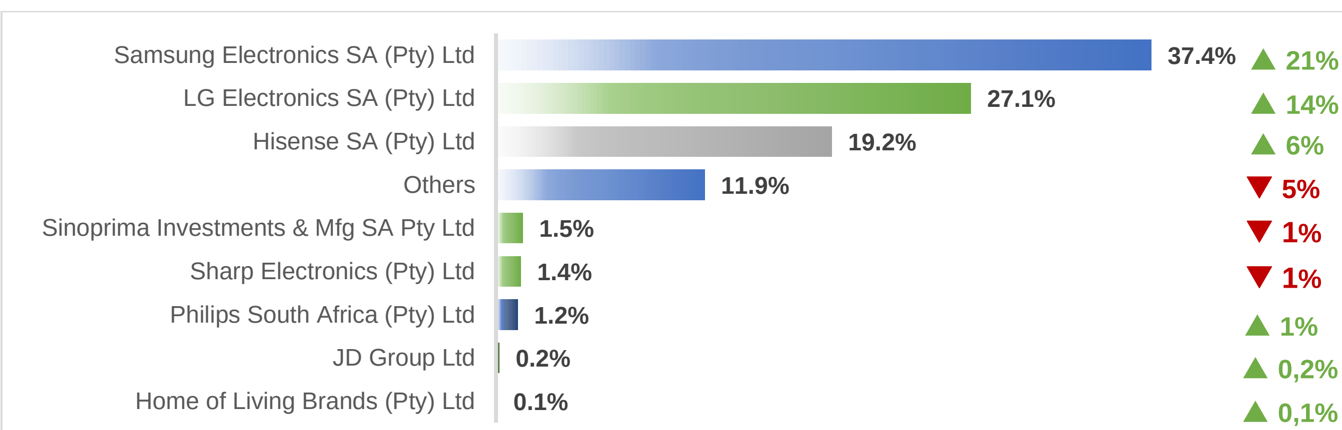


Figure 2-3: 2017 market shares of Home Video Equipment brand manufacturers and change in market share between 2008 and 2017 (Euromonitor, 2017b)

Since 2008, a number of home video products' brands disappeared from the shelves. These included, Amalgamated Appliance Holdings Ltd, Hyundai Group, Nu-World Industries, Sanyo, and Sony (Euromonitor, 2017b). This resulted in the market being dominated by three global brands - Samsung, LG and Hisense. Altogether, these three top brands, doubled their market share between 2008 and 2017 from 41.3% to 83.7% in 2017 (Euromonitor, 2017b). About 88% of the total units sold are distributed by Non-grocery specialists, with just over 83% sold by Electronics and Appliance Specialist Retailers (Euromonitor, 2017b).

Table 2-1 shows the distribution of LCD TVs by standby power mode. It is important to note that distribution is limited to the popular models included in the database for the study, which does have some gaps as some of the brand manufacturers did not display power consumption details on the advertising platforms sourced.

Table 2-1: Distribution of LCD TVs by standby power modes

Standby mode	Number of models (LCD TVs)	Brands	% Breakdown
0.3 W	3	Panasonic, Sharp	5 %
0.45 W	1	Sharp	2 %
0.5 W	40	Samsung, LG, Telefunken, Sinotec, HiSense, Philips, Panasonic, Skyworth,Sansui	66 %
0.6 W	1	Sharp	2 %
1.0 W	16	HiSense, Blaupunkt	26 %

(Compiled excel database by Urban-Econ)

It is evident that most of the TV models (about two-thirds) that are currently sold in South Africa have a standby power that does not exceed 0.5 W. This means that in the majority cases, the video equipment purchased by households is already far below the regulated level of 1.0 W. Having said this, there is still a relatively substantial number of TVs that are designed not to exceed 1.0 W (in standby mode); most of these TVs are sold by Hisense and Blaupunkt. Further, majority of the TVs that do not exceed 1.0 W in standby mode are manufactured/assembled locally by Hisense – having one-fifth of the market share of LCD TVs in South Africa (Euromonitor, 2017b).

2.3 MEPS opportunities

Many countries around the world have requirements for standby power that cover a range of equipment. One of the most comprehensive requirements for standby power is set out in Europe under *Commission Regulation (EC) No 1275/2008*, which was later amended by *Commission Regulation (EU) No 801/2013*. Under this regulation, standby power levels are set for four main categories of products:

- Household appliances (14 types nominated)
- Information technology equipment used in the domestic environment
- Consumer equipment (primarily audio and visual equipment)
- Toys, leisure and sports equipment.

The European standby requirements are currently:

- Power consumption in "off mode" shall not exceed 0.5 W.

- The power consumption of equipment in any condition providing only a reactivation function, or providing only a reactivation function and a mere indication of enabled reactivation function, shall not exceed 0.5 W.
- The power consumption of equipment in any condition providing only information or status display, or providing only a combination of reactivation function and information or status display shall not exceed 1.0 W.
- Equipment shall have an appropriate low power mode for use when the main function is not required
- Equipment shall have a power management function that reverts to a low power mode when the main function is complete.

Some later product-specific **EcoDesign regulations** included standby considerations. For example, the 2009 television EcoDesign directive superseded the horizontal standby requirements; whilst the washing machine and tumble dryer EcoDesign included standby within an overall annual energy efficiency calculation.

Energy Star is also a major international endorsement labelling programme that sets requirements for many types of office equipment and home entertainment equipment. Standby levels for many types of equipment are around 1 W, but this depends on functionality and type. California sets standby limits at 2 W for most audio and video equipment. China sets standby limits for a wide range of products and these are mostly at around 1 W. Korea set standby limits for a very wide range of electronic products with limits generally at around 1 W. Japan also have industry specified targets for many types of equipment, typically at around 1 W.

Many countries integrate low power mode energy consumption into their total energy consumption estimates, rather than having separate requirements for low power modes. This is commonly done in Europe, North America, Japan and Australia. This approach is discussed more in recommendations.

As the number of products with network connections is increasing, it is becoming harder to set firm standby power limits for many products, such as computers and network equipment, as there are varying degrees of functionality that have to remain active, even during periods of low demand. In recognition of this, Europe has introduced *Commission Regulation (EU) No 801/2013* to cover standby requirements for equipment with network functionality (as noted above this regulation amends *Commission Regulation (EC) No 1275/2008*, essentially widening the scope to include network equipment). Equipment with high network availability requirements is currently required to have a maximum power of 6 W in low power modes, while other equipment connected to a network is currently required to have a maximum power of 3 W in low power modes (this falls to 2 W in 2019).

2.4 Recommendations

There are two main policy approaches for dealing with standby power.

- The first is to set a limit on the measured power of a specified mode (generally off mode, standby mode or some other specified low power mode).
- The second approach is to measure low power mode energy and to include this into the total energy consumption for the appliance over a year.

It is also possible to apply both a limit to standby power and to include the low power mode energy into the declared annual energy consumption.

Considering South Africa's requirements for each of the product type regulated for energy consumption, the only gap lies in regulation of air conditioners. A recommendation to address this is included in the section on air conditioners.

Table 2-2: Current requirements in South Africa for low power modes for covered equipment

Product type	Limit on standby power	Low power energy included in annual energy
Air conditioner	🚫	🚫
Dishwashers	☑	🚫
Ovens	☑	🚫
Refrigerators and freezers	Not applicable	Not applicable
Tumble dryers	☑	☑
Combination washer-dryers	☑	🚫
Washing machines	☑	☑
Audio and video equipment	☑	🚫

Overall, though, standby requirements for South Africa are already at a level that is comparable to many other countries. Further tightening of the current requirements could be undertaken to match Europe (0.5 W), as the majority of the products are equal or below 0.5 W, citing the case with LCD TVs (see

Table 2-1). However, this is not likely to save a lot of energy as many products are already well below the 1 W requirement. Further analysis should be undertaken, and consultations with the manufacturers to assess the costs and benefits of lowering the requirement to 0.5 W. Note that Europe is considering lowering the horizontal standby requirement down to 0.3 W for many types of products.

The only existing requirements that may need to be revisited is that for set top boxes, as it is relatively weak in South Africa. **It is recommended that the requirements for simple set top boxes be aligned with Commission Regulation (EC) No 107/2009 in South Africa by 2020**. These requirements are set out in Table 2-3.

Table 2-3: Current simple top box requirements in Europe proposed for South Africa

Product and function where present	Standby mode	Active mode
Simple set top box	0.5 W	5.0 W
+ adder for display function	0.5 W	-
+ adder for hard disk	-	6.0 W
+ adder for second tuner	-	1.0 W
+ adder for decoding HD signals	-	1.0 W

Notes: All STB shall have a standby mode. All STB shall automatically power down from active mode to standby mode after three hours (with conditions).

Further consideration should be given to expanding the scope of standby power limits to a wider range of products (for example instantaneous gas water heaters; microwaves; toasters; grinders, coffee machines and equipment for opening or sealing containers for packages; electric knives; appliances for hair cutting, tooth brushing, shaving, massage and other body care appliances; scales; electric trains or car racing sets; hand-held video game consoles; and sports equipment with electric or electronic components) creating a quasi-horizontal requirement across a wider range of products, such as that specified in Europe. This is easy for products that are already regulated for energy but could be administratively difficult for products that currently have no energy requirements.

a) **Lower the current standby power level to 0.5 W by 2020**
b) **Expand the scope of standby power limits to a wider range of products**
c) **Align requirements for standby power for simple set boxes with Europe by 2020**

At this stage **no recommendations are made regarding the adoption of network standby requirements**. A watching brief on requirements in Europe and elsewhere should be maintained. A review of Regulation (EC) 1275/2008 was undertaken in 2017 and the Commission is considering a number of possible changes[5].

[5] see http://ecostandbyreview.eu/ .

3 LAUNDRY APPLIANCES: WASHING MACHINE

3.1 Context and background

Item	Comment	
Applicable standards and regulations	EE standard	• SANS 941
	Regulation	• VC 9008: ○ Washing machines shall comply with SANS 941 ○ Washing machines shall have a minimum energy efficiency rating of Class A.
	Performance measurement standard	• SANS 1695:2016/EN 60456: 2011: Clothes washing machines for household use – Methods for measuring the performance
Items regulated	• Household clothes automatic washing machines	
MEPS level	• Class A	
Test method used	• SANS 941 references *SANS 1695/EN 60456, Clothes washing machines for household use – Methods for measuring the performance* as the official test method for washing machines. Clause 4.2.9 states: *Household clothes washing machines shall comply with the energy and water consumption requirements in SANS 1695, and washing machines shall carry an energy efficiency label designed in accordance with the national annex on energy labels in SANS 1695*. Unlike for some other products, the bibliography of SANS 941 does not mention any European directive for washing machines. • SANS 1695 states that: *This national standard is the identical adoption of EN 60456:2011 (edition 2), but with the addition of an informative national annex AA on the energy labelling of washing machines. The label design and the technical information required for the calculation of energy classes were obtained from European Directive 1061/2010.*	

Origins of the performance measurement standard

SANS 1695 is an identical adoption of EN 60456:2011 (Edition 2). This standard is based on IEC 60456 (Edition 5 published in 2010) but with some significant modifications around the definition of half loads. These common modifications to the IEC standard are listed as Annex Z in the EN standard and are shown in red text.

While there are many small variations from IEC60456 in the EN standard, the main difference is the definition of half loads and the specification of loading and wash temperatures as follows:

- 3 runs at rated capacity for cotton 60°C
- 2 runs at half capacity for cotton 60°C
- 2 runs at half capacity for cotton 40°C.

Together, these runs are equivalent to a series of 5 runs at rated capacity under the test series in IEC 60456. There are also modifications to the measurement of low power mode in the EN common modifications.

EEI calculation methodology

To calculate the Energy Efficiency Index (EEI), the energy consumption of the test washing machine is compared to a reference line called the Standard Annual Energy Consumption (SAEc), which is defined as $51.7 + c \times 47$ where c is the rated capacity in kg. The annual energy consumption of the washing machine assumes 220 cycles per year (in the ratio of loads and wash temperatures defined above) plus low power mode energy for the remainder of the time. The EEI break points for labelling classes in SANS 1695 are identical to those in *European Directive 1061/2010* (labelling).

SANS 1695 also specifies a minimum washing performance level for clothes washers, which is based on *European Commission Regulation (EU) No 1015/2010* (EcoDesign). However, SANS 1695 does not set water consumption limits for washing machines that are included in the European EcoDesign requirements (SANS 941 does state that water consumption limits are defined). The spin-drying efficiency classes in SANS 1695 and *European Directive 1061/2010* (labelling) are identical. *European Commission Regulation (EU) No 1015/2010* (EcoDesign) mandates that a cold 20°C wash program must be present – this is not included in SANS 1695.

Current MEPS level

During the original investigation (FRIDGE, 2012) into the applicable and desired MEPS levels, the following arguments were made to recommend the above-mentioned MEPS:

- At the time of the study, the market for automatic washing machines was exclusively dominated by imports. This was validated by engagements with the major manufacturers and distributors who supplied a substantial amount (at least 80%) of washing machines to the local market.
- It was more convenient for the importers to agree to an energy rating prevalent with the common models they supplied to the local market. Coincidentally, the average energy class (baseline) was equivalent to the recommended energy rating (Class 'A'), and hence the ease of adoption.

3.2 Market description and composition

Market description

Based on the NRCS Approved LOA database, it was established that there are at least 126 brands[6] and 148 models (bigEE, 2015) in the market for washing machines. The front loader type with relatively smaller drum sizes have by far more model ranges than the medium and large clothes washers.

Market composition

Approximately 475 600 automatic washing machines were sold in 2017, generating a revenue of around R2.9 billion in the laundry equipment market (Euromonitor, 2017a). Despite an increment of sales volumes by 18.7% from 2012 (Euromonitor, 2017a), automatic washing machines are still perceived as non-essential items to the lower-income and some middle-income households (bigEE, 2015), given the penetration rate of below 50% (Euromonitor, 2017a). Free-standing washers generated about 93% of the revenue of the automated washers, with built-in washers making up the balance. With a compounded

[6] http://www.nrcs.org.za/content.asp?subID=68#1

annual growth rate of 5.3%, it is anticipated that sales of automatic washers will increase to 616 800 units in 2022 (Euromonitor, 2017a).

About 475 000 automatic washing machines sold in SA per annum with a ratio of 2:7 imported versus locally manufactured

Table 3-1 shows the distribution of the stock of washers between locally produced and imported units. About 78% of the stock of automatic washing machines in the domestic market are manufactured/assembled locally (Euromonitor, 2017a). According to the earlier report (FRIDGE, 2012), an excise duty of 30% was imposed on washing machines with a drum size 7 to 13 kg. The intention was to make it more cost effective to manufacture bigger models locally. Importers complained and claimed that their "higher quality" products became uncompetitive in the local market due to the high tariff – as they could not match the prices set by the local manufacturers. On the other hand, local manufactures argued that by setting a range, which the import duty was applied to, the objective of the import duty was compromised, as there was poor monitoring by the tax authorities. For example, importing a 13 kg washing machine and declaring it as 13.2 kg in size to qualify for exemption. Additionally, the earlier study argued that local manufacturing reduced significantly, as it was more profitable for Defy to import and pay the excise duty. However, based on the information gathered by Euromonitor - it appears that **local manufacturing activities, which also involve assembly, of automatic washing machines, still makes up the majority of the market in South Africa, as indicated below.**

Table 3-1: Distribution between imports and locally manufactured Automatic Washing Machines - 2017

Appliance	Estimated annual inventory		Total units sold p.a.	Estimated value of the market (ZAR million)
	Imports	Locally manufactured/ assembled		
Automatic Washing machine	126 300	443 100	475 600	2 861.8

(Euromonitor, 2017a)

Figure 3-1 shows the sales of automatic washing machines in the domestic market as per common configuration and size. The front-loading format constituted about two-thirds of the sales, with those of a capacity ranging between 6kg - 9.9kg accounting for 90% (426 700 units) of the sales volumes (Euromonitor, 2017a).The dominance in sales is alluded by the fact that popular type and size requires less space, can fit in modern kitchens, and hence is more preferred specifically by young and high-income users living in flats and apartments (Euromonitor, 2017a). Prices of these dominant washing machines vary depending on the manufacturer, size, technology, number of programmes, aesthetics, and to some extent energy classes.

Most popular washing machine type in SA:

- Front loader
- 6-10kg

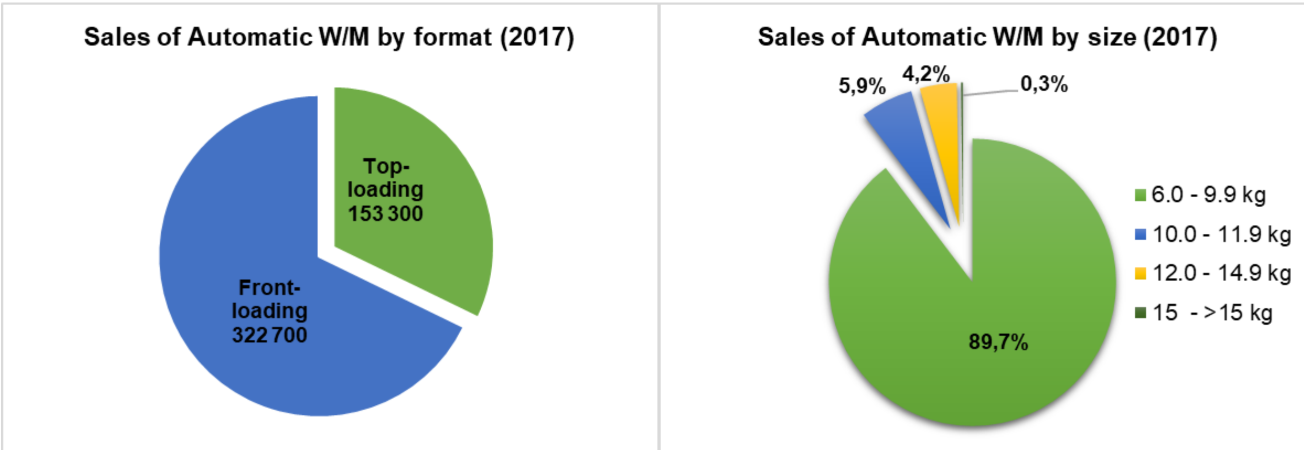


Figure 3-1: Sales of Automatic Washing Machine by format and size (Euromonitor, 2017a)

Figure 3-2 shows prices of the popular sold models of the leading manufacturers. First, it has been established that the popular model range adheres to, or is even better than the current MEPS level. Secondly, washing machines of bigger capacity cost slightly more than the smaller counterparts, regardless of the energy rating.

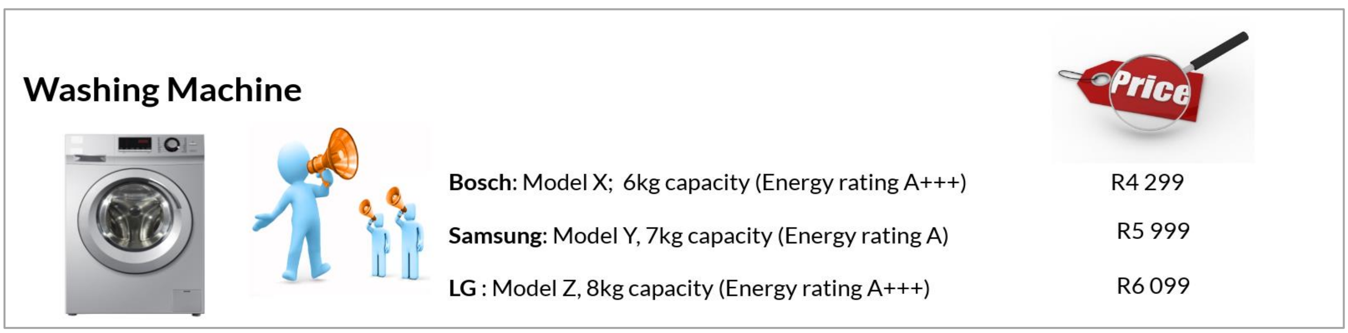


Figure 3-2: Average Prices for Automatic Washing Machines by Major Retailers (Euromonitor, 2017a)

3.3 Industry analysis

Figure 3-3 illustrates the market shares of the respective brands. LG, BSH group and Samsung have gained more of the market share in the manufacturing and distribution of automatic washing machines, at the expense of Defy Appliances (Euromonitor, 2017a). Defy is still the leading brand in the market, albeit having a marginal edge over LG. Similarly, the BSH group appear to be a close competitor of Samsung, as they seemingly have nearly equal market shares. The least segment is catered for with washing machines manufactured by Electrolux and other brands.

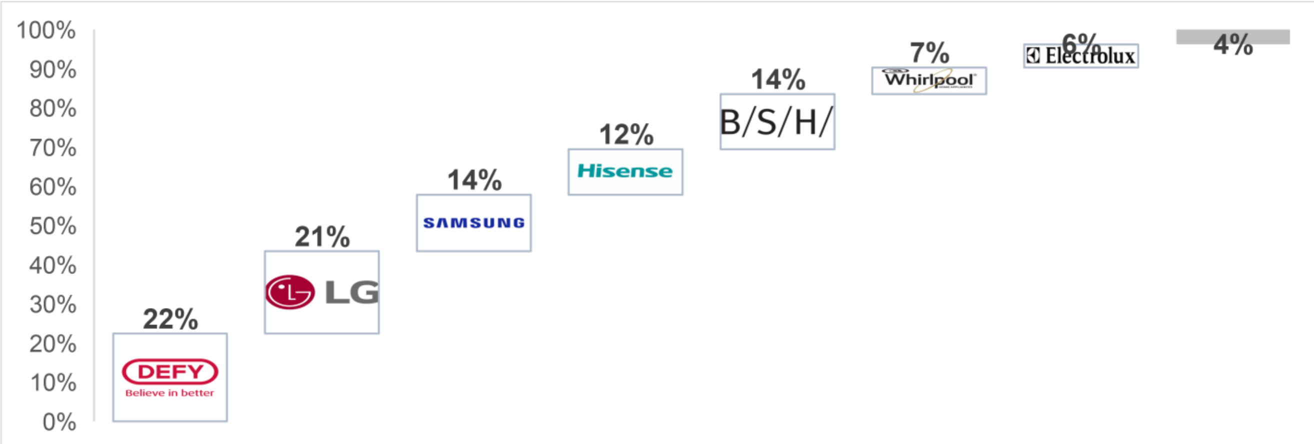


Figure 3-3: Market shares of Automatic Washing Machines manufacturers (Euromonitor, 2017a)

3.4 Usage and application

Usage and applications

Collectively, the stock of washing machines operated by households (in 2016) in South Africa amounted to about 7.5 million, with 5.37 million of these being automatic machines (AMPS, 2010-2016). Figure 3-4 illustrates the historical and projected stock of automatic washing machines. The trend suggests that 5.71 million automatic washing machines were used in 2017, with projections of 14.2 million units to be utilised by households by 2032.

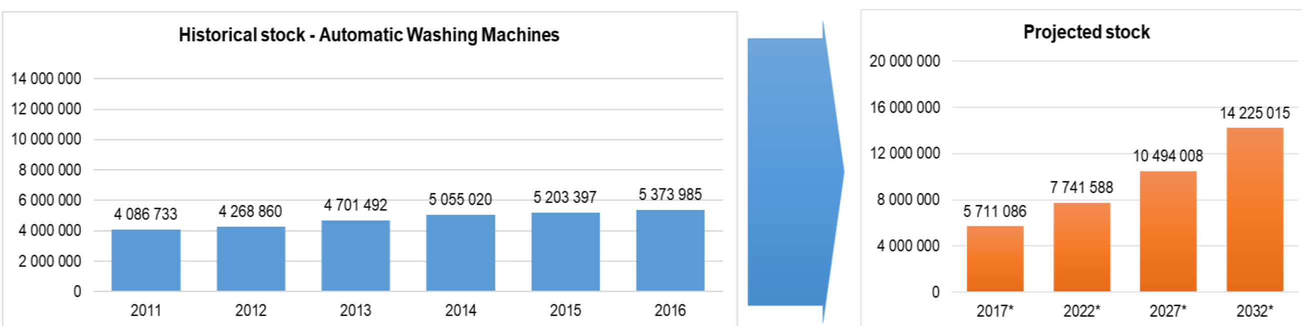


Figure 3-4: Historical and Projected stock – Automatic Washing Machines (Own analysis based on AMPS (2010 – 2016))

Figure 3-5 depicts stock of automatic and semi-automatic machines (twin-tub) across LSMs in 2016. Although the twin-tubs machines do not fall under the current S&L programme (FRIDGE, 2012), they have been included in this presentation to indicate the dynamics in the market of washing machines and choices made by households. It is evident that most of twin-tubs are owned by the middle-income to low-end users, with relatively fewer units owned by high-end users. Middle to high-income households owned many of the top-loading machines. Conversely, high-income households tend to substitute top-loading machines with the front-loading loading format.

LSM 6, 7 and 9 have shown the greatest absolute growth in ownership of automatic washing machines since 2011

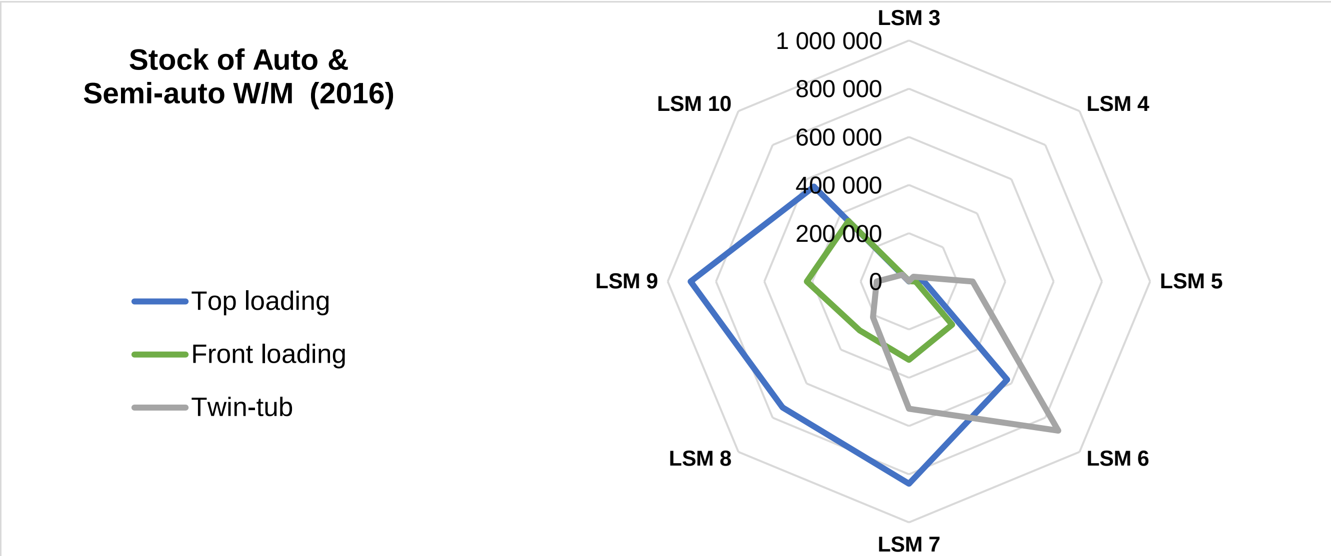


Figure 3-5: Stock of Automatic and Semi-Automatic Washing Machines (Own analysis based on AMPS (2010 – 2016))

Figure 3-6 shows the distribution of automatic washing machines (only) across the users. As suggested earlier (refer to Figure 3-5), much of the stock of automatic washing machines are operated by LSM 7 – 10 households. However, the greatest increases in stock (2011 to 2016) have been observed among LSM 9, followed by LSM 7 and LSM 6. Interestingly, households in LSM 4 – 6 groups have grown in operating more automatic washers at a faster rate (an average compounded annual growth rate of 20% per annum, although from a very low base) than the other income groups, since 2011.

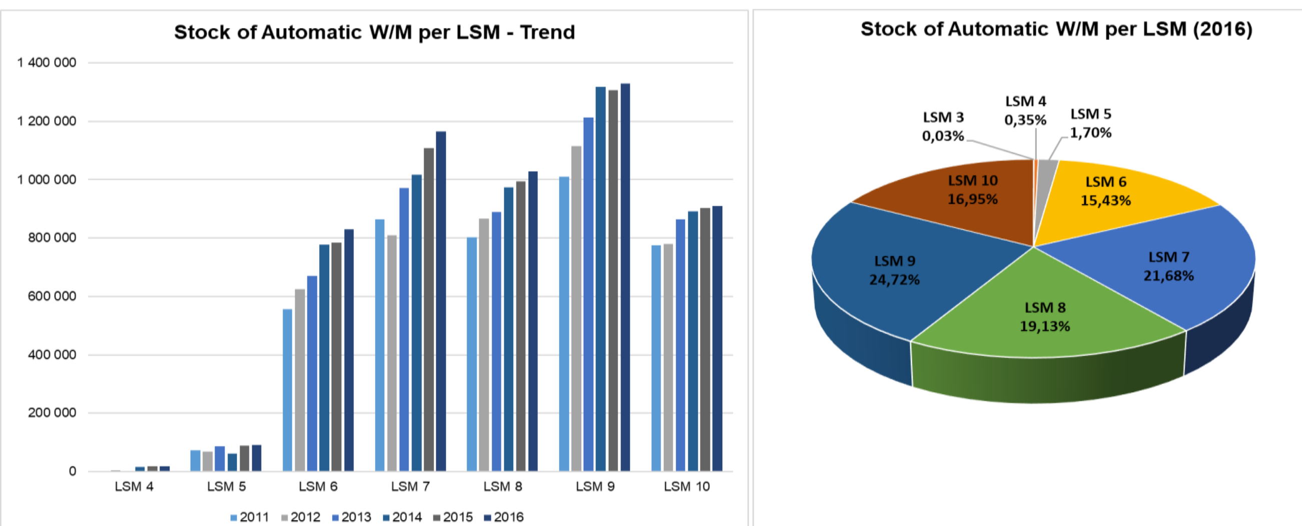


Figure 3-6: Distribution of stock - Automatic Washing Machines (Own analysis based on AMPS (2010 – 2016)

On average, the stock of automatic washers is expected to increase at a compounded annual rate of 6.3% across all LSMs. Lower growth rates in usage are anticipated among the high-income groups as compared to the low-income counterparts.

3.5 MEPS opportunities

The *European Commission Regulation (EU) No 1015/2010* (**EcoDesign**) sets the MEPS level for washing machines at an EEI < 68 from 1 December 2011, which is equivalent to Class A under energy labelling. This MEPS level was increased to an EEI of < 59 on 1 December 2013 for all machines with a rated capacity of 4kg or more, which is equivalent to Class A+.

There are over 20 countries in addition to Europe (which includes 28 countries) that currently set MEPS for washing machines. The majority of the countries outside of Europe (28) are using the European requirements as a template for their local regulations, including Eastern Europe, North Africa, several countries in South America and China. Requirements for Canada, USA and Mexico are quite different, in that North America focuses on top loading machines and the test method does not measure the washing performance. North American energy is determined by a simple average of all wash temperature options, so is not comparable to European requirements.

CLASP undertook a major international comparison of MEPS levels for various countries in 2014 (The Policy Partners 2014). For washing machines, this comparison showed that **Europe had the most stringent MEPS levels globally**, but the differences were not so large when compared to China and North America. Note that many countries have energy labelling for washing machines, but do not have MEPS (e.g. Australia and Japan). This brief analysis confirmed that European MEPS are the most stringent in force at this time.

Analysis by TopTen in Europe has shown that the share of high rating washers has been increasing in recent years. In 2013, 32% of sales in Europe were A+, 22% were A++ and 22% were A+++ (this is just prior to MEPS of A+ coming into force in Europe). A recent conference paper showed that the market share of A+ in 2015 had fallen to 21%, with A++ at 21% and A+++ at 55% (Michel, Bush & Attalie 2017). TopTen in Europe list more than 30 models with an energy labelling Class of A+++ and an EEI of < 46. Useful background on washing machines is given in a TopTen document[7].

3.6 Recommendations

a) **Retain the current Class A for the next few years**
b) **Consider increasing MEPS for automatic washing machines to Class A+ by 2022**

MEPS levels in South Africa are currently set at Class A, which aligns with the original MEPS set in Europe under EcoDesign in late 2011. This SA's MEPS level is comparable to the most stringent level in countries that have MEPS for washing machines.

In 2013, Europe upgraded MEPS to Class A+. and although, the current MEPS level in South Africa is certainly reasonable in terms of an international benchmark, **some consideration could be given to increasing the MEPS level to Class A+ to align with current European requirements by 2022** (this would represent a nine-year delay on European levels).

[7] http://www.topten.eu/uploads/File/Topten_recommendations_Washing_machines.pdf

There are certainly many different models now available that are able to attain this efficiency level (Class A+ or better) – nominally all models in Europe. However, the efficiency gains from such an increase are somewhat modest as Class A represents an EEI of 68 and Class A+ represents an EEI of 59, a saving of about 13%. While this is a worthwhile saving to achieve on paper, there are some questions about how such savings would translate to actual energy savings in South Africa. SAN 1695 assumes certain usage patterns (220 loads per year), specific loading patterns (3 full loads and 4 half loads), and specific wash temperatures (mainly 60°C, some 40°C). If lower wash temperatures and smaller loads during normal use are prevalent in South Africa (compared to the assumptions in SANS 1695), then the absolute energy savings may be smaller than the energy label would suggest (relative savings are probably reasonable).

On the basis that the current labelling requirements in South Africa also apply to vertical axis machines (top loading), it is unclear whether an increase in MEPS to Class A+ would leave any models on the market (as vertical axis machines currently make up the majority of the market). As a technology, vertical axis machines are inherently less efficient than drum machines (front loading). This could severely limit consumer choice with respect to type of washers available while only delivering modest and somewhat uncertain additional energy savings. On this basis, **it is recommended that current MEPS levels be retained at Class A**, unless there is reasonable consensus across manufacturers and suppliers about increasing MEPS to Class A+ in order to align with Europe.

Note: A new labelling framework directive was issued in 2017 (Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU). This sets out a process for re-grading all energy labels in Europe back to the original A to G classes and it also sets out a process for review and re-grading in the future. This may have some impact in South Africa, so developments in Europe should be monitored.

4 LAUNDRY APPLIANCES: TUMBLE DRYERS

4.1 Context and background

Item	Comment	
Applicable standards and regulations	EE standard	• SANS 941
	Regulation	• VC 9008: ○ Tumble-dryers shall comply with SANS 941 ○ Tumble-dryers shall have a minimum energy efficiency rating of Class D
	Performance measurement standard	• SANS 61121:2015/ IEC 61121:2012: Tumble dryers for household use – Methods for measuring the Performance
Items regulated	• Tumble dryers for household use	
MEPS level	• Class D	
Test method used	• SANS 941 references *SANS 61121/IEC 61121, Tumble dryers for household use – Methods for measuring the performance* as the official test method for tumble dryers. Clause 4.2.7 states: *Household tumble dryers shall comply with the requirements for energy consumption in SANS 61121, and tumble dryers shall carry an energy efficiency label designed in accordance with the national annex on energy labels in SANS 61121.* • The bibliography of SANS 941 mentions *Commission Delegated Regulation (EU) No 392/2012 of 1 March 2012 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household tumble driers* – this is the latest regulation in Europe. • SANS 61121 states: *The label design and the technical information required for the calculation of energy classes were obtained from European Directive 392/2012*.	

Origins of the performance measurement standard

SANS 61121 is an identical adoption of IEC 61121:2012 (Edition 4). The approach used for tumble dryers is different to washing machines in that the IEC standard is used as the base standard and the European (EN) requirements are drawn in through National Annex AA, which states that to determine the energy consumption, modifications to IEC 61121 as given in SANS 1704/EN 61121 should be applied. **These modifications are not included in SANS 61121**. The European modifications primarily focus on defining half loads and the testing sequence in a test series as follows:

- 3 runs at full load
- 2 runs at half load (Part A)
- 2 runs at half load (Part B).

Similar modifications to the measurement of low power modes as per the washing machine standard SANS 1695 are also included in the EN modifications.

National Annex BB of SANS 61121 covers the energy labelling requirements for South Africa. The requirements are essentially identical to the energy labelling requirements in *Commission Delegated*

Regulation (EU) No 392/2012 (energy labelling), except that condensation efficiency is not required on the label. The EEI label energy efficiency class levels are the same as that for Europe.

EEI calculation methodology

A standard annual energy consumption (reference EEI = 100) is calculated as $140 \times c^{0.8}$, where c is the rated capacity in kg. An additional modifier for vented driers is included in the equation for standard annual energy consumption. The measured energy consumption for the model in accordance with the standard assumes a total of 160 loads dried per year (in the ratio of 3 at rated capacity and 4 at half load) plus low power energy added for the time when the appliance is not in use. Only label classes from D to A+++ are defined for the energy label.

Current MEPS level

At the time of the initial investigation into MEPS in 2012, the market for tumble dryers was saturated by units locally produced, with Class 'D' being the average energy rating (FRIDGE, 2012). Conversely, the average rating for imported tumble dryers (which was a relatively small proportion of the supply to the local market) was Class 'C'. It was in the interest of safe guarding the local industry to recommend a MEPS level of Class 'C', although Class 'D' was adopted as the new MEPS level. This energy rating applies to all tumble dryers for domestic use.

4.2 Market description and composition

Market description

Consumers have options to purchase from at least 41 models (bigEE, 2015) , from the 21 brands[8] available in this niche market of laundry appliances.

Market composition

About 82 100 tumble dryers were sold in the local market in 2017, generating R624 million in revenue in the laundry equipment category (Euromonitor, 2017a). This reflects a decrease in sales volume by 4.1%, when compared to the units sold in 2012. Although positive, but having a very low CAGR of 0.5%, it is forecasted that 84 000 tumble dryers will be sold in 2022. The low CAGR coupled with the penetration rate of 9% shows that this appliance is regarded by the potential users in the local market as a secondary necessity among the laundry equipment (Euromonitor, 2017a).

Tumble dryers are secondary to washing machines - for every tumble dryer purchased, there are six (6) washing machines sold.

The market for tumble dryers is still dominated by local manufacturers. Only 3.3% of the annual stock supplied is imported (as illustrated in Table 4-1 below). The local manufacturers have maintained their market share due to the high tariff rate on imports (relative to washing machines and washer-dryer combinations), which made it more cost-effective to produce locally than importing (FRIDGE, 2012).

[8] http://www.nrcs.org.za/content.asp?subID=68#1

Table 4-1: Distribution between imports and locally manufactured Tumble dryers - 2017

Appliance	Estimated annual inventory		Total units sold p.a.	Estimated value of the market (ZAR million)
	Imports	Locally manufactured or assembled		
Tumble dryer	3 600	104 900	82 100	624.1

(Euromonitor, 2017a)

The prices of the commonly supplied dryers from the chief manufacturers are given below. It is important to note that the new and most popular models adhere to the MEPS level ('D' or better). It appears that **air vented tumble dryers cost less than the models that use a condenser**. Further, imported models and dryers of a larger capacity cost more than the smaller and locally produced units.

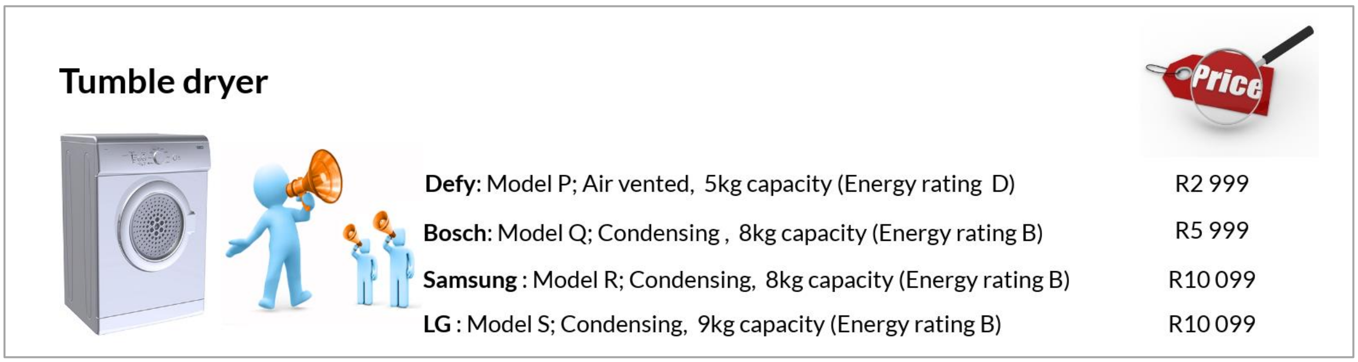


Figure 4-1: Average Prices for Tumble Dryers by major Retailers (Euromonitor, 2017a)

4.3 Industry analysis

As shown in Figure 4-2, Defy has proved to be the leading brand in this sub-category of laundry appliances, selling about 58 000 units in 2017 (Euromonitor, 2017a). It is estimated that about 3 out of 10 tumble dryers available in the market have a different brand other than Defy. Samsung and LG strive to have better competitive edge over each other (selling 3 800 and 3 700 units in 2017, respectively), as was the case with Samsung and BSH group in the market for washing machines.

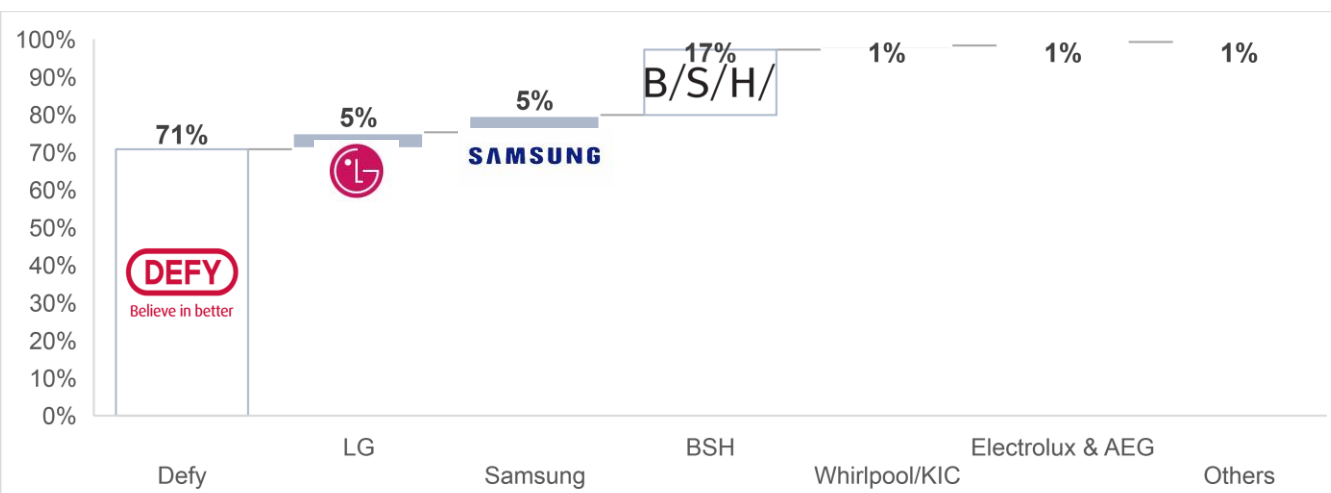


Figure 4-2: Market shares of Tumble dryer manufacturers (Euromonitor, 2017a)

4.4 Usage, application and energy consumption

Usage and applications

Households' usage of tumble dryers declined from 1.25 million (in 2010) to about 1.13 million units owned in 2016 (as shown in Figure 4-3). Based on the existing information, it is predicted that the stock of tumble dryers further declined to 1.12 million at the end of 2017 and this trend is expected to continue with only 887 000 units being used by 2032. The downward trend for the demand of dryers is attributable to the increasing popularity of washer-dryer combos, which perform the dual function of washing and drying while taking less space (Euromonitor, 2017a).

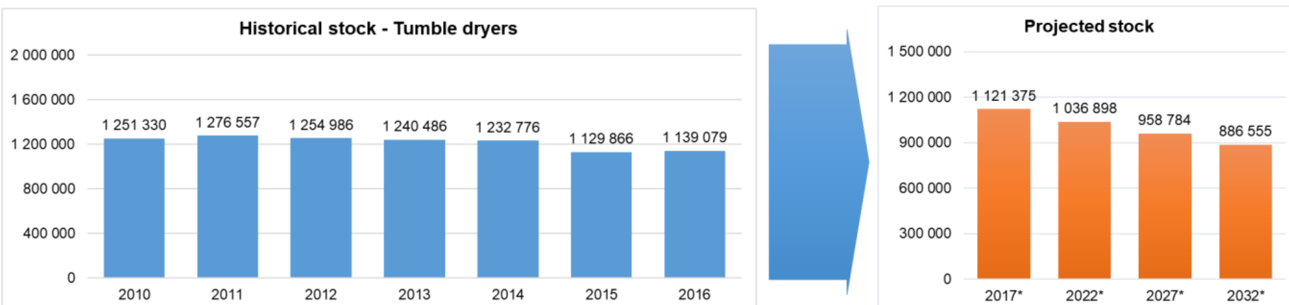


Figure 4-3: Historical and Projected stock - Tumble Dryers (Own analysis based on AMPS (2010 – 2016))

Figure 4-4 shows distribution of stock of dryers across the main users. It's evident that the **high-end consumers (LSM 9 – 10) own the majority of dryers** as compared to the other users. Except for households in LSM 10, stock of dryers per LSM has deteriorated over the past few years, and as mentioned above, **the stock of this laundry appliance is expected to decay in the future** at a rate of 1.6% per annum. However, the number of units are expected to grow especially from the top-income households (LSM 10), having an estimated annual growth rate of 71 basis points per annum. Part of the reasons are that LSM 10 households can afford a separate energy efficient tumble dryer in addition to an existing well-functioning washing machine and are not limited by space constraints if there is no need to replace the latter with a washer-dryer combination.

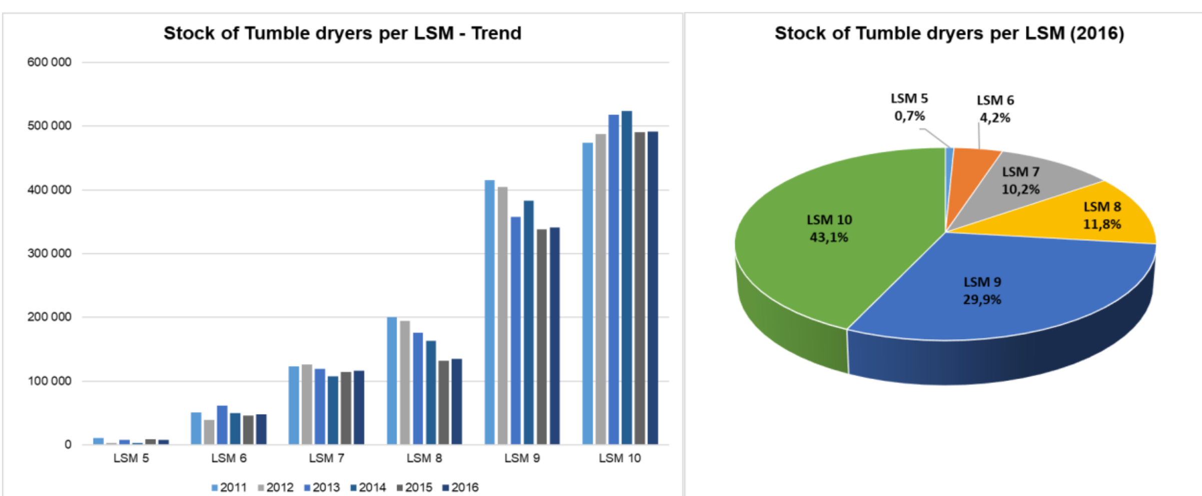


Figure 4-4: Distribution of stock - Tumble Dryers (AMPS, 2010-2016)

It is important to note though, that the uptake of tumble dryers in the Northern hemisphere – the US and Europe - is completely opposite of that in South Africa, which could be partially explained by the favorable climate conditions for outside cloth drying experienced throughout South Africa.

Energy consumption levels

The average annual consumption of a tumble dryer, based on the review of the Class D models available in the shops, is around 754 kWh, which is about 100kWh lower than that reported in bigEE report in 2015 (bigEE, 2015). This is likely explained by the fact that at the time of the bigEE study in 2015, the majority of tumble dryers did not conform to the MEPS levels and therefore included less energy efficient appliances.

Given that around 1.1 million units were in use in 2017 (see Figure 4-3), and assuming that the majority of tumble dryers are of older less energy efficient models, it is estimated that the current stock of tumble dryers in use yields a total annual electricity consumption of about 0.95 TWh (945 GWh).

Table 4-2: Tumble dryers – stock and electricity consumption

Appliance	Average weekly consumption (kWh)	Number of appliances (estimated for 2017)	Total electricity consumption per annum (GWh)
Tumble dryers	16.1	1 121 375	945

4.5 MEPS opportunities

The *Commission Regulation (EU) No 932/2012* (**EcoDesign**) specifies a maximum permitted EEI for dryers of 85 from 2013 (Class C or better) and a maximum permitted EEI for dryers of 76 from 2015 (Class B or better). It is worth noting that **the improvements in EEI for tumble dryers from Class C to Class B were made within two years from the introduction of Class C requirements**.

The previous energy labelling scheme for dryers in Europe was based on a simple kWh/kg load dried, so this had some size bias (smaller appliances tended to get a lower rating for the same technical efficiency). As a result, there was a tendency for suppliers to increase capacity to achieve better ratings. Also, larger capacity is perceived as better by consumers and they are prepared to pay more, even if they don't use this capacity. The new labelling algorithm reduces the previous size bias to some extent by having a reference line that is based on the capacity to the power of 0.8.

Traditionally, tumble dryers used resistive heating elements to heat air, which was blown through the wet clothes load to dry load items as the drum tumbled the clothes to promote mixing and air flow. While there were nominally some differences in energy efficiency across tumble dryer models, essentially the technology used was similar and the differences in energy consumption were generally small. Some efficiency improvements could be made by reducing heater power (which increases program time), improving hole spacing in the drum to increase air flow and periodically reversing of the drum rotation, to better mix and aerate the load. Some small savings were also possible though improved motors used for rotating the drum and fans. However, the achievable energy savings were of the order of 10% between models. A number of other technologies were investigated, like microwave drying, but generally these did not make it to market. Another common categorisation for dryers is condensing type versus vented type. These types effectively have the same energy efficiency where resistance heating is used.

In around 1997, a tumble dryer using a heat pump as a heat source was invented. While this type of product has been nominally available on the market since 2000, very few units were sold due to their extremely high cost. Since about 2009, a range of manufacturers have been developing heat pump dryers and these types have been making inroads into the market in Europe and elsewhere. The prices for these models have been falling dramatically due to increased market competition and achieved economies of scale enabled by the increased production volumes. The **energy consumption of heat pump dryers is substantially better than conventional resistance dryers**. Field trials in Australia showed measured energy savings of around 60% in homes where conventional dryers were replaced with heat pump dryers (Sustainability Victoria 2016).

The current label classes in Europe and South Africa can effectively be split into these two technologies: conventional resistance heating and heat pump.

- Conventional resistance heating dryers will always rate as Class D, C or B. Conventional dryers would be unlikely to ever achieve an EEI of less than around 70.
- In contrast, many heat pump dryers have an EEI of less than 32 (Class A++). TopTen report that in 2016 there were 57 models in Class A++ and 22 models in Class A+++. The best models on the market had an EEI of 23 (just Class A+++). This means that Class A and Class A+ (ranging from an EEI of 32 to 65) are mostly empty. While heat pump dryers use less than half the energy of a conventional resistance heating dryers, they are still quite expensive - typically around double the cost (or more) of a conventional resistance dryer. TopTen analysis has shown that simple total life-cycle costs are lower for high efficiency heat pump systems, but this is somewhat dependent on electricity tariffs and assumed usage levels (loading level and frequency of use). **Heavier users tend to have a more favourable outcome for heat pump dryers, whereas they are less cost effective for infrequent users**. However, as purchase costs fall, heat pump dryers will become cost-effective for a larger proportion of all users.

Globally, few countries outside of Europe set MEPS levels for dryers, apart from North America. CLASP undertook a major international comparison of MEPS levels for various countries in 2014 (The Policy Partners 2014). For tumble dryers, this comparison showed that the USA had the most stringent MEPS levels globally, but this was before the European 2015 MEPS levels were in force. The US test method is somewhat questionable, as small polyester-make weights are used in the test method and the drying behaviour for this material is likely to be somewhat different to a normal cotton load used in the IEC test. The differences between European and USA MEPS were not very large when these factors are taken into account. This brief analysis confirmed **that European MEPS are a sensible international benchmark for tumble dryers**.

Switzerland is currently the only country that has set a MEPS level that has effectively mandated the use of heat pump technology to meet the efficiency requirement (this means that conventional resistance heating dryers are effectively banned).

4.6 Impact analysis

In order to assess the implications of amending the MEPS level for tumble dryers, the following assumptions were made with respect to the most common models of dryers for each energy level:

Table 4-3: Tumble dryers assumptions

Characteristics	MELS level D	MEPS level C	MEPS level B
Size	5 kg	6-8 kg	7-9 kg
Energy usage per cycle	4.7125 kWh	-	4.7125 kWh
Annual electricity consumptions	754 kWh	635 kWh	567 kWh
Average prices	R3 249	R4 744	R8 899

As seen in the above table, the current prices for the more energy efficient tumble dryers are considerably higher than the dryers of the currently acceptable lowest MEPS level. Although it is likely that the prices of the dryers of higher energy efficiency than Class D will drop if the latter is banned from the market and therefore substituted for higher energy efficiency dryer, a quick assessment of the potential savings and payback period provides for some insight into the benefits that could be derived by the consumers and attractiveness of the specific class type.

Overall, Class C dryer offers a 16% savings on electricity usage on average, which equates to about R152 of savings on the utility bill per annum. Considering the current costs of the different tumble dryers and assuming a constant electricity tariff of 127.3 c/kWh, it will take a consumer about 10 years of electricity savings to pay for the more energy efficient dryer. The situation is quite bleak if Class D is compared to Class B, which suggests that the payback period will far exceed the life span of that appliance.

Table 4-4: Tumble dryers savings and costs calculation

Characteristics	MELS level D	MEPS level C	MEPS level B
Cost difference	-	R1 495	R5 650
Electricity savings – per annum	-	119 kWh	187 kWh
Electricity savings - %		16%	25%
Electricity savings – Rand value		R152	R 238
Change in cost vs savings payback period	-	10 years	24 years
Appliance lifespan	14 years	14 years	14 years

It should be born in mind that the popularity of this laundry appliance has been declining and the projected stock is expected to decrease in the future due to the perceived utility of the appliance. Considering that the target market for the tumble dryers has also consistently comprised of the higher income LSM groups, which are less sensitive to costs of the appliances than lower income groups, it could therefore be argued that increasing the MEPS level from Class D to Class C could have an insignificant impact on the demand particularly if the price of Class C dryers are to drop due to their uptake of the market share that was previously held by Class D dryers.

Having said this, while the increase in dryers' MEPS level to Class B would create notably greater savings in the utility bill for a household, it will also be considerably more expensive (it mainly uses condenser technology) making it less affordable for middle income household groups. Importantly, **the costs of a dryer of Class B level are closely approaching the costs of significantly more energy efficiency washer-dryer combination, which MEPS level is set to Class A**. Therefore, it could be argued that the increase in dryers' MEPS level to Class B could lead to the sharp deterioration of demand for this laundry appliance as a result of (a) unaffordability among middle income households and (b) substitution for washer-dryer combinations among higher income households.

From a national perspective, replacing the products with more energy efficient technologies without jeopardising the accessibility to these products by all income groups is the primary objective. Given that the jump from Class D to Class B is likely to negatively impact accessibility of this laundry appliance among the LSM 6-8 groups of households, with provision for no affordable alternative, it would be unwise to consider Class B at this stage. However, increasing the MEPS level to Class C should be considered. The following table provide five-year projection of the potential minimum electricity savings that the country could reap if the MEPS levels for tumble dryers were to change.

Table 4-5: tumble dryers – electricity savings over a five-year period

MEPS Level D	**Size considered**		**Average price**		**Estimated average annual electricity consumption**			
	5 kg		*R3249*		*754kWh*			
	Aggregated electricity consumption (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		61.828	61.828	61.979	62.431	63.26	63.336	374.66
MEPS Level C	**Size considered**		**Average price**		**Estimated average annual electricity consumption**			
	6-8 kg		R4744		634kWh			
	Aggregated electricity consumption (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		52.043	52.043	52.17	52.55	53.249	53.312	315.37
IMPACT ANALYSIS								
D to C	*Price difference*	*R/unit*	1495					
		%	46%					
	Electricity savings (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		9.785	9.785	9.809	9.881	10.012	10.024	59.2297

4.7 Recommendations

The current MEPS levels for tumble dryers in South Africa as set at Class D, the lowest available grade on the energy label. European MEPS were originally at Class C in 2013 and are now at Class B (since 2015). There would appear to be some merit in increasing the MEPS levels in South Africa to Class C at least, by 2020. This should remove the worst products on the market, although the overall impact of this MEPS increase will be relatively small. Note that the differences in technical efficiency amongst conventional resistance heating dryers is generally small.

The question is whether a more stringent MEPS level, that effectively bans conventional resistance heating dryers and mandates heat pumps, is warranted. Given the relatively low penetration of this appliance in South Africa and the likely low level of usage in many households due to the climate, this would seem to be inappropriate and may have low cost effectiveness. Such

a) Increase MEPS level for tumble dryers from Class D to Class C by 2020

b) Monitor the other countries' approach to mandating of heat pumps and introduction of this technology in South Africa, and revisit the MEPS levels accordingly

c) Consider initiating a supplementary programme to endorse heat pump technology tumble dryers

a MEPS level would double the purchase cost of this type of appliance (at least in the short term) and there may be significant social equity issues as a result. While Switzerland essentially mandates heat pump dryers, it is a very wealthy country where most people use dryers frequently due to the climate. These policy settings and usage patterns may not translate well to South Africa. Until Europe, or some other large trading block, mandates heat pump dryers, it would seem premature for South Africa to consider this option. Once another large trading block has mandated heat pump dryer MEPS for some time and manufacturing costs have declined, such a proposal could be considered again for South Africa.

Heat pump dryers, while expensive, are relatively available and the current energy label does allow these products to be readily differentiated. A complementary program to promote heat pump dryers (Class A++ and A+++) over and above conventional dryers could result in some energy savings, but this type of program is not in the scope of this project.

5 LAUNDRY APPLIANCES: WASHER-DRYERS

5.1 Context and background

Item	Comment	
Applicable standards and regulations	EE standard	• SANS 941
	Regulation	• VC 9008: ○ Washer-dryer combination machines shall comply with SANS 941 ○ Washer-dryer combination machines shall have a minimum energy efficiency rating of Class A
	Performance measurement standard	• SANS 50229:2010/ EN 50229:2007: Electric clothes washer-dryers for household use – Methods of measuring the performance
Items regulated	• Household electric clothes washer-dryer combination machines	
MEPS level	• Class A	
Test method used	• SANS 941 references *SANS 50229/EN 50229, Electric clothes washer-dryers for household use – Methods of measuring the performance* as the official test method for combination washer-dryers. Clause 4.2.8 states: *Household electric clothes washer-dryers shall comply with the energy and water consumption requirements in SANS 50229, and washer-dryers shall carry an energy efficiency label designed in accordance with the national annex on energy labels in SANS 50229*. • The bibliography of SANS 941 lists *Commission Directive 96/60/EC of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-dryers*. • SANS 50229 states that: *This national standard is the identical adoption of EN 50229, but with the addition of a national annex on the energy labelling of washer-dryers. The label design and the technical information required for the calculation of energy classes were obtained from European Directive 1996/60/EC.*	

Origins of the performance measurement standard

SANS 50229 is based on EN 50229:2007. This is a European only standard. Until recently, there was no IEC standard for combination washers-dryers. This is because many countries, such as Australia, separately applied washer standards to the washer function and dryer standards to the dryer function of these types of appliances. In 2012, IEC published a combination washer-dryer standard, largely based on the European standard, but with additional options for testing – see *IEC 62512:2012 Electric clothes washer-dryers for household use - Methods for measuring the performance*. The European standard specifies that the washer is loaded to rated capacity. At the completion of washing, the load is split into two (usually because the dryer capacity of washer-dryers is significantly less than the washer capacity). Half the split load is dried in the dryer and the remaining wet load items are stored in a plastic bag. The remainder of the wet load is then dried after the first half is dried. The IEC standard permits a load equal to the dryer capacity to be washed then dried in a continuous operation, which is a more reflective of normal user behaviour.

The European Commission guidance cites both EN 50229:2007 and EN 50229:2015. The 2015 edition came into force in early 2018.

The energy efficiency classes in the European Directive are based on an energy consumption per kg of clothes treated (complete operating (washing, spinning, drying) cycle using standard 60°C cotton cycle and dry cotton cycle). There is no reference energy equation – the label classes are based on a simple kWh/kg break point. The energy efficiency grades in SANS 50229 are identical to those in *Commission Directive 96/60/EC*. Class A is defined as a kWh/kg of < 0.68 for a load at rated capacity.

The washer-dryer label also includes wash performance classes from A to G. The wash performance grades in SANS 50229 are identical to those in *Commission Directive 96/60/EC* as well as those used for the previous European clothes washer directive. There is no requirement specified for a minimum washing performance in SANS 50229. Note that in the latest labelling regulation for clothes washers, Europe has moved away from wash performance classes declared on the label and instead specifies a minimum washing performance as a separate requirement in the EcoDesign regulations. Europe did not revise the label for combination washer-dryers under the new energy labelling EU *Directive 2010/30/EU* and did not introduce MEPS levels for combination washer-dryers under the EU EcoDesign Framework *Directive 2009/125/EC*. Note the washer-dryer labelling requirements do not include standby power in the annual energy consumption.

Current MEPS level

The minimum energy rating for washer-dryer combinations is currently Class 'A'. This MEPS applies to all washer-dryer combinations for household use. Like automatic washing machines (for washing clothes only), the market for washer-dryer combinations was dominated by imports at the time of the previous study. As a result, the baseline (average) energy rating of all the imported units was estimated to be Class 'A', hence the desirable and recommended minimum energy rating of 'A' back in 2012. The proposed minimum energy rating was not expected to negatively affect the sales of this laundry equipment on the local market.

5.2 Market description and composition

Market description

This sub-market of laundry appliances is very small relative to the other two laundry appliances discussed earlier. Consumers have a choice to select from approximately 11 models (bigEE, 2015), which are supplied by four brand manufacturers[9].

Market composition

Sales figures for washer-dryer combinations amounted to 20 900 units in 2017, demonstrating a 31% increase in the number of units sold from 2012 (Euromonitor, 2017a). The 2017 sales of washer-dryer combinations were valued at R404.6 million generating about 9.6% of the revenue in the home laundry equipment group[10]. The market research data suggests that sales of this appliance will increase at a

[9] http://www.nrcs.org.za/content.asp?subID=68#1

[10] When aggregating sales of automatic washing machines, washer-dryer combinations, tumble dyers and semi-automatic (twin tubs) clothes washing machines.

CAGR of 3.4%, implying 24 700 units to be sold in 2022 (Euromonitor, 2017a). Despite the positive market outlook, the penetration rate which is still below 3% suggests that this home laundry appliance is perceived by many households as non-essential (Euromonitor, 2017a).

The table below shows the composition of the market in terms of the origin of the product. It is evident that there is almost a balance between imports and locally manufactured units, although the locally produced/assembled products have slightly more of the market share.

Washer-dryer combo is a niche market laundry appliance: for every washer-dryer sold there are 24 automatic washing machines and four dryers purchased

Table 5-1: Distribution between imports and locally manufactured Washer-dryer combinations - 2017

Appliance	Estimated annual stock		Total units sold p.a.	Estimated value of the market (ZAR million)
	Imports	Locally manufactured		
Washer- dryer	14 400	17 000	20 900	404.6

(Euromonitor, 2017a)

The popular washer-dryers available on the market adhere to the current MEPS level (see Figure 5-1). Noteworthy is that the price of a locally assembled unit is higher than that of the imported models (comparison between Models X and Y).

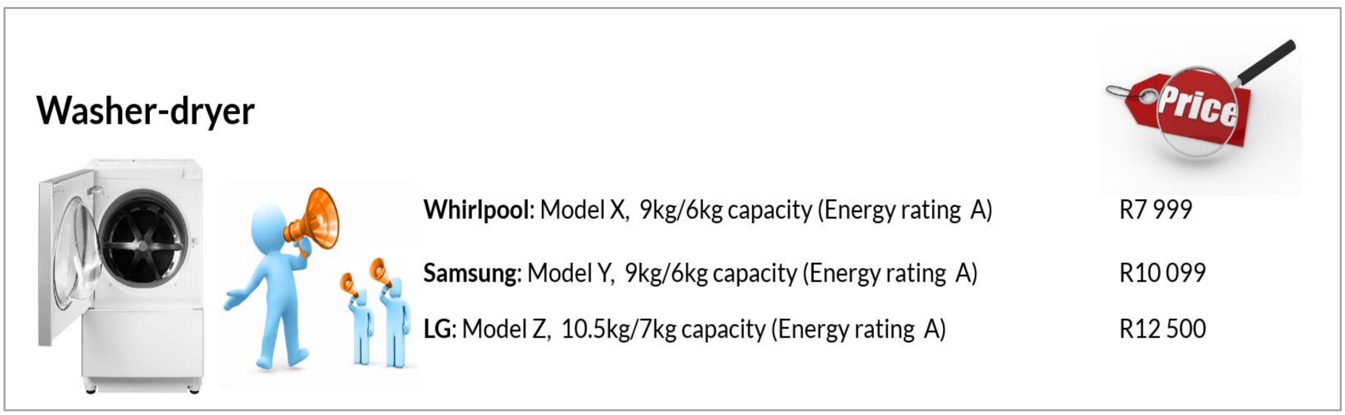


Figure 5-1: Average Prices for Automatic Washer-dryers by Major Retailers (Euromonitor, 2017a)

5.3 Industry analysis

Contrary to the situation depicted in the other sub-categories of laundry appliances, Defy Appliances does not have a recognisable footprint in the local market for washer-dryers (as depicted in Figure 5-2). About a third of the washer-dryers available in the market are manufactured by LG (Euromonitor, 2017a). Samsung is the closest competitor of LG in this appliance category, supplying about 5 700 units to the market in 2017.

Washer-dryer market is dominated by:

LG and Samsung

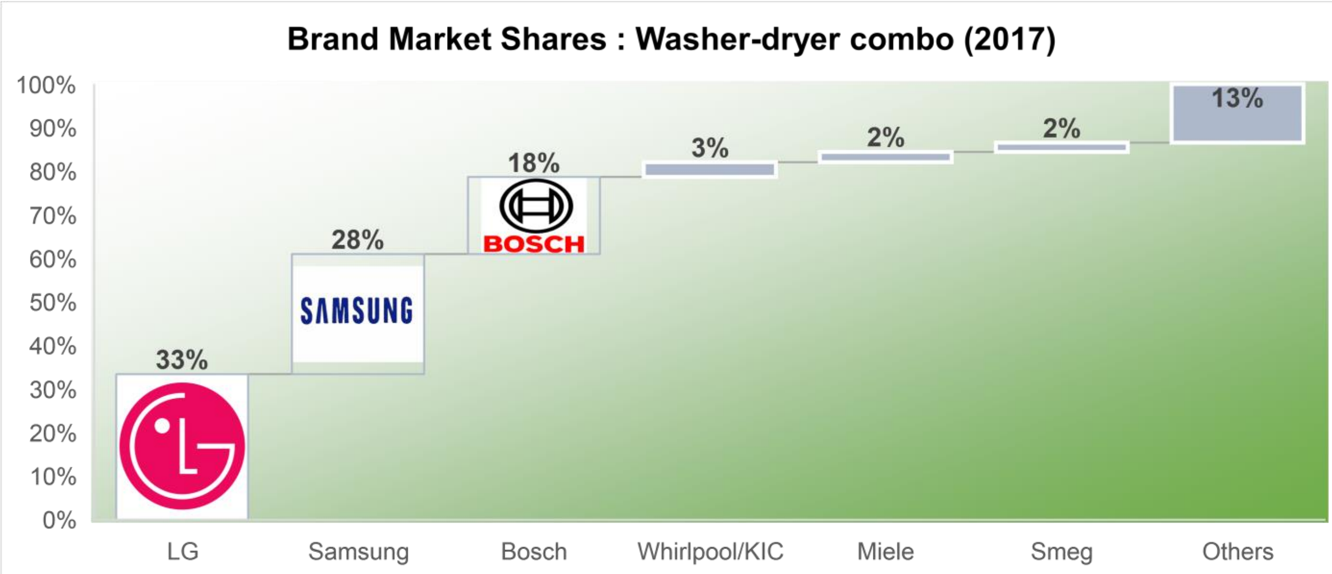


Figure 5-2: Market shares of Washer-dryer manufacturers (Euromonitor, 2017a)

5.4 MEPS opportunities

Combination washer-dryers are available in Europe and some parts of Asia (e.g. Korea), but otherwise are **not a very prevalent laundry appliance globally**. However, the only country to currently have MEPS for combination washer-dryers, apart from South Africa, appears to be Canada. No information on the Canadian test method is available so direct comparisons are not possible.

Combination washer-dryers only form a small part of the washer market in Europe (around 2.5%), so this may explain why little attention has been paid to these products in an energy sense. In Australia, front loaders make up around 50% of the market, while combination washer-dryers make up around 1.4% of the total washer market (Energy Efficient Strategies 2016).

Based on a brief market review, it would appear that most washer-dryers in Europe are Class A, although there are a few models at Class B and at least one model at Class C. TopTen identify the best models on the market for washer-dryers. The most efficient models available use a heat pump for the dryer component – these are significantly lower overall energy at around 0.41 kWh/kg load. However, the cost of these systems is significantly higher because including a heat pump in such a small product is complex and expensive. So, it would appear to be possible to achieve higher efficiency in washer-dryers if heat pumps are used.

5.5 Recommendations

There are a number of issues to consider for South Africa:

a) Firstly, the current energy labelling system was originally devised on the basis of a conventional drum washing machine with a resistance heating dryer. Class A is reasonable efficiency for that technology and indeed most models on the market are already able to achieve that. However, in the past few years, washer-dryers with heat pumps have become available and these use around 40% less energy. The current labelling system does not differentiate between a conventional dryer and a heat pump dryer as both will be rated as Class A. While this issue is not within the scope of this study, it should be addressed in South Africa at some point.

The only option for increased MEPS with a meaningful impact for this product is to mandate washer-dryers with a heat pump**.** This would require a kWh/kg under the SANS 50229 test method of around 0.45 or less. Initial market investigation suggests this would increase appliance costs significantly (of the order of double the cost), and the resultant economics for users may not be very favourable, except for very heavy users.

b) The next consideration is that combination washer-dryers are likely to be a small part of the market and the impact of more stringent MEPS is likely to be small. Washer-dryers are already a high end and expensive product, and most are already fairly efficient, so the scope for increased MEPS is not large.

c) The final issue is that Europe does not have a MEPS for this product and the only other country that does appear to have MEPS is Canada. South Africa is already leading in a regulatory sense for this product by setting a MEPS levels at Class A. This will certainly exclude some products from the market (but not all that many), so the net impacts are likely to be small.

In consideration of all of the above-mentioned issues, **it is recommended that South Africa retain the existing MEPS levels for combination washer-dryers at Class A** to safeguard from any backsliding in efficiency in the market. An increase of MEPS to mandate washer-dryers with heat pumps is feasible but would limit the market to just a handful of models and would result in large increases in prices. So, increasing MEPS levels is not recommended at this stage.

A watching brief on regulatory activities in Europe for washer-dryers should be maintained. Some way of differentiating washer-dryers with a heat pump and a convention dryer should be examined.

Recommendation

a) Retain existing MEPS level of Class A for washer-dryers

b) Investigate a way to differentiate between conventional and heat pump technologies in the labelling system

c) Develop a programme to endorse heat pump washer-dryers

6 REFRIGERATION APPLIANCES: REFRIGERATORS

6.1 Context and background

Item	Comment	
Applicable standards and regulations	EE standard	• SANS 941
	Regulation	• VC 9008: ○ Refrigerators and freezers shall comply with SANS 941 ○ Refrigerators shall have a minimum energy efficiency rating of Class B
	Performance measurement standard	• *SANS 62552/IEC 62552*
Items regulated	• Household refrigerators	
MEPS level	• Class B	
Test method	• SANS 941 references *SANS 62552/IEC 62552, Household refrigerating appliances – Characteristics and test methods* as the official test method for refrigerators. Clause 4.2.6 states: *Household refrigerators and freezers shall comply with the requirements for energy consumption in SANS 62552, and refrigerators and freezers shall carry an energy efficiency label designed in accordance with the national annex on energy labels in SANS 62552*. • The bibliography of SANS 941 lists the following reference for refrigerators: *Commission Delegated Regulation (EU) No 1060/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household refrigerating appliances*. • SANS 62552 states that: *This national standard is the identical adoption of IEC 62552 and IEC corrigendum 1, but with the addition of a national annex on the energy labelling of refrigerating appliances. The label design and the technical information required for the calculation of energy classes were obtained from European Directive 1994/2/EC.*	

Origins of the performance measurement standard

SANS 62552 is an identical implementation of IEC 62552:2007 and IEC corrigendum 1. This standard is based on the previous ISO 15502 standard, which was published in 2005 and was later transferred from ISO to IEC. This ISO standard was itself a result of the merging of four different ISO test methods for refrigerators and freezers for different product types that were developed in the 1990s.

IEC published a new global test method for refrigerators in 2015 that superseded IEC 62552 as follows:

- IEC 62552-1:2015 Household refrigerating appliances - Characteristics and test methods - Part 1: General requirements
- IEC 62552-2:2015 Household refrigerating appliances - Characteristics and test methods - Part 2: Performance requirements
- IEC 62552-3:2015 Household refrigerating appliances - Characteristics and test methods - Part 3: Energy consumption and volume

These new standards have already been adopted in some countries. Europe is currently in the process of adopting the new IEC test method by 2020.

National Annex AA of SANS 62552 specifies the energy label design for South Africa. This is important as the MEPS level is defined as an energy label class (MEPS = Class B). The Annex defines 10 types of refrigerators and freezers as follows, which are identical to definitions used in European Regulations:

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.*

EEI calculation methodology

National Annex AA follows the original European energy labelling directive fairly closely in that it defines a reference energy consumption line (called standard annual energy consumption SC_a) for each of the product categories. The Energy Efficiency Index (EEI) is then defined as the ratio of the energy consumption for an individual product as measured in accordance with the test method over the reference energy for the product size and category. The EEI is then used to determine the energy label grade, which also ascertains whether the product meets MEPS.

The standard annual energy consumption SC_a in SANS 62552 is defined as:

$$SC_a = M_a \times \sum \left[V_c \times \frac{25 - T_c}{20} \times FF \times CC \times BI \right] + N_a + CH$$

, where

M_a is a variable allowance in kWh/year/adjusted litre

N_a is a fixed allowance in kWh/year

V_c is the volume of each compartment in litres

T_c is the temperature of operation of each compartment in °C

FF is a factor equal to 1.2 for frost free compartments, otherwise 1.0

CC is a factor for climate class (tropical = 1.2, sub-tropical=1.1, other=1.0)

BI is a built in factor equal to 1.2 for built in appliances <58cm, otherwise 1.0

CH is a chiller allowance of 50 kWh/year for appliances with a chill compartment >1.5 litres

The values for M_a and N_a in South Africa under SANS 62552 are the same as for the original energy labelling and MEPS regulations for Europe (*Directives 1994/2/EC* and *96/57/EC* respectively). However, the standard annual energy consumption equation used in South Africa is based on the current European

Commission Delegated Regulation (EU) No 1060/2010 for energy labelling of refrigerating appliances. The referenced EU *Directive 94/2/EC* does not include the factors *BI* (built in) and *CH* (chiller). The fixed and variable factors are the same as the original European requirements. There are some small differences in the label grades as shown in Table 6-1.

Table 6-1: 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	EEI < 22
A++	EEI < 30	N/A	22 ≤ EEI < 33
A+	30 ≤ EEI < 42	N/A	33 ≤ EEI < 42*
A	42 ≤ EEI < 55	EEI < 55	*42 ≤ EEI < 55
B	55 ≤ EEI < 75	55 ≤ EEI < 75	55 ≤ EEI < 75
C	75 ≤ EEI < 90	75 ≤ EEI < 90	75 ≤ EEI < 95
D	90 ≤ EEI < 100	90 ≤ EEI < 100	95 ≤ EEI < 110
E	100 ≤ EEI < 110	100 ≤ EEI < 110	110 ≤ EEI < 125
F	110 ≤ EEI < 125	110 ≤ EEI < 125	125 ≤ EEI < 150
G	125 ≤ EEI	125 ≤ EEI	150 ≤ EEI

*Note *: The EEI break point for Grade A and A+ under EU 1060/2010 was changed from 42 to 44 on 1 July 2014.*

Table 6-1 shows that the label classes applied in South Africa are mostly the same as those used in Europe. SANS 62552 defines higher classes (A+ and A++) than covered by the original EU labelling regulation. The EEI break points for A+ and A++ are slightly different to the current EU regulations. The standard annual energy consumption equation in SANS 62552 is the same as the current EU labelling regulation.

The current MEPS level for household refrigeration units in South Africa is Grade B, which requires an EEI of <75 under all three systems (South Africa, original and current EU). So, South Africa has partly adopted the new European energy labelling values for EEI and the new formula for the calculation of standard annual energy consumption (including new factors). However, the reference energy lines for energy labelling and MEPS was altered in Europe for Categories 6, 8 and 9 in the 2010 European regulation, and these new reference lines have not been adopted in South Africa. So, labelling for these product categories is slightly tighter in South Africa than those in Europe.

Labelling for household refrigerators in South Africa is the same or tighter (for low temperature and food freezers) than that in Europe

Current MEPS level

The mandatory MEPS level for household refrigerators is currently set at Class 'B'. The energy rating holds for all types of household refrigerators (either fridges/single-door refrigerators or combined fridge-freezers) supplied to the local market. At the time of initial enquiry into the favorable MEPS levels back in 2012, the following points became apparent to recommend 'B' as the desired energy rating:

- Most of the refrigeration units produced locally had 'C' and 'D' energy performance ratings, or lower. The dominant local manufactures consulted in this sector understood the essence of eliminating inefficient models and agreed to a MEPS level that would facilitate the process of market transformation.
- The average energy efficiency ratings for imported refrigerators was 'A'.

As result, it was viable to recommend the MEPS level of Class 'B', which also was expected not to affect the importers and was acceptable by the local manufactures; although clearly it created an opportunity for the importation of appliances of lower energy efficiency rating than what was observed at that time, i.e. dumping.

6.2 Market description and composition

Market description

The market for refrigerators has a wide selection of models for consumers to choose from. It is estimated that at least 44 brand manufacturers[11] cater for the domestic market, offering not less than 784 models (bigEE, 2015). The small refrigerators class (with a volume of <340 litres) has the most model variations category, as compared to the model ranges available for medium and large refrigerators (of a capacity >340 litres).

Market composition

As indicated earlier, the current MEPS covers refrigerators/fridges and combined fridge-freezers. In 2017, the fridge-freezers contributed more in revenue in the refrigeration appliances department by selling 1.3 million units, as compared to only 41 400 refrigerators sold in the domestic market (Euromonitor, 2017a). The sales from the two refrigeration appliances generated about R9.8 billion in revenue (in 2017). Given a CAGR of 5.7% and 3.9% for fridge-freezers and refrigerators respectively, the combined sales volumes are expected to increase to about 1.8 million units in 2022. It is vital to note that fridge-freezers are regarded essential by many households (that have access to electricity and can afford this appliance), as the penetration rate is 70% (Euromonitor, 2017a). On the other hand, fridges have proved to be of less importance to households as the penetration rate is below 10%.

Fridge-freezer combos are considered essential – 70% penetration rate; demand for fridges (only) is low – one out of ten HHs owns a fridge

The distribution between locally manufactured and imported units, and the value the market of refrigeration appliances under investigation is given below.

Table 6-2: Distribution between imports and locally manufactured Refrigeration appliances - 2017

Appliance	Estimated annual inventory		Total units sold p.a.	Estimated value of the market (R million)
	Imports	Locally manufactured or assembled		
Fridges	241 100	37 300	41 400	140
Fridge-freezers	208 900	671 200	1 301 300	9 651.8

(Euromonitor, 2017a)

The market for refrigerators is dominated by international manufacturers, of which some have local manufacturing and component assembly plants in South Africa (dti, 2013). An example of these include Defy, Whirlpool and KIC. Other established international brands source whole products from their

[11] http://www.nrcs.org.za/content.asp?subID=68#1

international production facilities (dti, 2013). Table 6-2 Error! Reference source not found.shows that most of the fridge-freezers available on the market were assembled locally, indicating the major role local manufacturers play in the domestic market. This shows that the manufacturing capabilities were sustained, as it was estimated previously that approximately 60% of refrigerator combinations sold were manufactured locally (FRIDGE, 2012),. Conversely, at least six times the number of fridges locally produced was imported in 2017 (Euromonitor, 2017a). Most of these imported units were redistributed as exports, hence a relatively small domestic sales volume of 41 400.

Fridge sales

Fridges have a common characteristic of having a single door but differ when it comes to size or volume. The previous study (FRIDGE, 2012) differentiated among three size types - small (<340 litres), medium (341 – 510 litres), and large (>511 litres). The following figures depict the sales of refrigeration equipment, based on size. It is evident that small fridges accounted for about 87.4% of the sales for fridges in 2017 (see Figure 6-1). In particular, 22 600 units that were sold had a volume/capacity of less 142 litres. In the same year, consumers bought 13 600 units, which had 142 – 340 litres in capacity.

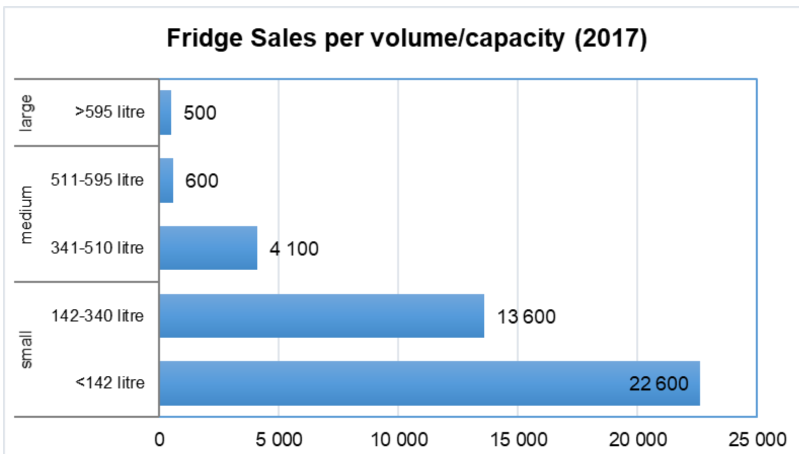
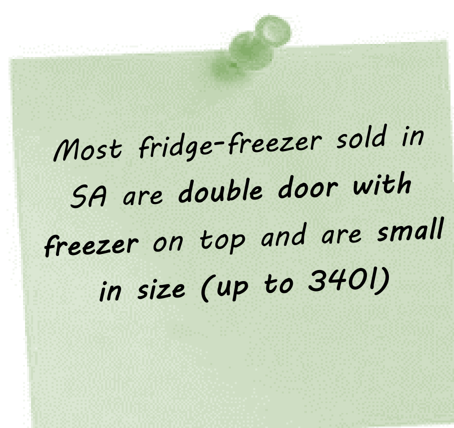


Figure 6-1: Sales of Fridges by size (Euromonitor, 2017a)

Fridge -freezer sales

Unlike fridges, fridge-freezers sold in SA have more designs and configurations as shown in Figure 6-2. The trend in retail volumes indicates that the most common sold format is the double-door, of which (Euromonitor, 2017a):

- Double-door refrigerators with the top compartment as the freezer accounted for about 65% of the annual sales in 2017.
- Fridge-freezers designed to have the top shelf as the fridge amounted to one fifth of the sales.



Models which are more sophisticated in terms of configuration had smallest share of the unit sales. Like the market for fridges, consumers purchased more small-sized fridge-freezers (90.2%) as compared to the medium and larger ones.

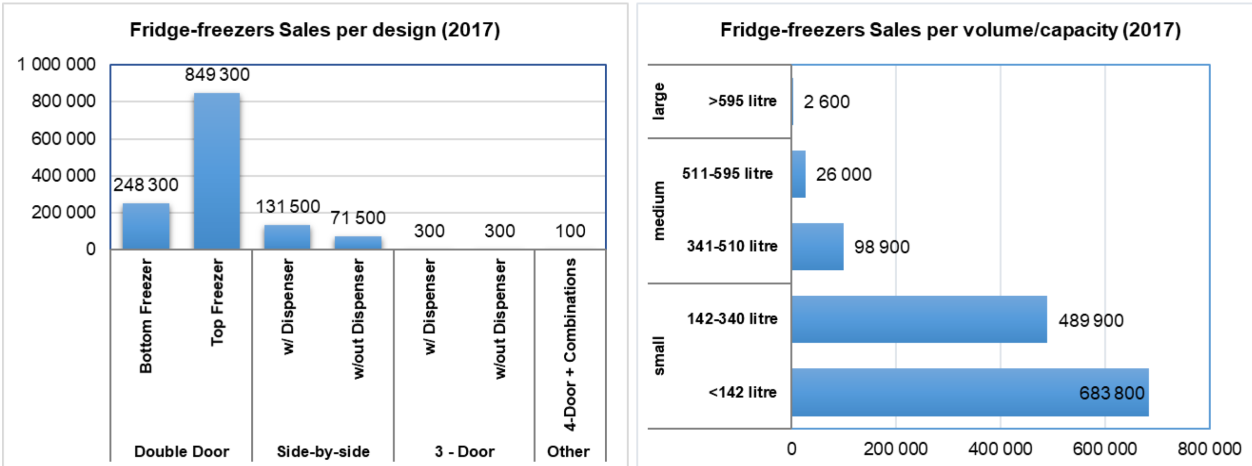


Figure 6-2: Sales of Fridge-freezers by format and size (Euromonitor, 2017a)

Energy efficiency and prices

The bulk of the refrigerators available to the consumers are of higher energy efficiency class ('A' or better) than the current MEPS level (refer to

Figure 6-3). As indicated earlier, the market is characterized by a lot of variations, the popular format being the double door. As anticipated, locally produced/assembled and smaller sized units e.g. with a gross capacity of 216L and a usable volume of 215L (G 216/N 215L) cost less than the larger and more advanced models, which are typically imported. Further, the more sophisticated models have higher ratings ('A+' or better).

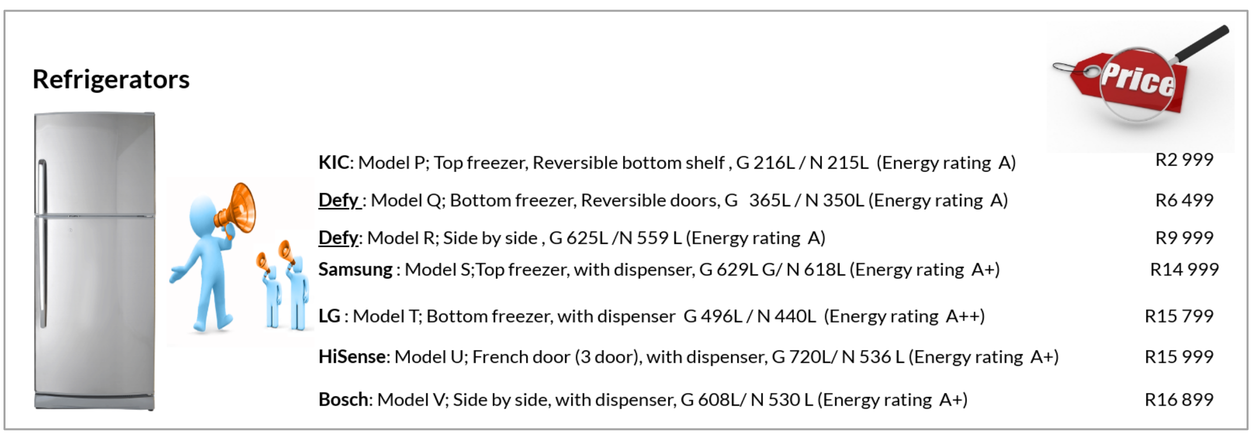


Figure 6-3: Average Prices for Refrigerators by Major Retailers (Euromonitor, 2017a)

6.3 Industry analysis

> Fridge-freezer market is dominated by HiSense and Defy; fridge market – by Defy and BSH

A brief overview of the brand mix and their market shares shows that the leading brands have different market shares for the two sub-markets of refrigeration equipment, as indicated in Figure 6-4.

- HiSense has the greatest market share in the market for fridge-freezer combinations; followed by Defy Appliances with just over 20% of the market and then Whirlpool/KIC and LG with an equal units of fridge-freezer combinations sold.
- On the contrary, Defy Appliances is the largest supplier in the niche market for fridges, while HiSense had only 6.8% share of the market. A quarter of this niche market has fridges manufactured by the BSH group, which is very different from the situation depicted in market for fridge-freezers (2.3% market share). Whirlpool also stood out in the market for fridges and seemingly strives to overtake BSH group in terms of sales.

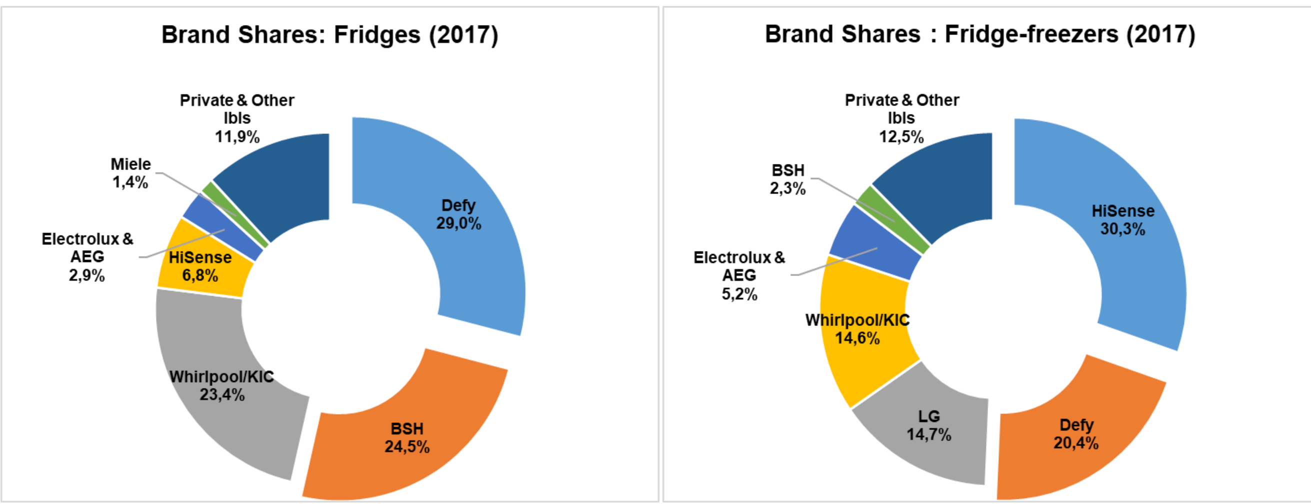


Figure 6-4: Market shares of Fridges and Fridge-freezers manufacturers (Euromonitor, 2017a)

6.4 Usage, application, and energy consumption

Usage and applications

The stock of refrigerators owned and operated by households increased from almost 11 million in 2010, to about 14 million units in 2016, as shown in **Figure 6-5**. Based on the historical trend, it is predicted that the stock of refrigerators increased to 14.1 million at the end of 2017. The projections are that approximately 28.7 million refrigerators will be used by South African households by the year 2032.

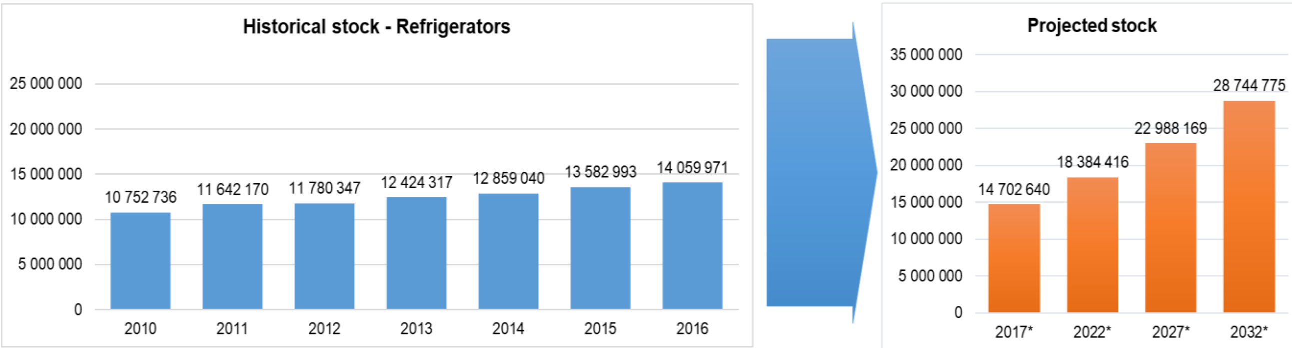


Figure 6-5: Historical and Projected stock – Refrigerators (Own analysis based on AMPS (2010 – 2016))

Figure 6-6 shows the distribution of refrigerators per LSM. Refrigerators are mainly used by LSM 4 – 10 groups with LSM 5 – 7 constituting the largest portion of the domestic demand. LSM 6 & 7 groups of households have been established as the dominant groups that have procured more refrigerators over the past few years (2011 to 2016). The two LSM categories acquired around 690 000 and 480 000 more units in 2016, respectively.

It is estimated that the stock of refrigerators had increased at a CAGR of 4.6% since 2010. The lower income groups (LSM 2 and 3) exhibited the highest growth rates of 8.7% and 8.2% respectively, indicating a very strong desire for cooling appliances by the low-end market. On the contrary, the high-end market (LSM 10) had the lowest growth rate (2.1%), since the majority (almost all) of households in this category already own this household appliance. It is plausible to conclude that the more sophisticated designs and larger sizes of refrigeration equipment are purchased mainly by the high-end market, who are less concerned about the value-position of the product.

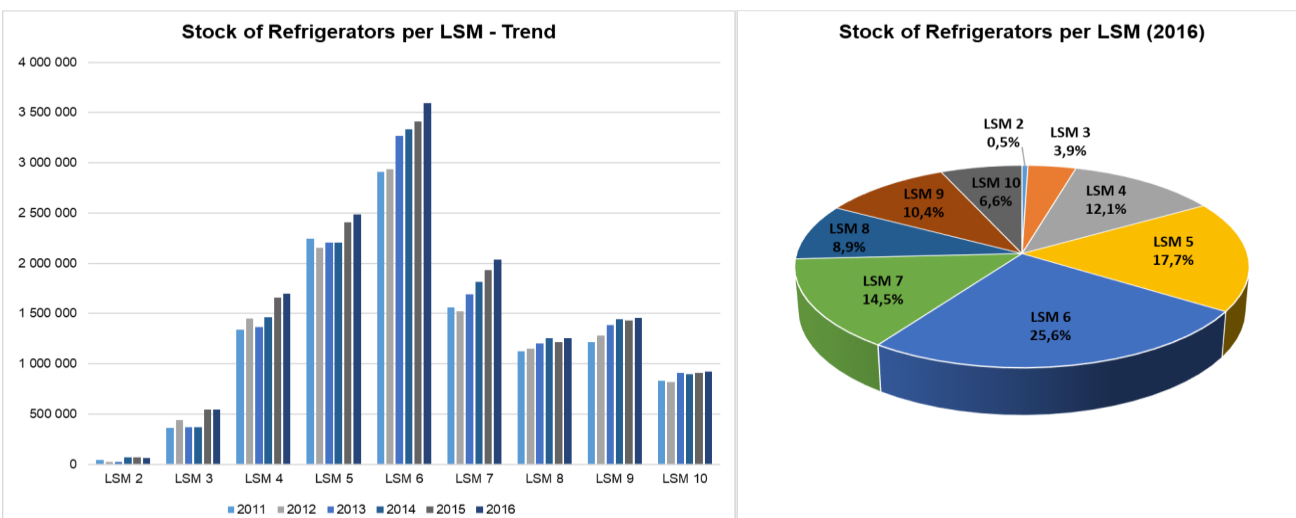


Figure 6-6: Distribution of stock – Refrigerators (Own analysis based on AMPS (2010 – 2016))

Energy consumption levels

On average, a refrigerator used roughly 472 kWh per annum a few years ago (bigEE, 2015). This translates to a weekly consumption of about 9.1 kWh. The review of the selected Class B models currently available in the shops suggests that the average consumption of a refrigerator adhering to MEPS is about 247 kWh, which clearly shows that the introduction of MEPs has significantly improved the efficiency of refrigerators sold in the market. However, it is likely that the majority of refrigerators currently in stock comprise of pre-MEPS models, suggesting that the average energy usage of the refrigerators in stock is likely to be lower than the current MEPS.

In 2017, there were approximately 14.7 million units in use (refer to Figure 6-5), thus the total amount of electricity consumed for the year, given the total stock and the pre-MEPS level appliance's energy consumption amounted to 6.9 TWh (6 957 GWh).

Table 6-3: Refrigerators – stock and electricity consumption

Appliance	Average weekly consumption (kWh)	Number of appliances (estimated for 2017)	Total electricity consumption per annum (GWh)
Refrigerators	9.1	14 702 640	6 957

6.5 MEPS opportunities for refrigerators and freezers

Refrigerators are the most regulated product for energy efficiency around the world with some 75 countries having energy related requirements of some description (Energy Efficient Strategies & Maia Consulting 2014). Refrigerator energy consumption is generally difficult to compare across countries and regions because of differences in test methods, which mean that energy values are often not directly comparable. However, there are some well established relationships that allow general comparisons to be made.

The first region to compare is Europe. This is relatively straight forward as the test method is the same and the rating system is almost the same. The original MEPS levels for Europe were set under European Directive 96/57/EC and came into force in 1999. A series of maximum energy lines (MEPS) were defined for each category and effectively these were at the bottom of Class C for most categories (this permitted products of Class A to Class C to be sold), except for chest freezers (Category 9), which had a MEPS line at the bottom of Class E (Class A to Class E could be sold).

In 2009, a new **EcoDesign** requirement was defined in Commission Regulation (EC) No 643/2009. This regulation changed the reference energy line for some categories of products as noted above (Categories 6, 8 and 9 – all were made slightly weaker), but it set a uniform MEPS level for all products at Class A from 1 July 2010. This was increased to Class A+ on 1 July 2012. The definition of Class A+ was slightly tightened from an EEI of 44 to an EEI of 42 on 1 July 2014. On this basis, the MEPS level for Europe is substantially tighter than the existing MEPS level in force in South Africa – the European MEPS levels are 0.56 of the maximum energy permitted in South Africa (a reduction of 44%).

CLASP undertook a major international comparison of MEPS levels for various countries in 2014 (The Policy Partners 2014). For refrigerators and freezers, this comparison showed that **Europe had the most stringent MEPS levels globally at the time for smaller products, while US 2014 levels were slightly more stringent for larger products** (that are less common in Europe). Similar findings were noted in an international review of MEPS levels for the International Energy Agency 4E Mapping and Benchmarking Annex (IEA 4E Mappring and BenchMarking Annex 2014). Note that the test method conversion does make this direct comparison difficult. A separate review of policies in Asia found that proposed Australian MEPS (equivalent to US 2014) were the most stringent in Asia, including China in 2014 (Energy Efficient

Strategies 2014). The above, though, supports the proposition that European MEPS for refrigerating appliances are currently the most stringent globally.

TopTen in Europe list a wide range of high efficiency refrigerators and freezers currently on the market. These all have an efficiency Class of A+++ and most have an EEI in the range 20 to 22.

6.6 Impact analysis

In order to assess the implications of amending the MEPS level for refrigerator, the following assumptions were made with respect to the most common models:

Table 6-4: Fridge-freezer assumptions

Characteristics	MELS level B	MEPS level A	MEPS level A+
Size	93 to 203 l	220 – 233 l	219 l
Annual electricity consumptions	247 kWh	236 kWh	121 kWh
Average prices	R2 759	R3 149	R3 799

Considering the above assumptions, it was estimated that a purchase of a Class A refrigerator will lead to marginal electricity savings and will unlikely result in savings for the household over the lifespan of the appliance. At the same time, though, a consumer is likely to pay about 14% more, which could be a considerable increase given the primary target market of lower income households for the small refrigerators. However, it is important to note that strong evidence from Australia and the USA has shown that introduction of more stringent MEPS levels for appliances generally has small or negligible impacts on purchase prices if introduced in an orderly manner with sufficient notice (Harrington & Lane 2010; US Department of Energy 2011a, 2011b); therefore, it is safe to assume that the replacement of the refrigerators of Class B level by Class A, for example, is unlikely to lead to the increase in prices and is more likely to reduce the current prices of Class A refrigerators in South Africa.

However, increasing the MEPS level to class A+ will render significant savings for the consumer and although it would cost about 37% more, it offers 51% savings on electricity. As a result, the additional money that will need to be paid for a more energy efficient appliance will be paid back in savings on the utility bill over a six-year period – far ahead before the appliance reaches its life span.

Table 6-5: Fridge-freezer savings and costs calculations

Characteristics	MELS level B	MEPS level A	MEPS level A+
Cost difference	-	R390	R1 040
Electricity savings – per annum	-	11 kWh	126 kWh
Electricity savings - %		4%	51%
Electricity savings – Rand value		R14	R 160
Change in cost vs savings payback period	-	28 years	6 years
Appliance lifespan	14-17 years	14-17 years	14-17 years

The following table provides an insight into the potential electricity savings that could be derived if the refrigerators sold in the next five years were to adhere to MEPS level A or A+.

Table 6-6: Fridge-freezer electricity savings projections

<table>
<tr><td rowspan="4">MEPS Level B</td><td colspan="2">Size considered</td><td colspan="2">Average price</td><td colspan="4">Estimated average annual electricity consumption</td></tr>
<tr><td colspan="2">93-203L</td><td colspan="2">R2759</td><td colspan="4">247kWh</td></tr>
<tr><td rowspan="2">Aggregated electricity consumption (GWh)</td><td>2017</td><td>2018</td><td>2019</td><td>2020</td><td>2021</td><td>2022</td><td>Total</td></tr>
<tr><td>321.42</td><td>330.83</td><td>344.71</td><td>360.37</td><td>377.37</td><td>424.35</td><td>2 159</td></tr>
</table>

MEPS Level A	**Size considered**		**Average price**		**Estimated average annual electricity consumption**			
	220-233L		R3149		236kWh			
	Aggregated electricity consumption (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		307.11	316.1	329.36	344.32	360.56	405.45	2 063
MEPS Level A+	**Size considered**		**Average price**		**Estimated average annual electricity consumption**			
	219L		R3799		121kWh			
	Aggregated electricity consumption (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		157.46	162.07	168.87	176.54	184.86	207.88	1 058
IMPACT ANALYSIS								
B to A	*Price difference*	*R/unit*	389					
		%	14					
	Electricity savings (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		14.31	14.73	15.35	16.05	16.81	18.9	96.15
B to A+	*Price difference*	*R/unit*	1039					
		%	38					
	Electricity savings (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		163.96	168.76	175.85	183.83	192.50	216.47	1 101.4

As indicated earlier, the majority fridge-freezers on the market comprises of global brands, some of which have local assembly/manufacturing facilities. Only about one in ten refrigerators sold in the country are represented by private and less known brands. This also suggests that introducing more stringent requirements is unlikely to have a significant impact on the domestic market and lead to structural changes that may be disruptive for the local producers.

6.7 Recommendations

a) Introduce Class A for refrigerators by 2020 and class A+ by 2022

b) Review the calculation methodology by considering (i) removal of the built-in, chiller and climate factors in the reference equation and (ii) reducing the frost-free factor

c) Conduct a detailed review of refrigerator requirements

The MEPS requirements for refrigerators and freezers in South Africa is currently based on a hybrid of old and new requirements for energy labelling in Europe. A specific point to note is that EEI values to define the label class do not fully align with old or new EU label thresholds. The reference energy lines used in South Africa are based on the latest reference equation used in Europe, which includes factors for built-in appliances, climate class, chillers and frost-free compartments. The allowances for built-in appliances and chillers are new and were not included in the original labelling or MEPS requirements. A detailed review by Intertek, Refrigeration Developments and Testing (UK) and Kevin Lane in 2012 **recommended the removal of the built-in, chiller and climate factors in the reference equation and a reduction in the frost free factor** (Intertek 2012), so this should also be considered in the South African context. It should also be noted that the reference lines for Categories 6, 8 and 9 in South Africa are not currently aligned with European requirements. There is some merit in keeping requirements broadly aligned with Europe in the medium term. The consultancy team would recommend **a detailed review of refrigerator requirements, especially in the light of the proposed change by Europe to the new IEC test method and label regrading by 2020**.

Currently **MEPS levels in Europe are close to the most stringent globally for refrigerators and freezers** for many types of products. Given that MEPS levels in Europe were set to Class A in mid-2010 (almost 8 years ago), it is likely that it would be feasible for MEPS levels for refrigerators in South Africa to be tightened further. A possible timetable would be **Class A by 2020 and Class A+ by 2022** – this would be a 8-year lag time behind European requirements and would give local manufacturers time to adjust and redesign their products.

7 REFRIGERATION APPLIANCES: FREEZERS

7.1 Context and background

Item	Comment	
Applicable standards and regulations	EE standard	• SANS 941
	Regulation	• VC 9008: ○ Refrigerators and freezers shall comply with SANS 941 ○ Freezers shall have a minimum energy efficiency rating of Class C
	Performance measurement standard	• *SANS 62552/IEC 62552*
Items regulated	• Household freezers	
MEPS level	• Class C	
Test method used	• Same as that of refrigerators (refer to previous section)	

As illustrated in the table above, the desired MEPS level for household freezers was set at Class 'C'. The recommended MEPS levels considered the following market characteristics that prevailed during the time of the FRIDGE (2012) study:

- The domestic market relied substantially on freezers (predominantly chest freezers) manufactured locally.
- The energy performance of the dominant freezers in the local market had a very low-ranking, having an average energy rating of 'F'. Further, it was acknowledged that some of the freezers available on the market had not been tested and their energy efficiency ratings were unknown.

In light of the above, the desirable and recommended minimum energy efficiency rating was proposed to be at Class 'C'. However, the study also emphasised the need for manufacturers to be afforded adequate time to restructure and improve their manufacturing plants, in addition to ensuring the availability of testing facilities for performance testing.

7.2 Market description and composition

Market description

Freezers have many brands (approximately 31)[12] but have fewer models than that of refrigerators. It was estimated that there is a minimum of 110 models (bigEE, 2015), with most of these models classified as small.

Market composition

The market for freezers is relatively smaller than the market for refrigerators analysed in the previous section. Around 329 900 freezers were sold in 2017, resulting in an annual turnover of about R1.2 billion (approximately 11% of the revenue from all refrigeration appliances[13]) (Euromonitor, 2017a). Despite having a low penetration rate of 28.7%, freezers have exhibited a reasonably high-sales volume growth of 25% from 2012 to 2017 (Euromonitor, 2017a). However, it is predicted that the demand for freezers by the local market will decline during the next few years. Given a compounded decay rate of 0.3%, it is expected that the sales volumes will drop to 325 600 units in 2022 (Euromonitor, 2017a).

The table below shows the composition of the market in terms of where the product is sourced. Again, the local manufactures have great influence in the local market for freezers, as was the situation at the time of the original investigation in 2012 (FRIDGE, 2012).

Table 7-1: Distribution between imports and locally manufactured Freezers - 2017

Appliance	Estimated annual inventory		Total units sold p.a.	Estimated value of the market (ZAR million)
	Imports	Locally manufactured or assembled		
Freezers	31 600	202 600	329 900	1 193.6

(Euromonitor, 2017a)

As anticipated, the market for freezers is still dominated by the chest format (see Figure 7-1). The upright format (accounting for a third of the market) was also found to be popular and preferred by consumers to the table-top freezers. In terms of size, freezers of a capacity of less than 142 litres constituted about 50% of the market sales (refer to Figure 7-2). Moreover, small-sized units (below 340 litres in capacity) contributed about 87% of the retail sales of freezers. Medium and large freezers have a very low demand, like the scenario reflected in the market for refrigerators.

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[12] http://www.nrcs.org.za/content.asp?subID=68#1

[13] When summing up revenues from sales of fridges, electric wine coolers, fridge-freezer combinations and freezers.

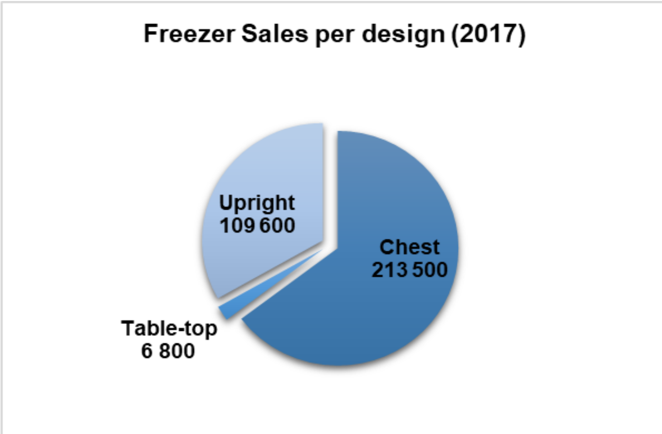

Figure 7-1: Sales of Freezers by format (Euromonitor, 2017a)

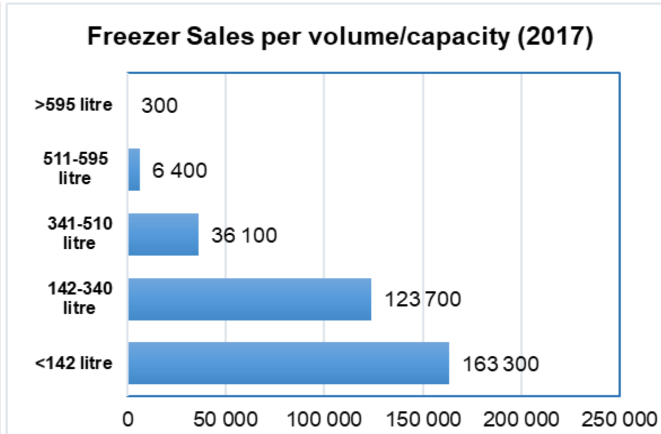

Figure 7-2: Sales of Freezers by size (Euromonitor, 2017a)

The prices of the popular sold models of freezers are reflected in Figure 7-3. First, it has been established that the energy ratings of **the bulk of the units available currently on the market is higher ('B' or better) than the current MEPS level**. Secondly, the **upright format has a higher price point than the chest freezers**, which explains why the latter has the highest turnover.

Freezers

HiSense: Model P; Chest Freezer , G 130L/ N 100L (Energy rating A)	R2 199
KIC: Model Q; Chest Freezer, G 210L/ N 207L (Energy rating B)	R2 399
Defy : Model R; Chest Freezer, G 260L/ N 254 L(Energy rating A)	R3 899
Samsung: Model S; Upright, with Reversible door, G 306L/ N 277L (Energy rating A)	R13 099

Figure 7-3: Average Prices for Freezers by Major Retailers (Euromonitor, 2017a)

7.3 Industry analysis

Whirlpool/KIC and Defy Appliances manufacturers supply most of the units in this market segment and seem to have equal market shares (as illustrated in Figure 7-4). A tenth of the units sold in 2017 were manufactured by HiSense, with the other brands making up the difference.

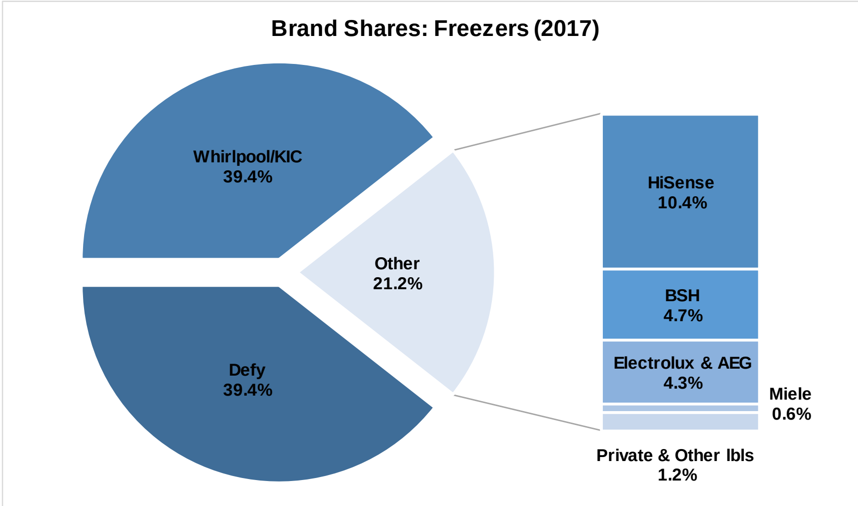

Figure 7-4: Market shares of Freezer manufacturers (Euromonitor, 2017a)

7.4 Usage, application, and energy consumption

Usage and applications

The stock of freezers in South Africa increased from about 2.8 million in 2010 to roughly 3.5 million units in 2012 (refer to Figure 7-5). Based on the trend (CAGR of 3.5%), it is estimated that the stock increased further to 3.6 million at the end of the year 2016.

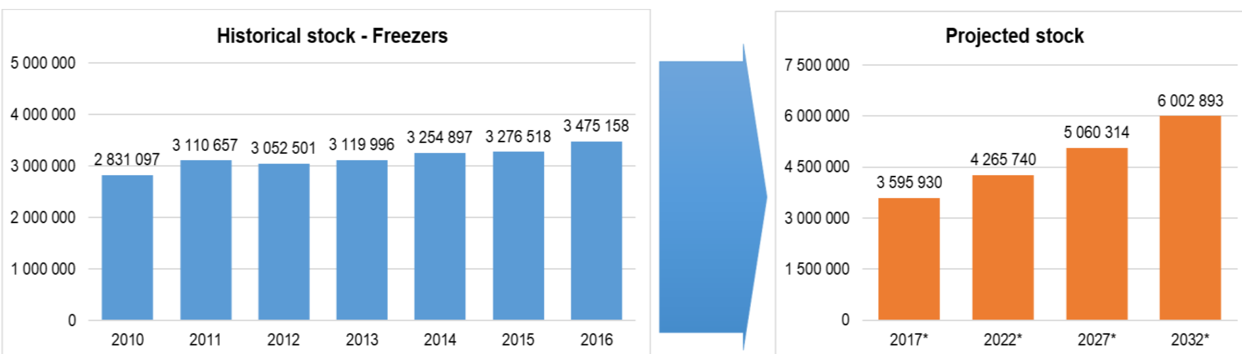

Figure 7-5: Historical and Projected stock – Freezers (Own analysis based on AMPS (2010-2016))

Figure 7-6 depicts that upper-middle to high-income households (LSM 6-10) are the largest group of customers for freezers and represent a significant share of the local demand. The stock of freezers has augmented in many LSM groups, except for the LSM 4 category. The increase in stock was mainly because of the growth in demand by LSM 5 and 6 households (Stats SA, 2016). The two groups had roughly 542 000 more units owned in 2016, when compared to the freezers in use in 2011.

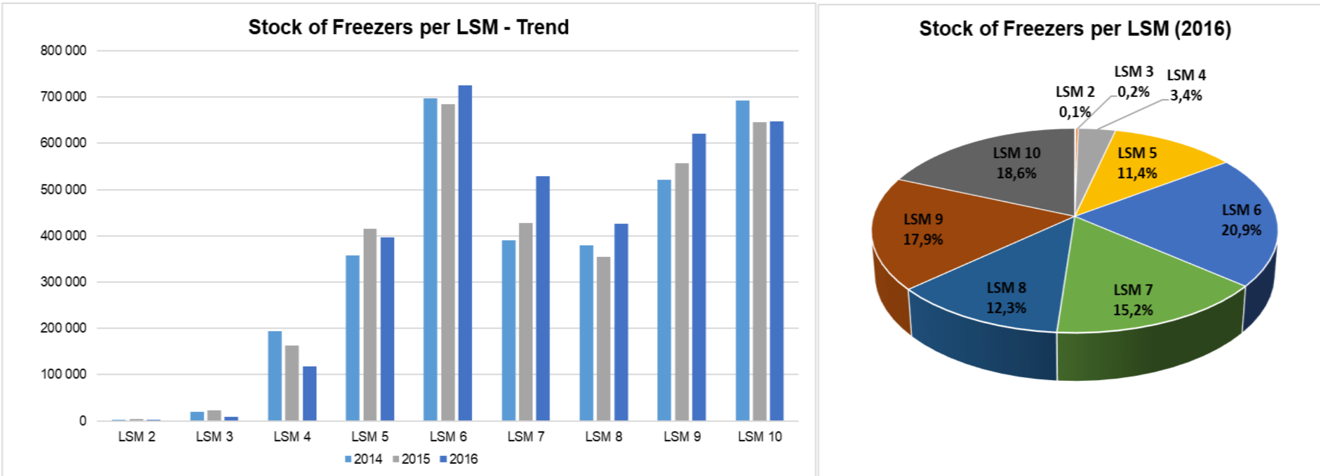

Figure 7-6: Distribution of stock – Freezers (Own analysis based on Stats SA, 2016)

Energy consumption levels

The average annual consumption of electricity by a freezer prior the introduction of MEPS was about 473 kWh (bigEE, 2015), which yields a weekly consumption of about 16.2 kWh. Considering that about 3.6 million freezers were in use in 2017 (see Figure 7-5), the total annual electricity consumption from the estimated stock was roughly 1.7 TWh (1 702 GWh). This is assuming that the majority of the freezers in use are of older less energy efficient models, as the stock has not been yet replaced by the new more energy efficient models since the introduction of MEPS.

Table 7-2: Freezers – stock and electricity consumption

Appliance	Average weekly consumption (kWh)	Number of appliances (estimated for 2016)	Total electricity consumption per annum (GWh)
Freezers	9.1	3 595 930	1 702

7.5 MEPS opportunities

Refer to previous section on refrigerators.

7.6 Impact analysis

The following tables outlines some of the assumptions related to the most common models of freezers of different energy efficiency that can be now found on the market in South Africa. As mentioned earlier, the retailers do not currently stock freezers of Class C, which suggests that the market has organically progressed to the higher MEPS level than the currently regulated level making introduction of MEPS Class B a necessity.

Table 7-3: Freezer assumptions

Characteristics	MEPS level C	MELS level B	MEPS level A
Size	Difficult to find on the market	194 – 292 l	130 – 330 l
Annual electricity consumptions		419.5 kWh	282.5 kWh
Average prices		R2 899	R3 032

Therefore, the question arises whether the MEPS for freezers should be tightened even further and increased to Class A. As indicated in the table below, the potential savings on the electricity consumption and subsequently the utility bill for consumers offered by a Class A freezer are considerable relative to the price increase. Essentially, for a 4.5% increase in price, a consumer receives a 33% saving on electricity consumption.

Table 7-4: Freezer savings and costs calculations

Characteristics	MELS level B	MEPS level A
Cost difference	-	R133
Electricity savings – per annum	-	137 kWh
Electricity savings - %		33%
Electricity savings – Rand value		R174
Change in cost vs savings payback period	-	1 year
Appliance lifespan	12-20 years	12-20 years

The following table provides an insight into the potential electricity savings that could be derived if the freezers' MEPS level were to be set to Class A – similar to refrigerators.

Table 7-5: Freezer electricity savings projections

MEPS Level B	**Size considered**		**Average price**		**Estimated average annual electricity consumption**			
	194-292L		*R2899*		*419.5kWh*			
	Aggregated electricity consumption (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		138.393	142.252	149.594	157.396	166.038	136.589	890.263
MEPS Level A	**Size considered**		**Average price**		**Estimated average annual electricity consumption**			
	130-300		R3032		282.5kWh			
	Aggregated electricity consumption (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		93.197	95.796	100.74	105.99	111.814	91.982	599.522
IMPACT ANALYSIS								
B to A	*Price difference*	*R/unit*	133					
		%	5%					
	Electricity savings (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		45.196	46.457	48.854	51.402	54.225	44.607	290.741

7.7 Recommendations

Freezers in South Africa currently have a MEPS level of Class C (which is an EEI of <90). Current MEPS levels in Europe are an EEI of <42 (Class A+), which is less than half of the energy consumed by Class C freezers. While it is true that chest freezers started with weaker MEPS levels in Europe in 1999, all freezers now have to meet Class A+ in Europe. This would indicate that tighter MEPS levels for freezers in South Africa are also warranted. Given that a higher share of the market is held by the locally manufactured or assembled products, a timetable for increasing MEPS levels could be done in steps. However, it should be noted that since the majority of products on the market are already of Class B and above, increasing the **MEPS to Class B should and could be done immediately. As such, a suggested timetable would be Class B in 2020, Class A in 2022 and Class A+ by 2026.**

At this stage there is no common or consensus approach to setting MEPS for refrigerating appliances, so there is a plethora of requirements in different countries as well as a range of test methods. Current MEPS levels in Europe have been at A+ for around four years and these appear to be feasible for a wide range of suppliers to achieve. Adopting these MEPS levels in South Africa would be a significant step up for local suppliers, so a staged approach over a period of about six years should give enough time for local industry to make the necessary adjustments.

a) **Introduce Class B for freezers by 2020, Class A by 2022, and Class A+ by 2026**
b) **Consider the adoption of the new IEC test method and eventual alignment with future European requirements from 2020 onwards**
c) **Start investigating new policy instruments once all appliances on the market are Class A and above**

An important consideration with this approach is the transition currently under way in Europe. European regulators are in the process of adopting the new IEC62552-3-2015 standard for energy consumption. They are also in the process of undertaking a complete regrade of their energy label back to the A to G scale (removing A+ and higher grades from the label). The transition to the new label and test procedure should be complete by 2020. While this is not a major concern for South Africa in the short term, some **consideration should be given to the adoption of the new IEC test method and eventual alignment with future European requirements in the medium term**. A wide range of countries are in the process of adopting the new IEC test method because it allows countries to develop more locally relevant energy estimates using a series of standardised tests that are global in nature.

Another consideration for South Africa if more stringent MEPS levels are adopted is **the role of energy labelling**. If a new MEPS level of Grade A is adopted, this would only leave Grades A, A+ and A++ on the market. Having a small number of label classes on the market, which are all very efficient in terms of consumer perceptions, means that any market pull from the energy label as a policy instrument will be substantially diminished. This is an issue for all labelled products where MEPS grades are at A or higher.

8 COOKING APPLIANCES: ELECTRIC OVENS

8.1 Context and background

Item	Comment	
Applicable standards and regulations	EE standard	• SANS 941
	Regulation	• VC 9008: ○ Electric ovens shall comply with SANS 941 ○ Small/medium electric ovens shall have a minimum energy efficiency rating of Class A ○ Large electric ovens shall have a minimum energy efficiency rating of Class B.
	Performance measurement standard	• SANS 60350-1:2015/IEC 60350-1:2011: Household electric cooking appliances. Part 1: Ranges, ovens, steam ovens and grills – Methods for measuring performance.
VC 9008 oven definitions	• Small oven is 12 litres ≤ oven cavity volume < 35 litres • Medium oven is 35 litres ≤ oven cavity volume < 65 litres • Large oven cavity volume ≥ 65 litres. ***Note:*** *There may be typographic errors in VC9008 regarding the oven size ranges – the above is an interpretation of the text.*	
MEPS level	• Class B – large electric ovens • Class A – small/medium electric ovens	
Test method used	• SANS 941 references *SANS 60350-1/IEC 60350-1, Household electric cooking appliances – Part 1: Ranges, ovens, steam ovens and grills – Methods for measuring performance* as the official test method for electric ovens. Clause 4.2.5 states: *Household electric ovens shall comply with the requirements for energy consumption in SANS 60350-1, and ovens shall carry an energy efficiency label designed in accordance with the national annex on energy labels in SANS 60350-1.* • The bibliography of *SANS 941* lists *Commission Delegated Regulation (EU) No 65/2014 of 1 October 2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of domestic ovens and range hoods* as a relevant document.	

Origins of the performance measurement standard

SANS 60350-1 is an identical adoption of IEC 60350-1:2011 (Edition 1 including corrections 1 and 2). In addition, there are modifications in Annex AA that are applied as specified in SANS 1692 (these changes are listed in a separate standard). SANS 1692 effectively applies a range of changes to the IEC standard to convert this to be equivalent to EN 60350-1. In general terms, these changes are small and cover energy measurement during the cool down period and a check of the applied microwave energy during measurement.

The label classes on the energy label are from D to A+++. Other information on the energy label is the same as the most recent *European Commission Delegated Regulation (EU) No 65/2014*. Note that the original European energy labelling directive for ovens (*Commission Directive 2002/40/EC*) has not been used in South Africa and is now withdrawn (superseded) in Europe.

EEI calculation methodology

SANS 60350-1 specifies a standard energy consumption value (in kWh to heat a standardised load) for electric ovens as $0.0042 \times V + 0.55$ where V is the volume of the oven in litres. The EEI is the ratio of the measured energy for the oven over the standardised energy. The label efficiency class definitions in SANS 60350-1 are identical to *European Commission Delegated Regulation (EU) No 65/2014* (energy labelling).

VC9008 defines oven sizes (small/medium/large) as noted above. These **sizes are not in the current European energy labelling or EcoDesign regulations, and sizes are not currently used to differentiate any products**. The size definitions in VC9008 match the original size definitions in *Commission Directive 2002/40/EC*, but it is **not clear why these have been used in South Africa**.

Current MEPS level

The initial study (FRIDGE, 2012) identified that the market for ovens was dominated by locally produced units, with 'B' being the baseline energy rating[14]. The average energy rating for imported units was Class 'A', although imports had a very small market share relative to the local manufactured units. As a result, Class 'A' was regarded as the desired MEPS level. However, the regulator adopted Class 'A' as the minimum energy rating for small and medium ovens, and 'B' for large ovens (NRCS, 2014).

8.2 Market description and composition

Market description

The market for ovens has a minimum 304 models[15] from the 57 brand manufacturers (bigEE, 2015). Unlike refrigeration appliances, the bulk of the models for electric ovens are in the category of large ovens (capacity of >65L).

Market composition

The market for ovens is subdivided into the built-in and free-standing types. The free-standing (referred to as a cooker) is a combined unit of the oven and hob, with the hob fitted at the worktop level. Only 28% of the ovens sold in 2017 were built-in, indicating the extent to which cookers are more common and preferred by South African households (Euromonitor, 2017a). Further, the penetration rate of cookers was commendable with almost three out of four households owning one (i.e. 73.2%) (Euromonitor, 2017a). The built-in type had a penetration rate of 20.6%, and very few households were eager to purchase a range cooker (given the lowest penetration rate of less than 1%) (Euromonitor, 2017a).

> Electric ovens are split into built-in and free-standing, with the latter - termed cookers - being the most common in SA

Collectively, sale of cookers, range cookers and ovens (built-in) generated about R2.9 billion in revenue in 2017, which accounted for roughly 72% of the turnover from large cooking appliances. Given the forecasted CAGR of 5.4%, 4.2% and 4.8% for cookers, ovens and range cookers respectively, sales are

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[14] This study could not identify specific minimum energy ratings recommended for the distinct oven sizes (small, medium and large) in the initial study (FRIDGE, 2012).

[15] http://www.nrcs.org.za/content.asp?subID=68#1

expected to increase to 532 100,199 600, and 5 000 units for the three respective products by the year 2022.

A breakdown of the sales in terms of product origin is given below. It can be observed that the S&L programme did not restructure the market for ovens and cookers, as it is still dominated by local manufacturers.

Table 8-1: Distribution between imports and locally manufactured Cookers and built-in Ovens - 2017

Appliance	Estimated annual inventory		Total units sold p.a.	Estimated value of the market (ZAR million)
	Imports	Locally manufactured or assembled		
Cookers	126 200	459 000	409 600	1 006.3
Ovens (Built-in)	42 400	158 200	162 800	1842.2
Range cookers	Unknown	Unknown	3 900	82.3

(Euromonitor, 2017a)

Prices of electric ovens and associated range of appliances depend on:

- whether it is freestanding or built-in
- if the food is cooked by surrounding it with hot air (static oven) or by circulating the air through the fan (convection type)
- the usable volume

Given a certain size/volume, free-standing units generally cost more than the built-in formats since there is an added component of the cooktop. Additionally, convection ovens have a higher price point than the models with static configuration. Moreover, most of the large-sized models sold on the market have a higher energy rating (Class 'A') than the MEPS.

Figure 8-1 shows prices of the popular ovens in the market. The list excludes range cookers since the degree to which they are used by local households is very low (penetration rate of 0.2%), and the common models have a potential for fuel switching.

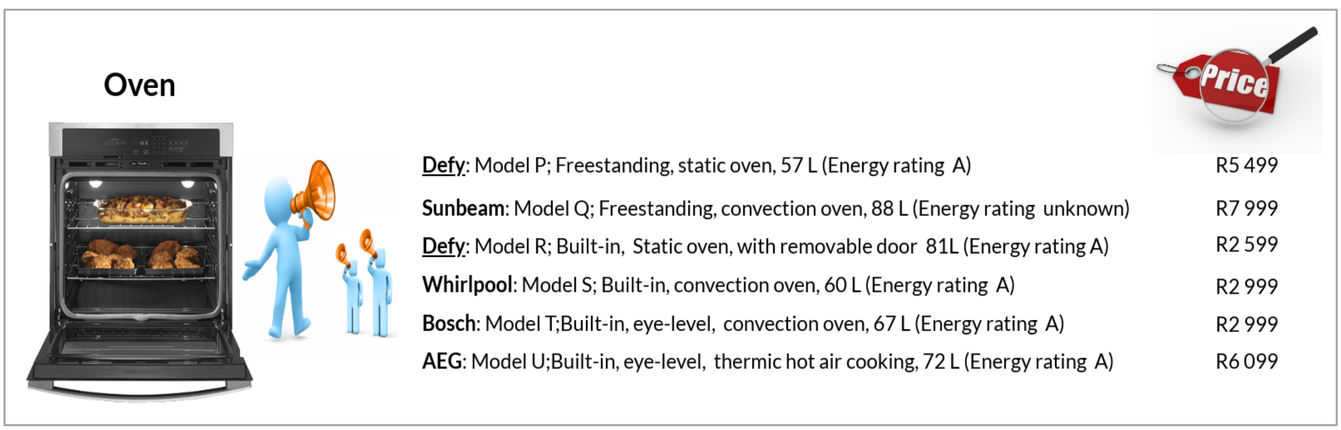


Figure 8-1: Average Prices for Ovens by Major Retailers (Euromonitor, 2017a)

8.3 Industry analysis

A brief overview (see Figure 8-2 below) shows that there are different brand manufacturers in the market segments of the freestanding and built-in ovens. The market for cookers has fewer identifiable brands as compared to the built-in counterparts. Nevertheless, Defy Appliances is the leader in both niche markets. Roughly at least 50% of the products supplied in the two markets are branded by Defy. Private and other labels also appear to have footprint in this sub-market of cooking appliances, by accounting for almost a fifth of the sales in 2017.

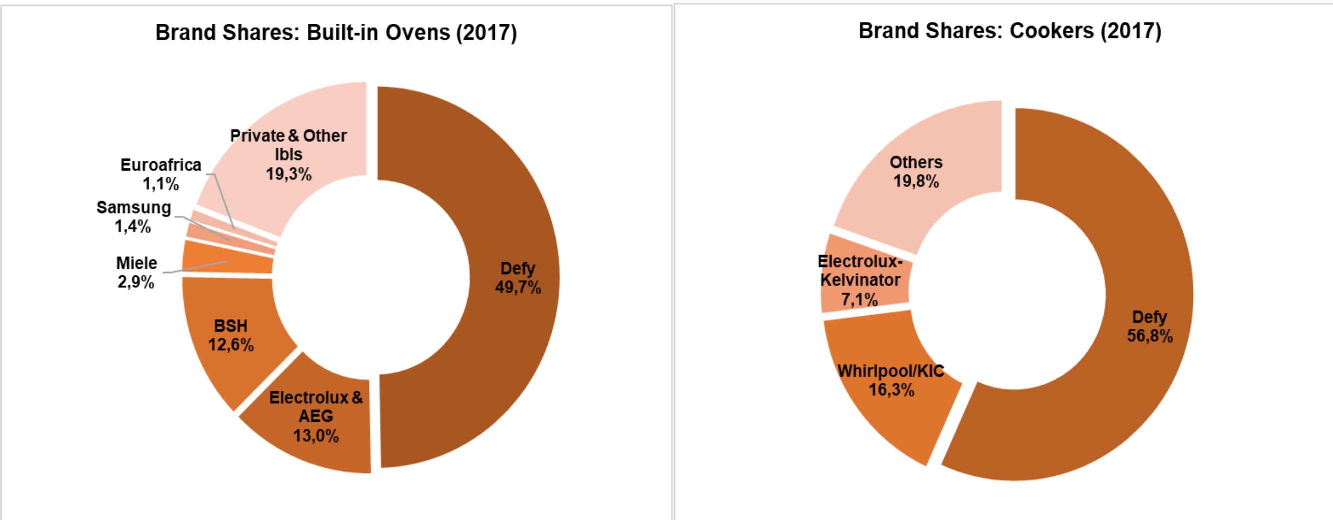


Figure 8-2: Market shares of Oven Manufacturers (Euromonitor, 2017a)

8.4 Usage and applications

Usage and applications

There were approximately 8.3 million ovens in use by households in South Africa in 2010. The number increased to 10.9 million units in 2016, as indicated in Figure 8-3. The historical trend suggests that the stock of this cooking appliance increased further to 11.5 million units at the end of 2017. It is also forecasted that almost 23 million ovens will be operated by households by the year 2032.

Much of the large electric ovens are used by LSM 6 and 7 (as illustrated in Figure 8-4), accounting for 28% and 19% of the oven users in the domestic market, respectively. This upper-middle income segment has also accounted for the largest increases in acquiring more stock, operating almost 500 000 more units per group in 2016.

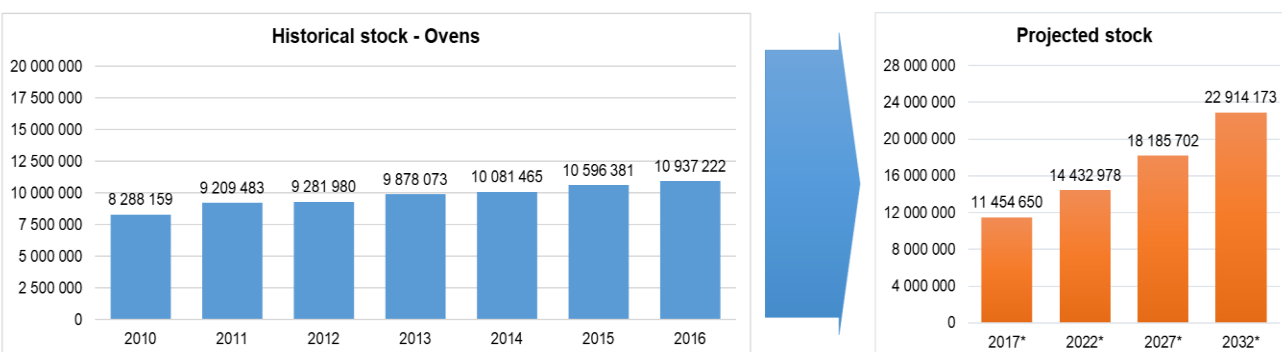


Figure 8-3:Historical and Projected stock – Ovens (Own analysis based on AMPS (2010 – 2016))

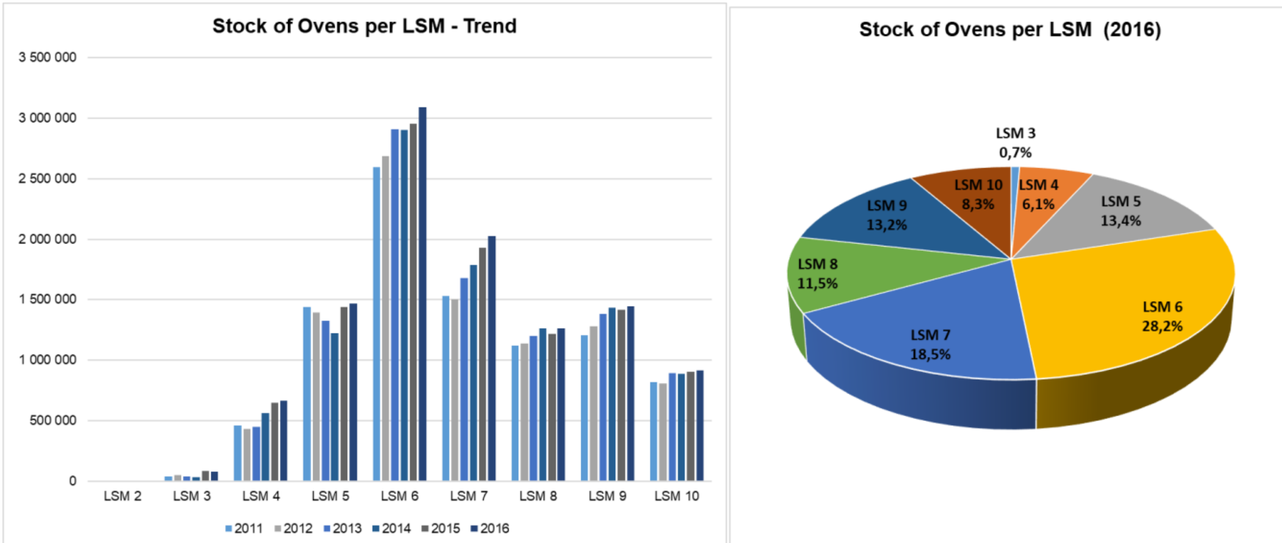


Figure 8-4: Distribution of stock – Ovens (Own analysis based on AMPS (2010 – 2011))

The analysis suggests that the stock of ovens is expected to increase at a CAGR of 4.7%. Narrowed down to income groups, LSM 3 and 4 exhibited the highest growth rates of 14.9% and 7.6% respectively. This illustrates the growing demand for larger cooking appliances by low-income households.

Energy consumption levels

On average, an electric oven of the pre-MEPS period consumed about 702 kWh per annum (bigEE, 2015), translating to a weekly consumption of roughly 13.5 kWh. The total stock of large electric ovens operated by households was estimated to be around 11.5 million units in 2017 (as illustrated in Figure 8-3). The weekly consumption of 155 GWh by the total stock produced an annual demand of about 8 TWh (8 041GWh). Again, similar to the other appliances, this calculation is based on the assumption that the electric ovens currently owned and use by the households have not been entirely replaced by the more energy efficient models since the introduction of MEPS. At the same time, the figures presented below is likely to be somewhat overestimated since there are more than half a million of electric ovens that have being sold on an annual basis since the introduction of MEPS.

Table 8-2: Electric oven – stock and electricity consumption

Appliance	Average weekly consumption (kWh)	Number of appliances (estimated for 2017)	Total electricity consumption per annum (GWh)
Electric Ovens (large)	13.5	11 454 650	8 041

8.5 MEPS opportunities

A few countries appear to have some form of MEPS for electric ovens including Brazil, Costa Rica, Israel and Switzerland (see https://clasp.ngo/policies). North America also has MEPS (Mexico, USA and Canada). Russia nominally has MEPS for electric ovens, but these are very old and are likely to be no longer in force or relevant.

Originally Europe mandated energy labelling for ovens under Commission Directive 2002/40/EC. This was replaced by the energy label specified in *European Commission Delegated Regulation (EU) No 65/2014* (energy labelling). At the same time, new MEPS levels were set for ovens in *Commission*

Regulation (EU) No 66/2014 (**EcoDesign**). The timetable for European MEPS requirements for ovens is as follows:

- 20 February 2015: EEI < 146 (eliminates bottom half of Class C)
- 20 February 2016: EEI < 121 (eliminates bottom half of Class B)
- 20 February 2019: EEI < 96 (eliminates bottom half of Class A)

This EcoDesign directive (for electric ovens) is unusual as it sets MEPS levels in terms of an EEI that does not align with an energy labelling class.

TopTen Europe list around 20 of the highest rating oven models in Europe. While there are a few models with an EEI of less than 80, most models listed are in the range EEI 80 to 82. Given that Class A+ is defined as an EEI of less than <82, **there would seem to be very few models that can achieve an efficiency that is significantly better than Class A** (defined as an EEI < 107). The best models in Europe are just a few percent better than the lower EEI value for Class A.

8.6 Impact analysis

Considering that small electric ovens are already set to Class A, the assessment of the potential impact of setting more stringent MEPS level is investigated only for large ovens. The following table outlines some of the assumptions related to the most common models of large electric ovens of different energy efficiency that can be now found on the market in South Africa. It shows that on average, the more energy efficient large electric ovens of MEPS level A are already cheaper than those that have MEPS level B, which suggests that implementing a MEPS level of Class A is likely to have no effect on consumer accessibility to the appliance or demand.

Table 8-3: Large electric ovens assumptions

Characteristics	MELS level B	MEPS level A	MEPS level A+
Size	80 – 86 l	60 - 78 l	60 - 76 l
Annual electricity consumptions	221.2 kWh	156 kWh	143.5 kWh
Average prices	R5 932	R5 419	R10 549

Improving MEPS even further, to Class A+, though would significantly increase the price of the large electric ovens jeopardising access to this appliance by the largest segment of the target market – LSM 6 and 7. The increase in energy saving of 35%, while having to pay almost double for the appliance would also mean that it would not be considered a good value for money even among the groups of households that could potentially afford it[16]. The above could likely have a negative implication on the demand for the appliance and inadvertently affect the sales volumes and revenues.

[16] If products lie in the middle of A and we force MEPS to A+, the savings will only be half a label grade as the best product in Europe can just make A+.

Table 8-4: Freezer savings and costs calculations

Characteristics	MELS level B	MEPS level A	MEPS level A+
Cost difference	-	-R513	R4 617
Electricity savings – per annum	-	65 kWh	78 kWh
Electricity savings - %		29%	35%
Electricity savings – Rand value		R83	R99
Change in cost vs savings payback period	-	-	99 years
Appliance lifespan	13-20 years	13-20 years	13-20 years

The following table provides an insight into the potential electricity savings that could be derived if the freezers' MEPS level were to be set to Class A – similar to small and medium electric ovens.

Table 8-5: Large electric ovens savings projections

MEPS Level B	Size considered		Average price		Estimated average annual electricity consumption			
	80-86L		*R5932*		*221kWh*			
	Aggregated electricity consumption (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		36.007	37.489	39.126	40.762	42.377	44.146	239.907
MEPS Level A	Size considered		Average price		Estimated average annual electricity consumption			
	60-78L		R5419		156kWh			
	Aggregated electricity consumption (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		25.397	26.442	27.596	28.751	29.89	31.138	169.213
IMPACT ANALYSIS								
B to A	*Price difference*	*R/unit*	-513					
		%	-9%					
	Electricity savings (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		10.610	11.047	11.529	12.011	12.487	13.009	70.694

8.7 Recommendations

a) **Leave MEPS at Class A for small and medium ovens**
b) **Increase MEPS for larger ovens to Class A by 2020**

South Africa is already setting relatively strong MEPS levels at an energy efficiency level of Class A for smaller ovens and Class B for large ovens. These are approximately comparable with current European MEPS levels (slightly weaker for large ovens, slightly stronger for small and medium ovens). A brief review of the best products in Europe reveal that there are only a few models that can achieve an EEI of less than 80. While there appear to be plenty of models that can achieve Class A+, most of these are barely inside the threshold for Class A+. This suggests that **there is very little scope to increase MEPS for smaller electric ovens in South Africa at this stage over and above the existing MEPS levels**.

For larger ovens, the current MEPS level in South Africa is Class B. This is slightly weaker than current European MEPS levels and in 2019 it will be about 1.5 classes weaker than Europe. Based on a review of products in Europe, there appear to be many models for larger ovens that can achieve Class A or A+.

In South Africa, these are also available, and it is important to note that Class A electric ovens cost the same or even cheaper than a similar size Class B electric oven. However, at the same time, Class A+ electric ovens are almost double the price of Class A electric ovens. Considering that the majority of consumers of this appliance fall within the lower- and upper-middle income groups (LSM 5-7), increasing the appliance's MEPS level to Class A+ would most likely make this appliance unaffordable for the biggest segment of the target market and negative impact on the domestic manufacturing industry. An increase of MEPS from Class B to Class A also represents approximately 20%-30% reduction in energy consumption, which is a worthwhile energy saving.

The recommended action is to **leave MEPS at Class A for small and medium ovens and to increase MEPS for larger ovens to Class A by 2020**. This will leave MEPS levels in South Africa at comparable levels to Europe (slightly weaker for all sizes) and on a similar timetable. Increasing MEPS levels by a further 11 EEI points from 107 (Class A) to 96 (European MEPS in 2019) is not recommended as this does not coincide with a label grade, which will make enforcement more difficult.

9 DISHWASHING APPLIANCES

9.1 Context and background

Item	Comment	
Applicable standards and regulations	EE standard	• SANS 941
	Regulation	• VC 9008: ○ Dishwashers shall comply with SANS 941 ○ Dishwashers shall have a minimum energy efficiency rating of Class A.
	Performance measurement standard	• SANS 50242:2010/ EN 50242/EN 60436:2008: Electric dishwashers for household use – methods for measuring performance.
Items regulated	• Household dishwashers	
MEPS level	• Class A	
Test method used	• SANS 941 references *SANS 50242/EN 50242, Electric dishwashers for household use – Methods for measuring the performance* as the official test method for dishwashers. Clause 4.2.3 states: *Household dishwashers shall comply with the requirements for energy and water consumption in SANS 50242, and dishwashers shall carry an energy efficiency label designed in accordance with the national annex on energy labels in SANS 50242*.	

Origins of the performance measurement standard

The foreword of SANS 50242 states: *This national standard is the identical adoption of EN 50242/ EN 60436, but with the addition of a national annex on the energy labelling of dishwashers. The label design and the technical information required for the calculation of energy classes were obtained from European Directive 1997/17/EC*. This EN standard is based on IEC 60436 (Edition 3 published in 2003) but with some European modifications. These common modifications to the IEC standard are listed as Annex Z in the EN standard and are shown in red text throughout the standard.

A brief summary of the main differences between EN 50242 and IEC 60436 (Edition 3) are:

- Only a cold-water connection is permitted
- Specified voltage and frequency for Europe
- Modified room temperature and humidity (these were altered in a later IEC amendment Edition 3)
- Only hard water permitted
- Modified detergent dose and rinse aid
- Age limit on load items
- Oven drying is required (air drying not permitted)
- Small variations in specified soils, preparation and application
- Glass soiled with milk also loaded to the oven for drying
- Minor adjustments to calculations and reporting
- Changes to the thermal oven specification.

The latest version of the IEC standard is IEC 60436 Edition 4 was published in October 2015. This includes many of the changes included in the EN common modifications (but not all). Note that SANS 50242 does not include any measurement of low power modes. This was included in IEC 60436 Edition 3 Amendment 2 in 2012. Furthermore, the current SANS 50242 only includes the original reference machine specification - Miele G590, which has not been commercially available since 2000. A **new reference machine Miele G1223 (reference) was included in IEC 60436 Amendment 1 in 2009, but this is not included in SANS 50242 standard**. This may be **an issue for any new test laboratory that attempts to acquire a reference machine**.

Current MEPS level

The current MEPS levels for dishwashing machines is Class 'A'. This minimum energy rating applies to all dishwashers for household use. Similar to automatic washing machines and washer-dryer combinations, the manufacturers consulted at the time of the original study in 2012 confirmed that the market for dishwashers relied on imports (FRIDGE, 2012). Thus, the baseline energy rating was derived from the common models imported. As a result, the recommended MEPS level was set to Class 'A', also supported by the suppliers.

9.2 Market description and composition

Market description

The survey conducted indicated that about 22 brand manufacturers[17] provide at least 123 models (bigEE, 2015) of dishwashing appliances in the local market.

Market composition

The sales volume of dishwashers grew by 7.8% from 2012 to reach 95 400 units in 2017 (Euromonitor, 2017a). The annual turnover was around R727.3 million in 2017. Dishwashers are still perceived as a non-essential appliance, given the low penetration rate of 11% (Euromonitor, 2017a). Many households continue to hand wash dishes, considering the initial cost of acquiring this appliance coupled with the rising cost of utilities. Regardless, sales of dishwashers are expected to increase (CAGR of 2.6%) resulting in a turnover of approximately 108 600 units in 2022 (Euromonitor, 2017a).

Dishwashers are primarily imported with full-size being the most common and popular design

About 90% of the new stock of dishwashers in 2017 was imported, with the remaining portion being assembled/produced locally (as demonstrated in Table 9-1). The dominance of importers in delivering this product to the local market has continued after the adoption of the energy efficiency standards.

Table 9-1: Distribution between imports and locally manufactured Dishwashers - 2017

Appliance	Estimated annual inventory		Total units sold p.a.	Estimated value of the market (ZAR million)
	Imports	Locally manufactured/assembled		
Dishwashers	88 100	9 900	95 400	727.3

(Euromonitor, 2017a)

[17] http://www.nrcs.org.za/content.asp?subID=68#1

The data on sales of dishwashing appliances also indicates a breakdown by type of configuration. As illustrated in Figure 9-1, full size dishwashers were the most popularly purchased design among all the other formats. The table-top, compact and slimline layouts accounted for the remaining 19% of sales.

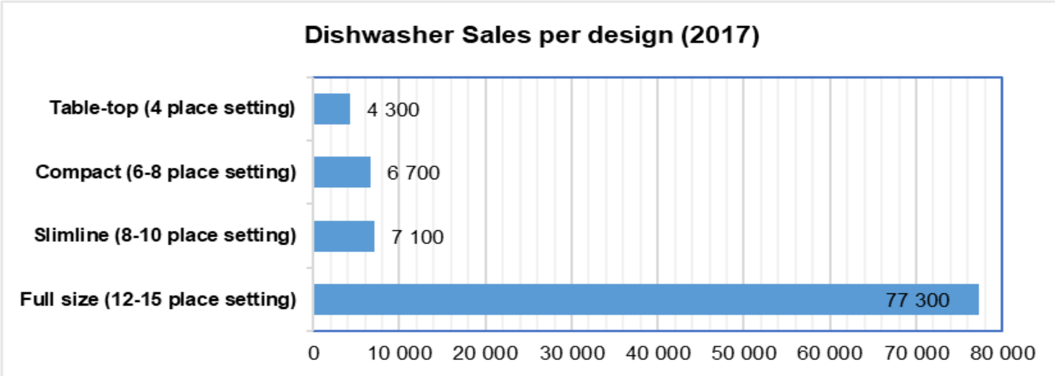


Figure 9-1: Sales of Dishwashers by format (Euromonitor, 2017a)

Figure 9-2 shows the prices of the commonly sold dishwashers in the domestic market. Worth noting is that the popular models have a higher energy rating ('A+' or better) than the current MEPS level.

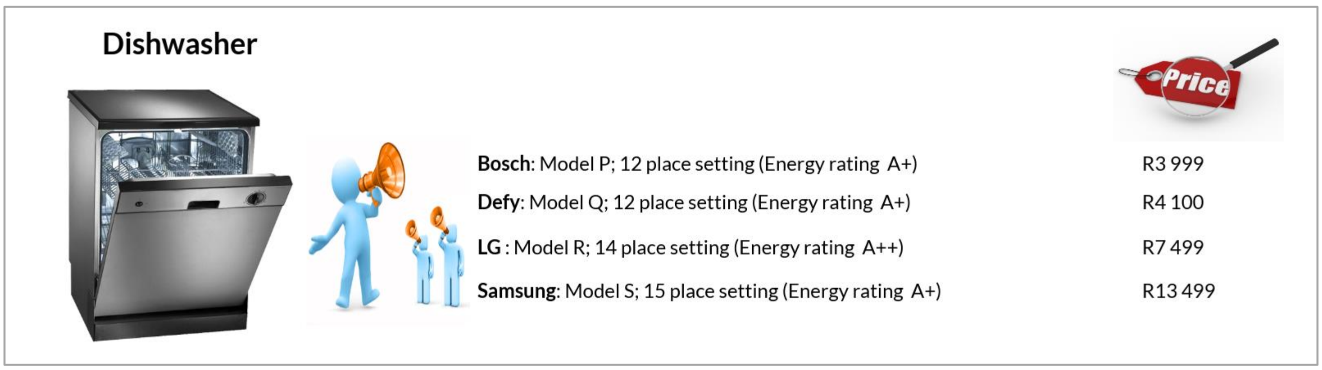


Figure 9-2: Average Prices for Dishwashers by Major Retailers (Euromonitor, 2017a)

9.3 Industry analysis

Defy Appliances and the BSH group are the prime leaders in the manufacturing and distribution of dishwashing appliances within the domestic market (refer to Figure 9-3). Samsung and LG have equivalent market shares, with the two companies supplying a combined two-thirds of the sales units in 2017.

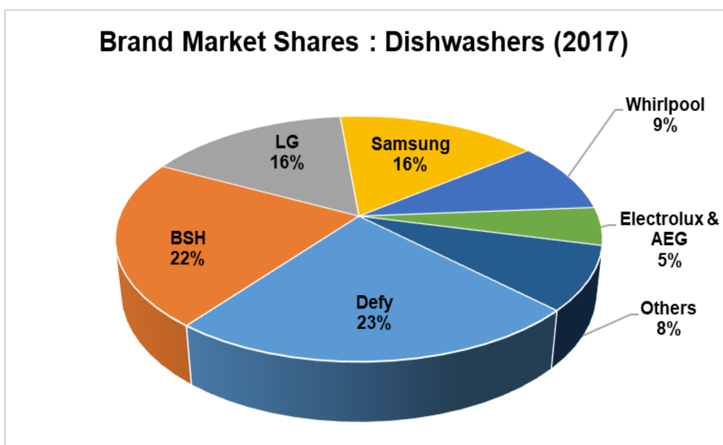


Figure 9-3: Market shares of Dishwasher manufacturers (Euromonitor, 2017a)

9.4 Usage and application

The number of dishwashers owned by households grew from 2014 to 2016, despite the earlier signs of decreasing demand from 2012 to 2014 (as shown in Figure 9-4). It is estimated that about 550 000 dishwashers were in use in local households in 2016, showing an increase of 90 000 units from 2010. The trend suggests that the stock increased to approximately 570 000 units at the end of 2017, and it is further anticipated to grow to 870 000 units by the year 2032.

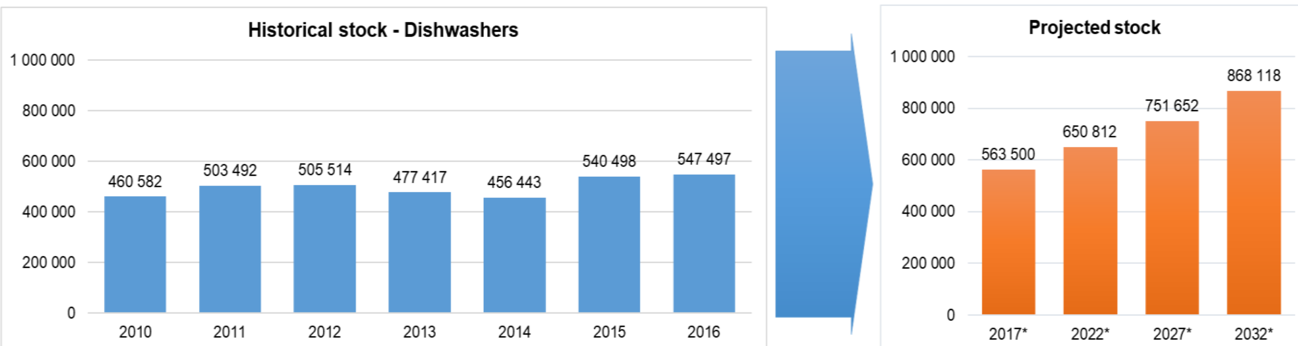


Figure 9-4: Historical and Projected stock - Dishwashers (Own analysis based on AMPS (2010 – 2016))

Figure 9-5 depicts distribution of stock of dishwashers across the users (LSM 6 – 10 households). Just over two-thirds of dishwasher users are in the top-income category, and about one in every five dishwashers purchased will be operated by a household in LSM 9. Also, households in LSM 9 and 10 accounted for the greatest increases in acquiring more dishwashers – owning 25 000 and 20 000 more units in 2016 compared to 2011, respectively.

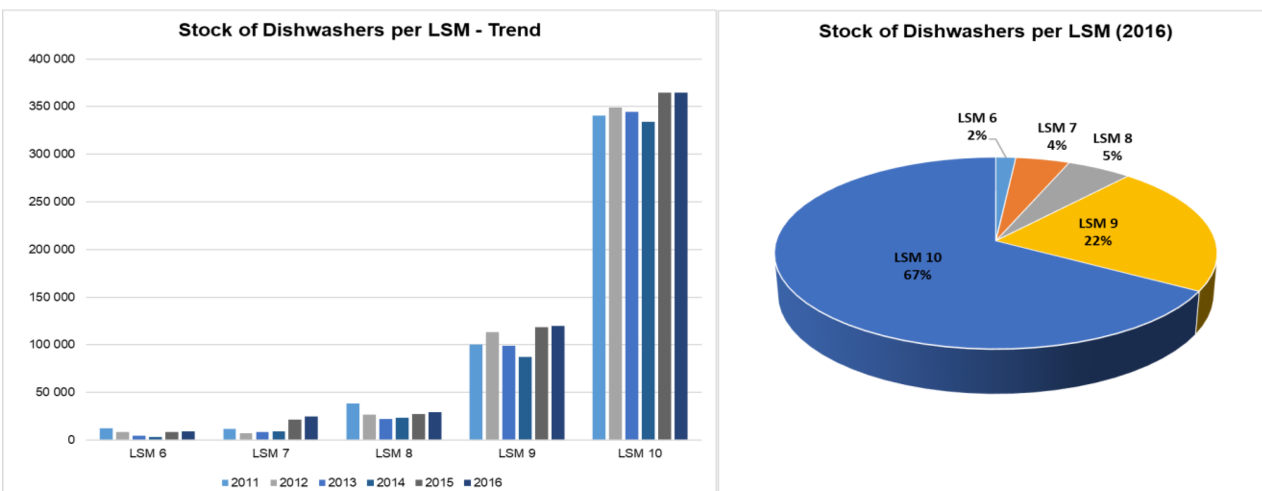


Figure 9-5: Distribution of stock – Dishwashers (Own analysis based on AMPS (2010 – 2016))

On average, the stock of dishwashers is expected to increase at a CAGR of 2.9%. As suggested earlier, ownership of this appliance is expected to increase particularly among the upper-middle to high-end consumers. Although LSM 9 – 10 groups accounted for the largest increases in ownership, the use of dishwashers is expected to increase rapidly among households in LSM 7 category. The CAGR of dishwasher ownership by LSM 7 households was estimated to be 16.1%, albeit from a low base.

9.5 MEPS opportunities

The energy labelling of dishwashers in South Africa is aligned with the original specifications in European *Commission Directive 97/17/EC* (from 1997). The label specifies efficiency classes from A to G, energy in kWh/cycle, cleaning and drying performance A to G, place settings and water consumption in litres per cycle. The energy efficiency, washing efficiency and drying efficiency classes are identical to those in *Commission Directive 97/17/EC*. Effectively the energy efficiency classes are defined relative to a reference line C_R which is 1.35 + 0.025 × S for 10 or more place settings and 0.45 + 0.09 × S for less than 10 place settings (where S is place settings). The EEI is defined as the measured energy for the cycle over the reference energy C_R.

In 2010 updated energy labelling requirements for dishwashers in Europe were contained in *Commission Delegated Regulation (EU) No 1059/2010*. The update included:

- Three new energy efficiency classes (A+, A++ and A+++)
- Removing of the washing performance Classes E to G
- Conversion of energy and water to a per annum value (based on 280 cycles per year)
- Adding low power mode energy into the overall energy

The A to G scale for drying performance was retained (the scale remained unchanged). The old and new energy efficiency classes are summarised in Table 9-2.

Table 9-2: Energy efficiency classes for dishwashers

Energy Efficiency Grade	SANS 50242 Directive 97/17/EC	Regulation (EU) No 1059/2010
A+++	N/A	EEI < 50
A++	N/A	50 ≤ EEI < 56
A+	N/A	56 ≤ EEI < 63
A	EEI < 64	63 ≤ EEI < 71
B	64 ≤ EEI < 76	71 ≤ EEI < 80
C	76 ≤ EEI < 88	80 ≤ EEI < 90
D	88 ≤ EEI < 100	EEI ≥ 90
E	100 ≤ EEI < 112	N/A
F	112 ≤ EEI < 124	N/A
G	EEI ≥ 124	N/A

Note: EEI is expressed as points or percentage

There are differences in the energy calculation in *Commission Delegated Regulation (EU) No 1059/2010* as the energy has been converted to an annual value (which includes low power mode energy). However, the reference line is effectively the same (per cycle reference times 280 cycles per year). Note that the new labelling regulation in Europe has adjusted the efficiency class break points for all efficiency classes, but particularly around Class A and B.

Commission Regulation (EU) No 1016/2010 (**EcoDesign**) set MEPS levels and performance requirements for dishwashers as follows:

- December 2011: energy efficiency Class A or better, cleaning performance of Class B or better (Pc ≥ 1.12)
- December 2013: energy efficiency Class A+ or better for 10 or more place settings, drying performance Class A for 8 or more place settings and Class B for 7 or less place settings

- December 2016: energy efficiency Class A+ or better for 8 and 9 place settings
- Minimum cleaning and drying performance requirements were specified and cleaning performance was removed from the dishwasher label

Notes: *Dishwashers with 10 place settings and a width≤ 450mm had a different timetable for MEPS, which is not included above.*

An important point to note for dishwashers is that generally the label classes are quite narrow as shown in Table 9-2. The difference in energy between Class A and Class A+, for example, is just 12%.

TopTen list many dishwasher models that are able to attain an EEI of less than 50 (efficiency Class A+++ under the new EU scale) with a few models achieving an EEI below 40. No sales weighted data for dishwashers is currently available for Europe, but it would appear that a significant number of models are able to reach Class A++ or better efficiency.

Globally, outside of Europe there are few countries that set MEPS for dishwashers. Several countries in the Middle East have requirements that broadly follow Europe. USA and Canada have MEPS levels, but these are not equivalent because of differences in test conditions (water supply temperatures – most dishwashers are connected to hot water) and the absence of washing and drying performance measurements in North America (non-sensing dishwashers are tested with a clean load). Korea has set MEPS levels, but it is unclear how these would translate under the IEC test method (no details of testing are available). So, this data suggests that Europe currently has the most comprehensive and stringent MEPS levels globally.

9.6 Recommendations

As is evident from Table 9-2 that the energy label efficiency classes appear to have been adjusted slightly under the new EU labelling regulation in 2010. This is likely in part to take low power mode energy into account and other small changes in the test procedure. However, in general terms, the new energy efficiency classes are slightly narrower (10 EEI points per class for lower classes and less than 8 points per class for higher classes) compared to the original labelling classes (all 12 points per class). The energy efficiency classes in *Commission Delegated Regulation (EU) No 1059/2010* (energy labelling) can be considered only to be very broadly equivalent to those in SANS 50242 and not directly equivalent due to these adjustments.

a) **Leave MEPS for dishwashers at Class A**
b) **Phase in specification of minimum washing and drying performance levels for new dishwashers**
c) **Adopt a more up to date test method with the new reference machine and the measurement of low power modes**
d) **Realign labelling requirements to include low power mode energy**

It is useful to examine Class A, which is where MEPS levels are currently set in South Africa. Under the SANS 50242 system, Class A is defined as an EEI of < 64, while under the new labelling regulation, Class A+ is defined as an EEI of < 63. Given that standby power is generally fairly low for dishwashers in general (or should be), this puts the current MEPS levels in SANS 50242 for South Africa (Class A) for a low standby dishwasher to be approximately equivalent to the current MEPS level of A+ as defined in *Commission Regulation (EU) No 1016/2010* (EcoDesign).

It would appear that there are many high efficiency dishwashers on the market in Europe. Given that the current MEPS level in South Africa is approximately equivalent to current MEPS levels in Europe in any case, there is no strong case to increase MEPS levels any further. It is important to note that European **EcoDesign requirements specify minimum washing and drying performance levels for new dishwashers**. Specifying MEPS for dishwashers without any benchmark requirement for cleaning and drying performance is potentially dangerous and could undermine the integrity of the programme and degrade the energy service that consumers are delivered by this appliance. It is strongly recommended that minimum cleaning and drying performance requirements be adopted for South Africa to align with those specified in European regulations as part of this regulatory change.. Consideration should also be given **to adopting a more up to date test method with the new reference machine and the measurement of low power modes**, to bring this more closely into line with the current European requirements. The test method should be updated to include the newest reference machine as the one currently specified is not available. This would be most expediently achieved by using the latest EN standard. **Labelling requirements should also be realigned to include low power mode energy**.

10 AIR-CONDITIONING APPLIANCES

10.1 Context and background

<table>
<tr><th>Item</th><th colspan="2">Comment</th></tr>
<tr><td rowspan="3">Applicable standards and regulations</td><td>EE standard</td><td>• SANS 941</td></tr>
<tr><td>Regulation</td><td>• VC 9008:
o Air conditioners shall comply with SANS 941
o Air conditioners shall have a minimum energy efficiency rating of Class B.</td></tr>
<tr><td>Performance measurement standard</td><td>• 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</td></tr>
<tr><td>Items regulated</td><td colspan="2">• Wall mounted spilt air conditioners
• Window air conditioners
• Portable air conditioners</td></tr>
<tr><td>MEPS level</td><td colspan="2">• Class B</td></tr>
<tr><td>Test method used</td><td colspan="2">• SANS 941 references SANS 54511-3/EN 14511-3, Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 3: Test methods as the official test method for air conditioners. Clause 4.2.1 states: Air conditioners and heat pumps for space heating and cooling shall comply with the requirements of SANS 54511-3, and shall carry an energy efficiency label designed in accordance with the national annex on energy labels in SANS 54511-3.
• The foreword of SANS 54511-3 states: This national standard is the identical adoption of EN 14511-3, but with the addition of a national annex on the energy efficiency of air conditioners. The technical information required for the calculation of energy classes were obtained from European Directive.
• While SANS 54511-3 does contain detailed test methods, the conditions of measurement for capacity and energy consumption are defined in EN 14511-2 (test conditions), which is only indirectly cited in SANS 54511-3 in Annex AA.</td></tr>
</table>

Origins of the performance measurement standard

SANS 54511-3 is an identical adoption of EN 14511-3:2013 (Edition 3). This European Standard is made up of four parts as follows:

- EN 14511-1: Terms, definitions and classification
- EN 14511-2: Test conditions
- EN 14511-3: Test methods
- EN 14511-4: Operating requirements, marking and instructions.

The test conditions applicable to South Africa are as cited in SANS 54511-2, which mirrors EN 14511-2. Table 3 of SANS 54511-2 specifies the indoor and outdoor conditions for heating mode tests. Table 4 of SANS 54511-2 specifies the indoor and outdoor conditions for cooling mode tests. For split systems and window types, these test conditions are the same as ISO conditions for air-to-air source heat pumps and air conditioners as follows:

- Cooling condition T1: indoor 27°C dry bulb and 19°C wet bulb, outdoor 35°C dry bulb and 24°C wet bulb
- Heating condition H1: indoor 20°C dry bulb and 15°C (max) wet bulb, outdoor 7°C dry bulb and 6°C wet bulb.

SANS 54511-2 for double duct systems (nominally portable), the test conditions are:

- Cooling condition: indoor and outdoor 35°C dry bulb and 24°C wet bulb
- Heating condition: indoor and outdoor 20°C dry bulb and 12°C (max) wet bulb.

SANS 54511-2 for single duct systems (nominally portable), the test conditions are:

- Cooling condition: indoor and outdoor 35°C dry bulb and 24°C wet bulb
- Heating condition: not specified, but an indoor and outdoor 20°C dry bulb and 12°C (max) wet bulb is specified in *Commission Regulation (EU) No 206/2012*.

These **ISO conditions (T1 and H1) for split and window types are widely used around the world to rate the performance of air conditioners and heat pumps**.

Europe uses a seasonal rating approach for many types of air conditioners, which requires testing at several different conditions in addition to the ISO rating conditions, depending on the product type (mainly dependent on whether the compressor is single speed, multi-speed or variable speed). These are then combined in a specified way to reflect average usage conditions in Europe. The details are set out in *Commission Regulation (EU) No 206/2012*. Additional climate ratings are available in ISO standard (T2, T3, H2 and H3), but these are not commonly used for ratings in milder climates like South Africa and Europe.

The energy labelling (and therefore MEPS) requirements for South Africa are based on the measured Energy Efficiency Ratio (EER or cooling efficiency) and the measured Coefficient of Performance (COP or heating efficiency) at rated capacity rather than a seasonal rating. I**n terms of measured energy efficiency, label classes differ by type of product** as shown in Table 10-1.

Table 10-1: Comparison of efficiency level by label class for different types of air conditioners in South Africa

Efficiency level	Split type	Portable type	Window type
EER/COP > 3.6	A++	A	A
3.6 ≥ EER/COP > 3.4	A+	A	A
3.4 ≥ EER/COP > 3.2	A	A	A
3.2 ≥ EER/COP > 3.0	B	A	A
3.0 ≥ EER/COP > 2.8	C	A	B
2.8 ≥ EER/COP > 2.6	D	A	C
2.6 ≥ EER/COP > 2.4	E	B	D
2.4 ≥ EER/COP > 2.2	E	C	E
2.2 ≥ EER/COP > 2.0	E	D	F
2.0 ≥ EER/COP > 1.8	E	E	G
1.8 ≥ EER/COP > 1.6	E	F	G
1.6 ≥ EER/COP	E	G	G

Note: Classes shown with orange shading are not permitted under MEPS in VC9008.

Current MEPS level

Three different types of air conditioners were earmarked for regulation in South Africa, with 'B' as the minimum energy rating. The **MEPS level stipulated in VC9008 applies to all the window, portable and wall mounted split units which have a cooling capacity of 7.1kW (24 000btu/h), or lower**. The minimum energy rating was suggested based on the BUENAS analysis[18], since insufficient information was provided by the manufacturers at the time of the initial investigation (FRIDGE, 2012). The methodology employed to estimate potential energy savings used comparison of the Business as Usual (BAU) unit energy consumption with unit energy consumption in the Efficient (EFF) case. Although air conditioners were expected to have a low penetration rate, they were ranked third in terms of potential savings due to their high hourly usage (especially the reversible spilt systems). It was argued that the most effective policy would impact on at least 50% of the models in the market (FRIDGE, 2012). Based on the average unit energy consumption (UEC), about 54% of the air-conditioners had an energy rating of 'C' or lower (FRIDGE, 2012). Thus, the recommendation and subsequent adoption of Class 'B' as the minimum energy rating was expected to generate significant potential energy savings.

While the VC9008 stipulates that window, split-type, and portable air-conditioners should comply with the level B minimum energy requirements, **engagements with the industry during the current study however revealed that the window, console, and portable air-conditioners are exempted from the MEPS and labelling regulations**. **Only the wall mounted split-type air-conditioners with a cooling capacity of 7.1kW (24 000btu/h) or lower are being subjected to the energy efficiency regulations**. Because of the wording used in the regulation, it is even understood that ceiling mounted split-type air-conditioners within the set cooling capacity threshold are also exempted.

> Window, console, and portable air-conditioners are **exempted** from the regulations at the moment; ceiling mounted split-type air-conditioners are **excluded** by virtue of the "definition" used in the regulation

10.2 Market description

Market description

A separate database is to be provided showing the range of brands and energy efficiency classes of the popular models in the market.

Market composition

A total of 294 100 air conditioners were sold in the local market in 2017 (Euromonitor, 2017a). **The majority (about 98%) of the units supplied in the domestic market were the wall mounted split type**, which generated R1.3 billion in revenue. Discussions held with the industry revealed that the

[18] Bottom-up Energy Analysis System (BUENAS) was used to determine the potential savings of planned South African MEPS to compare and complement recommendations derived from consultations with manufacturers. However, BUENAS was preferred in the case of air-conditioners as insufficient data was provided from the engagement (FRIDGE, 2012).

demand and use of split units are for both residential and commercial application, with those of a capacity below 8.8 kW mainly for residential use. The sales volume of split units grew by roughly 13%, when comparing with the turnover in 2012 (Euromonitor, 2017a). Given a CAGR of 2.4%, it is predicted that around 350 500 units will be sold in 2022 (Euromonitor, 2017a).

Wall mounted units are the dominant type of air-conditioners, which are used both in residential (high income HHs mainly) and commercial applications.

The **trends for portable and window air conditioners are very different from the picture reflected in the market for split systems**. In 2017, suppliers distributed an overall 6 700 units for portable and window air-conditioners (Euromonitor, 2017a). Portables are mainly used for residential application, and the demand is driven by the following reasons, among other factors:

- More affordable relative to split units, and one does not incur installation costs
- In some cases, body corporates and many home owners restrict installation of wall and window air-conditioners in apartments/flats, which forces the resident to opt for a portable cooling unit

According to the industry experts, **at least 90% of the window units sold are for commercial application**, citing the mobile office containers and telecommunication base stations as the key users of this technology. The turnover in 2017 showed a decrease in sales volume by 0.4% and 60.2% for portable and window air conditioners, respectively, when compared with the turnover in 2012 (Euromonitor, 2017a). The market outlook from Euromonitor suggests that the supply will decrease at a compounded annual rate of 0.3% and 24.9%, resulting in sales of 2 600 and 1 000 units in the year 2022 for portable and window air conditioners, respectively.

Use of portable units are on the rise stimulated by the residential market; while sales of window units are on a decline and mainly used in mobile office containers and telecom base stations

The penetration rate for split air conditioners was gauged to be 18.5% (Euromonitor, 2017a). Less than 1% of the households in South Africa have either a portable air conditioner, or a window air conditioning system (Euromonitor, 2017a). This shows that in general, air conditioners have a small market relative to the population, with **the majority of the units purchased by the high-end market**. Moreover, it is argued that **households in the lower to middle-income brackets find cooling fans as an affordable and appealing alternative to air conditioners** (Euromonitor, 2017a).

Table 10-2 shows the structure of the market for air conditioners in terms of the distribution between locally manufactured and the imported supplies. The sector is clearly still dominated by imports.

Table 10-2: Distribution between imports and locally manufactured Air conditioners

Appliance	Estimated annual inventory		Total units sold p.a.	Estimated value of the market (ZAR million)
	Imports	Locally manufactured/assembled		
Portable	24 000	3 500	2 400	13.5
Split	143 200	34 300	287 400	1 342.2
Window	1 800	1 500	4 300	16.7

(Euromonitor, 2017a)

10.3 Industry analysis

Based on the information gathered from the industry representatives, **local manufacturing of air conditioners for household use was discontinued**. Commercial air-conditioners, which have a capacity of at least 50 kW are still being manufactured locally, with a few manufacturing plants located in Cape Town, Durban, and Johannesburg.

Suppliers of air-conditioners in South Africa are grouped into international brands, representatives or agencies, and independent distributors.

The companies involved in the distribution channel of air-conditioners for household use to the end user in the domestic market are classified into three main categories below:

- *International brands* with direct subsidiaries in the local market
- *Representatives or agencies*, distributing on behalf of international companies
- Private companies, commonly referred to as *independent distributors* who sell air conditioners under their own brands, which were manufactured "to order" from a catalogue of various designs and specifications by the equipment manufactures outside South Africa (mainly in Asia)

Independent distributors supply about 50% - 60% of the air-conditioners (of the capacity below 7.1kW) sold to the local market. Based on some industry representatives, it was suggested that this segment of the market is of particular concern. Independent distributors purchase the air conditioners from the original equipment manufacturers, which offer a catalogue of different types, models, and designs of products. These products are then branded under the name the independent distributor chooses. While some of the large original equipment manufacturers adhere to strict standards, it cannot be said for everyone; in reality, it is possible to purchase a small batch of air conditioners labelled at the required MEPS yet they would not withstand the compliance test if they were to be actually tested.

Having said the above, there is still competition between established manufacturers and private brands. Looking at an **overview of the market shares in the overall market** (see Figure 10-1), almost a third of the total air conditioners supplied are manufactured by LG. Samsung also has a significant footprint in this market, supplying a fifth of the units sold in 2017 (Euromonitor, 2017a). No-name and private brands supplied around 28% of the units. The persistence of these brands is sustained by the demand for cheaper air conditioners, particularly by consumers who cannot afford perceived "expensive" brands such as LG and Samsung.

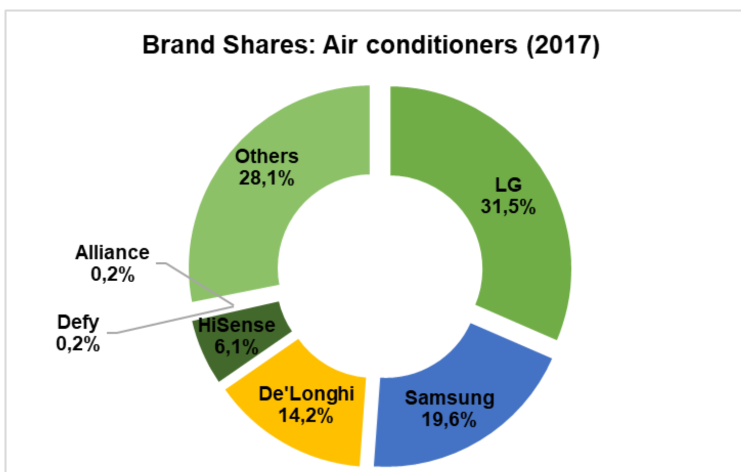


Figure 10-1: Market shares of Air conditioner manufacturers (Euromonitor, 2017a)

The analyses of the market shares of brands among the three different types of air-conditioners further indicates that LG proved to be the lead manufacturer in both the market for window and split systems, with a very low performance in the supply of portable air conditioners. Samsung also demonstrated to be pertinent, especially in the market for portables and split systems. Although Defy Appliances withdrew from the market due to the intense competition (FRIDGE, 2012), they still supplied at least a quarter of the portable units sold in 2017.

LG dominates the market of split and window A/C; with Defy, Samsung and alliance being the most common brands among portable A/C

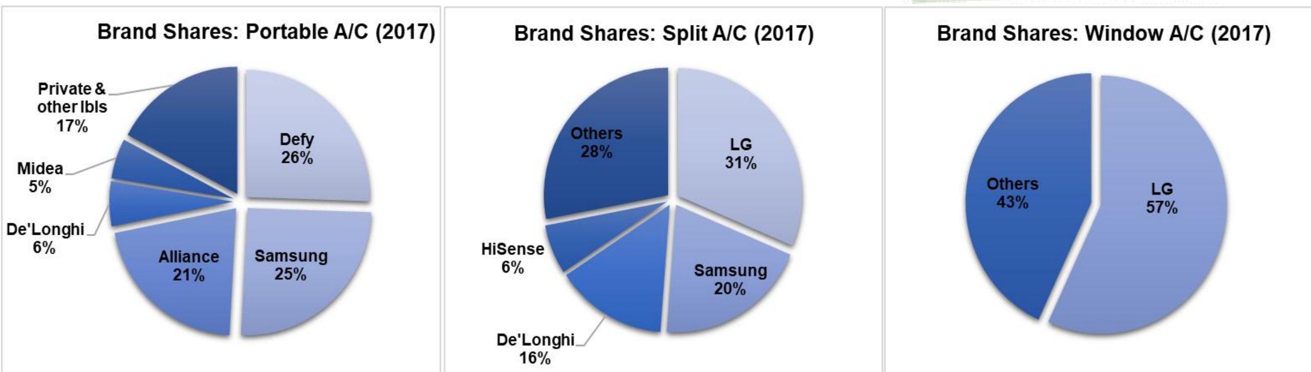


Figure 10-2: Market shares of manufacturers for the diverse types of Air conditioners (Euromonitor, 2017a)

Table 10-3 provides a summary of the market for air conditioners, mainly for household use. Another concern expressed by the representatives was the issue of dumping of energy inefficient models. South Africa's lack of testing facilities, and the inability to verify the authenticity of energy ratings of air-conditioners gives a leeway for direct importers and other independent distributors to distribute models labelled with a higher energy rating, yet the actual energy rating will be very low.

Table 10-3: Profile of the market for Air-conditioners

	Importers		***SA-manufactures***
Composition of the industry	Some of the key suppliers are classified into the following categories:		• Local manufacturing of air-conditioners for household use was discontinued.
	International brands with direct subsidiaries:	• Samsung • LG • Daikin	
	Agencies:	• MS Aircon, on behalf of Mitsubishi • Airco, distributes for Fujitsu • Redbase, distributing for Trane Fourways, on behalf of Samsung • AHI Carrier, distributing for Toshiba	
	Independent distributors:	• Midea • Alliance • GMC Aircon • Jet-Air • Aux	

Market dominance	• The market for air-conditioners for household use is dominated exclusively by imports. Moreover, there is still competition between established international brands and private brands supplied by independent distributors.
Price comparison	• The average price of a portable unit with 'D' energy rating is R5 000. An 'A' rated inverter reverse-cycle split system air-conditioner costs R7 000 on average.

10.4 Usage, application and energy consumption

Usage

About 745 000 air conditioners were utilised by households in 2016, showing an increase of about 230 000 units from the usage in 2010, as illustrated in Figure 10-3 (AMPS, 2010-2016). It is predicted that the stock increased even further, to roughly 790 000 units at the end of 2017. The trend in household usage patterns suggests that the stock will increase to about 1.99 million by 2032.

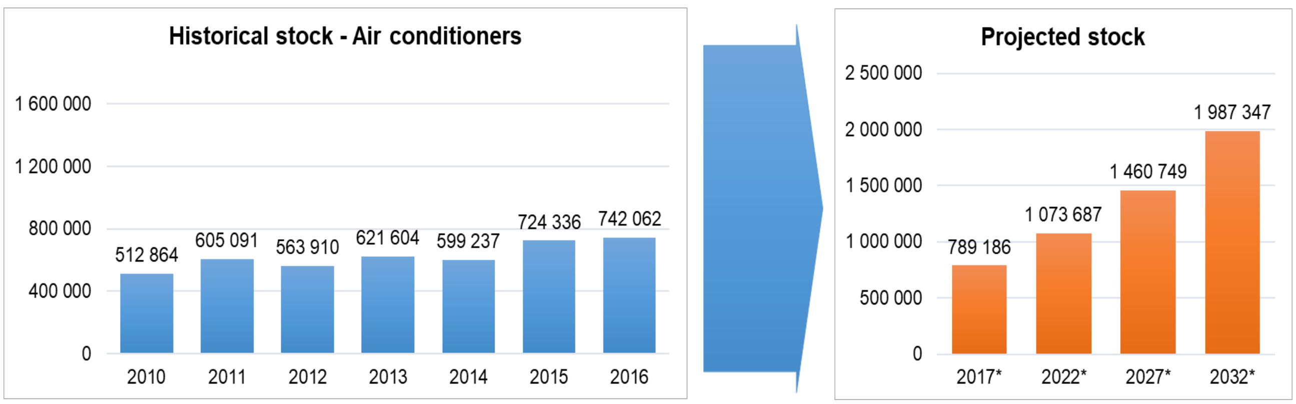
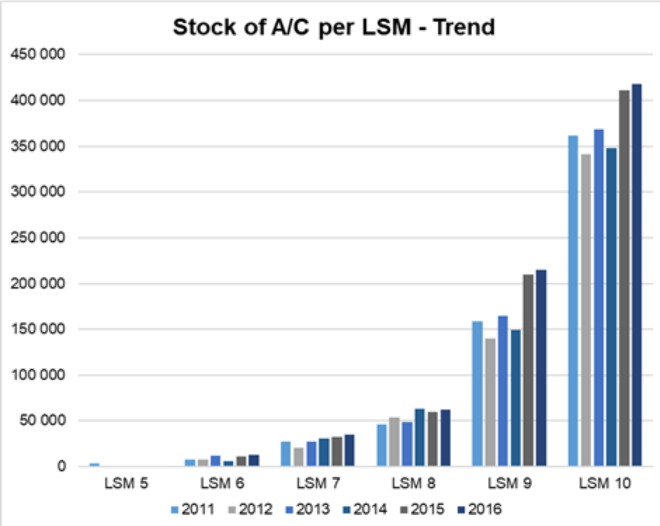


Figure 10-3: Historical and Projected stock - Air conditioners (Own analysis based on AMPS (2010-2016))

Distribution of stock shows that air-conditioners are used by the upper-middle to high-income households (refer to Figure 10-4). The bulk of the air-conditioners is operated by the LSM 9 and 10 groups, having a share of 29% and 56%, respectively. Additionally, the data suggests that the two LSM groups proved to have purchased more units over the past few years (AMPS, 2010-2016). LSM 9 and 10 operated about 56 200 and 55 900 more units in 2016 when compared to the usage in 2011, respectively.

On average, the stock of air conditioners is anticipated to increase at a CAGR of 6.4%, with a low growth in stock expected from the LSM 10 group. Utilisation of air conditioners grew much faster among households in LSM 6 group (CAGR of 9.9%), although from a low base when compared with the other LSM groups.

The industry representatives also suggested that ownership of air-conditioners is relatively high in coastal areas (specifically in KwaZuluNatal – at 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. This is also confirmed by the analysis of the penetration rates at the provincial level, depicted in Figure 10-5. As an example, a penetration rate of 12% shown for KZN would imply that 120 in every 1 000 households (or 12 in every 100 households) within the province own at least one air-conditioner. However, with respect to replacement, the lifespan of an air conditioner in KZN is generally reduced from 15 – 20 years, as is the case with other more in-land provinces such as Gauteng, to about 4 – 5 years due to high level of corrosion.



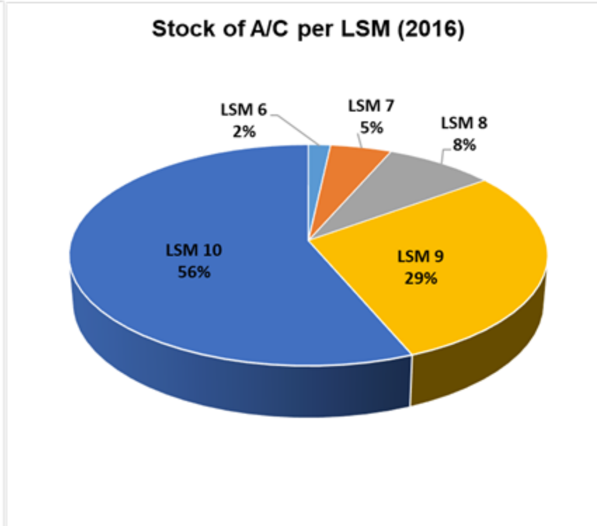


Figure 10-4: Distribution of Stock – Air conditioners (AMPS, 2010-2016)

An assessment of household penetration rates of air-conditioners at the provincial level also suggests that Gauteng (5.3% or 53 in every 1 000 households) is the province with the second largest penetration rate, followed by the Western Cape (3.4% or 34 in every 1 000 households) and Mpumalanga Provinces (3.2% or 32 in every 1 000 households). The Eastern Cape Province had the lowest penetration rate of 1.2% (or 12 in every 1 000 households).

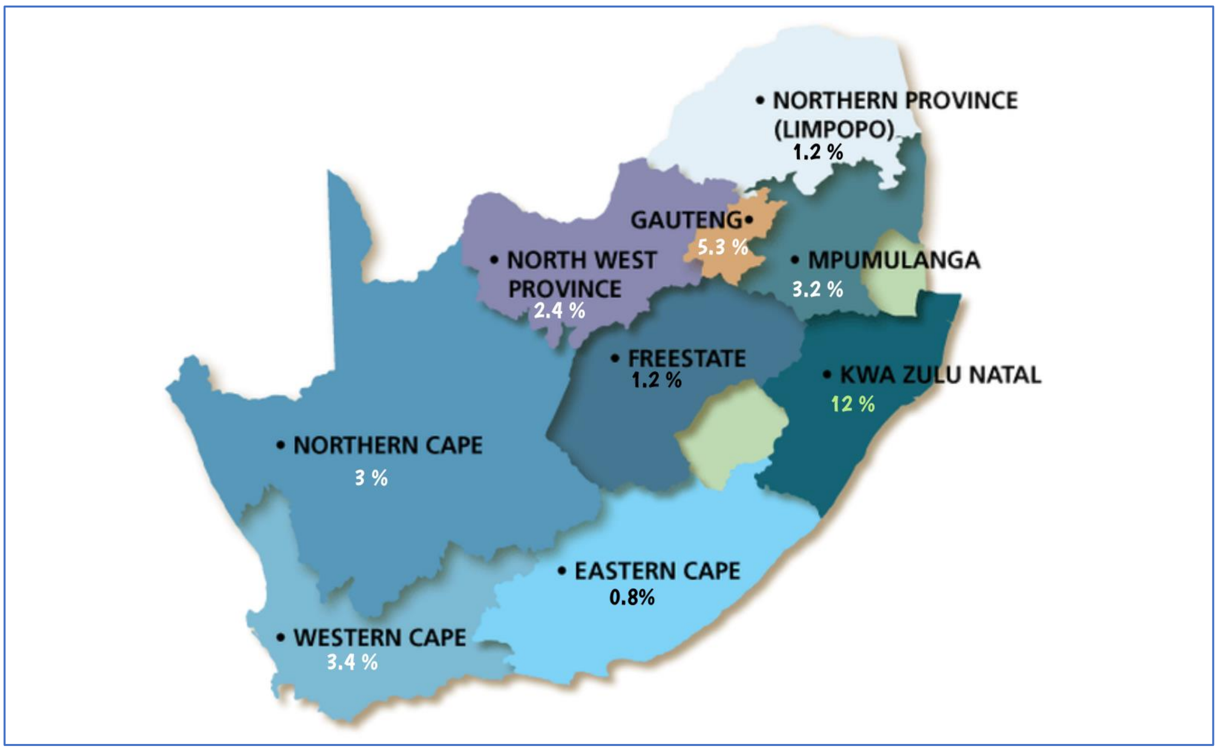


Figure 10-5: Penetration Rate of Air conditioners in Households across South African Provinces– 2016 (Own analysis based on AMPS and Stats SA (2016))

Energy consumption levels

In 2015, prior the introduction of MEPS, an average model of an air conditioner consumed about 60 kWh per week (bigEE, 2015). The total stock of residential and light-commercial application air-conditioners was estimated to be almost 800 000 units in 2017, as illustrated in Figure 10-3. Assuming that the average efficiency of the majority of air conditioners has not been changed since 2015 and given the total stock use, it is estimated that air-conditioners consumed about 2.4 TWh in 2017. However, this figure is likely to be overestimated, since there were about 290 000 air conditioners sold on an annual basis in the past couple of years which had to conform to the MEPS levels.

Table 10-4: Air-conditioners stock and electricity consumption

Appliance	Average weekly consumption (kWh)	Number of appliances (estimated for 2017)	Total electricity consumption per annum (GWh)
Air conditioners	59.62	789 186	2 446

10.5 MEPS opportunities

Air conditioners are a product that is very widely regulated around the world with around 65 countries having energy related requirements of some description for room air conditioners (Energy Efficient Strategies & Maia Consulting 2014). In the past, most countries have tested air conditioners at standard ISO conditions at rated capacity. However, the annual/seasonal energy efficiency ratio (SEER) is beginning to be adopted by various economies and is becoming the focus of future development in some regions. Currently Europe uses a seasonal rating for energy labelling and MEPS for most types of air conditioners, so this makes direct comparisons with South Africa difficult. North American countries (Mexico, USA and Canada) also use seasonal ratings for larger systems and split systems (but not for window-wall systems).

SEER values are not easily comparable between economies, as the mix of values feeding into a single SEER value, and their weighting, is different across economies. Most economies do not require disclosure of the contributing factors in a SEER calculation, so this makes comparison of air conditioner energy performance more difficult (The Policy Partners 2014).

The IEA 4E Mapping and Benchmarking Annex undertook a detailed comparison of MEPS for air conditioners in 2011 which examined Canada, Australia, Europe, Korea and China (IEA 4E Mappring and BenchMarking Annex 2011). This study found that Korea had the most stringent MEPS levels at that time (3.38 for split systems 0-4kW, 2.98 for split systems 4-10kW, 2.88 for unitary systems including window types), but these have now been surpassed by many other countries including Europe and Australia.

The 2014 CLASP study found that MEPS for air conditioners for some key countries were typically around the level of EER/COP 2.9 to 3.2 (W/W), which is broadly comparable with current MEPS levels for split systems in South Africa (The Policy Partners 2014). In fact, a number of countries such as Japan and Australia set much higher MEPS levels for split systems in the smaller size range (Australian MEPS is 3.66 for up to 4kW and 3.22 over 4kW). MEPS for window/wall systems in Australia has been an EER/COP of 3.1 since 2013.

It is difficult to compare MEPS levels in South Africa with those in Europe as defined under *Commission Regulation (EU) No 206/2012* (**EcoDesign**) as most air conditioners have MEPS defined in terms of seasonal performance. Interestingly, Europe have defined different MEPS levels depending on the global warming potential (GWP) of the refrigerant used, with lower GWP units having a less stringent MEPS requirement.

Europe define MEPS levels for double duct and single duct units, both of which are generally classified as "portable" types. Smaller double duct systems (up to 6kW) have a MEPS level of 2.6 for refrigerant GWPs >150 and 2.34 for refrigerant GWPs ≤150. South African MEPS (2.4) is slightly weaker than the high GWP requirement for double duct systems in Europe at 2.6, but again it should be noted that the portable air-conditioning units in South Africa are currently exempted from MEPS and labelling regulations.

Europe also set MEPS levels for single duct systems. These types generally have very poor efficiency and they present many problems for testing as they draw air from the inside air space and run this over the condenser, which is then expelled to the outdoor space (these are also called unbalanced systems). Under test their initial efficiency appears reasonable, but in practice during operation in the home the efficiency falls after a period of operation as the indoor air space gradually heats up as air is drawn from outside or other parts of the building as more air is expelled from the room over time. Europe set MEPS for single duct systems at the same level for cooling a double duct system, but at a much lower COP of 2.04 for heating. Note that SANS 54511-2 does not specify test conditions for heating mode for single duct air conditioners (these are specified in *Commission Regulation (EU) No 206/2012*) so are not currently specified in South Africa.

10.6 Impact analysis

The following table outlines the assumptions related to the wall mounted split units, as they are the most dominant type found in South Africa.

Table 10-5: Air-conditioners assumptions

Characteristics	MELS level B	MEPS level A
Size	12 000 BTU	12 000 BTU
Energy usage	1.14 kW	1.06 kW
Annual electricity consumptions	591.7 kWh	550.14 kWh
Average prices	R5 797	R11 499

The analysis of the average prices for various wall mounted split units of different energy efficiency shows that Class A are considerably more expensive than Class B – almost double in prices. This price differentiations reflects the use of different technologies (Class A relay mainly on inverter technology) but could also be a pricing strategy adopted by the distributors and brands.

The discussion with the industry representatives indicated that the market is extremely competitive, particularly among the "independent distributors" where brand loyalty is less of a priority and consumer's decision is mainly driven by the price. Therefore, it would be logical to assume that the current relatively high price of Class A air conditioners is meant to differentiate the market among lower priced, more affordable, less efficient air conditioners and more expensive models using newer technologies that make them also more energy efficient. If the air conditioners were to follow a more stringent MEPS level, it is likely that the price of Class A air conditioners would be reduced (due to economies of scale). Considering that this appliance is mainly purchased by the upper-middle and high-income households who are less sensitive to prices and is generally considered to be a luxury item (outside the high-humid coastal areas, where it is more of a necessity), the slight increase in costs that may follow for some short period may likely lead to some changes in the market shares. The latter though will depend on how fast the suppliers respond to the requirements and how they set up their pricing strategies.

Table 10-6: Air-conditioners savings and costs calculations

Characteristics	MELS level B	MEPS level A
Cost difference	-	R5 702
Electricity savings – per annum	-	42 kWh
Electricity savings - %		7%
Electricity savings – Rand value		R53
Change in cost vs savings payback period	-	108 years
Appliance lifespan	15-20 years	15-20 years

A concern though is that the current Class A air conditioners do not necessarily offer a significant savings in electricity consumption for a single household. However, considering the number of air conditioners that is projected to be purchased in the future, improving MEPS from Class B to Class A could provide for significant national-scale savings on electricity as presented below.

Table 10-7: Air-conditioners electricity savings projections

MEPS Level B	**Size considered**		**Average price**		**Estimated average annual electricity consumption**			
	12000 btu		*R5797*		*591.66kWh*			
	Aggregated electricity consumption (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		174	179.5	186.6	194.2	202.8	209.5	1 146.6
MEPS Level A	**Size considered**		**Average price**		**Estimated average annual electricity consumption**			
	12000 btu		R11 500		550.14kWh			
	Aggregated electricity consumption (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		161.8	166.9	173.5	180.6	188.6	194.8	1 066.1
IMPACT ANALYSIS								
B to A	*Price difference*	*R/unit*	5702					
		%	98					
	Electricity savings (GWh)	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
		12.2	12.6	13.1	13.6	14.2	14.7	80.5

10.7 Recommendations

MEPS for air conditioners are generally reasonable but could be strengthened to be more in line with global best practice. In particular, **MEPS levels for split systems should be increased from the current EER/COP of 3.0 (Class B) to a level of 3.2 (current Class A), as this is a level that is widely used in many countries and could be easily achievable by most suppliers on the market**. Note that many countries set MEPS levels of EER/COP > 3.5 for split systems with a cooling capacity of under 4kW, which would be a popular size in South Africa. Adopting a more stringent MEPS of 3.4 for small split systems could be considered if there was a significant market share.

MEPS levels for **window systems** could be increased from the current EER/COP of 2.8 (Class B) to a level of 3.0 (Class A). This is by no means the most stringent MEPS in the world for this type of product and there should be a broad selection of products that can be considered for improvement in energy efficiency. However, considering that the market in South Africa for this type of air-conditioners is small and continuously declining, the effort taken to implement a more stringent MEPS (considering that this type is currently exempted from the regulations) may not be considered a "good value for money". However, **lifting the exemption currently applied to this type of air-conditioners would be a more cost-efficient approach** although this is likely to result in significant price increases for this particular air-conditioning technology. Later on, a phased step up to a EER/COP of 3.0 can be considered.

a) Increase MEPS levels for split systems from the current EER/COP of 3.0 (Class B) to a level of 3.2 (current Class A)
b) Lift the exemption applied to window and portable systems
c) Set up a local testing facility at the sea level
d) The label grades should allocate an efficiency class based on an absolute EER/COP value across all types
e) Include low power mode energy into the annual energy consumption value displayed on the energy label
f) Include standby mode considerations in calculation of an annual EER and COP
g) Include heating energy for 500 hours use on the energy label for reverse cycle model

The same recommendation (i.e. lifting exemption) could be made with regard to portable air-conditioners - although they are covered under existing MEPS, as purported by the industry, they are not currently regulated.

One issue of general concern is the different EER/COP grades that are currently applied to different types of air conditioners in South Africa. A normal consumer, who may be comparing different types of air conditioning units, could expect a Class A split system to be of comparable energy efficiency to a Class A window system. However, this is not the case under the current labelling system in South Africa, which is potentially misleading for consumers. **The label grades should allocate an efficiency class based on an absolute EER/COP value across all types**. If all split systems are more efficient than window systems (which they generally are), then the label classes should reflect this fact. Currently MEPS is set at a uniform efficiency class across all three types of air conditioners, but this is at a different EER/COP for each type. A more transparent system would be to have a uniform grading system for energy efficiency class across all types and to set the MEPS levels at different classes for each type of product, depending on the technical efficiency that can be achieved.

Another important issue is low power mode energy consumption. Currently air conditioners are exempt from any standby or off mode requirements. Many air conditioners have significant power consumption when not operating (typically from 2W to 10W), primary associated with remote control operation. While not common in air conditioners that are currently stipulated for regulation in South Africa (split systems, window types and portable), some air conditioners also have crankcase heaters present, which can have a power consumption of 60W or more (unbeknownst to the consumer)**. It is important to include this**

low power mode energy into the annual energy consumption value displayed on the energy label and to adjust the operating EER and COP to give an annual value for rating purposes (to determine the efficiency class). Currently the energy label for air conditioners provides an energy estimate for 500 hours of operation for cooling mode only. It is easy to calculate an annual EER and COP value by assuming the specified number of hours of operation at the rated EER or COP (giving a total input energy and total output energy for 500 hours) and then to add non-operating energy for the remaining hours in the year (8,260 hours in this case) to the input energy. This total input energy can then be used to calculate the annual EER and COP by dividing by the output energy. For a product that has 0.0W standby power, the operating and annual EER and COP will be the same. As the standby power increases, the annual EER and COP degrades. This approach forces suppliers to focus on standby power and minimise this as far as possible, which is why this approach - **to calculate an annual EER and COP - is strongly recommended for inclusion in South Africa**. It is also **recommended that heating energy for 500 hours use be included on the energy label for reverse cycle models** (currently only heating output and heating class is provided).

Also, consideration maybe put forth for placing a voluntary label on air conditioners, indicating that the appliance is without certain types of refrigerants (ozone information). Some eco-labels take refrigerants into account as one of their criteria, and at least one MEPS makes use of the refrigerant GWP to amend the efficiency requirements[19]. However, there is need for further investigation to evaluate the value of such an approach in the context of South Africa.

Last but not least, whatever recommendations are implemented with respect to the changes to MEPS, South Africa needs to set up **its local testing facility for air conditioners to ensure monitoring and enforcement of the regulations related to this appliance**. This is promoted by the industry, particularly those representing international brands and distributors.

[19] Commission Regulation (EU) No 206/2012 of 6 March 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for air conditioners and comfort fans

11 KEY FINDINGS AND CONCLUDING REMARKS

The status quo review of the existing appliances under the S&L programme revealed a few of MEPS improvements that could be considered to maximise the potential energy and GHG emission savings in South Africa considering various socio-economic factors. Possible MEPS improvements were identified for five out of the nine appliance groups currently covered by MEPS. Table 11-1 below provides a snapshot of the recommended MEPS improvements. In addition, a number of recommendations are proposed to improve the monitoring and verification of the compliance of different manufacturers, suppliers, and distributors with the regulations.

Table 11-1: Summary of recommendations

Appliance	MEPS		
	Current	**Proposed**	**Additional recommendations**
Audio-visual	1W	• Lower the current standby power level to 0.5 W by 2020	• Requirements for simple set top boxes in SA be aligned with *EC No 107/2009* by 2020 • Consider expanding the scope of standby power limits to a wider range of products
Washing Machines	A	• Retain the current Class A for the next few years	• Consider increasing the MEPS level to Class A+ by 2022 to align with current European requirements
Tumble Dryers	D	• Increase MEPS level for tumble dryers from Class D to C by 2020	• Monitor the other countries' approach to mandating of heat pumps and introduction of this technology in South Africa, and revisit the MEPS levels accordingly • Consider initiating a supplementary programme to endorse heat pump technology tumble dryers
Washer Dryers	A	• Retain existing MEPS level of Class A for washer-dryers	• A watching brief on regulatory activities in Europe for washer-dryers should be maintained • Investigate ways to differentiate between heat pump and conventional washer-dryers. Possible considerations could include the development of a programme that endorses heat pump washer-dryers
Refrigerators	B	• Introduce Class A for refrigerators by 2020 and Class A+ by 2022	• Review the calculation methodology by considering: ○ removal of the built-in, chiller and climate factors in the reference equation, and ○ reducing the frost-free factor • Conduct a detailed review of refrigerator requirements
Freezers	C	• Introduce Class B Class by 2020, Class A by 2022, and Class A+ by 2026	• Consider adopting the new IEC test method and eventual alignment with future European requirements from 2020 onwards • Start investigating new policy instruments once all appliances on the market are Class A and above
Electric ovens	Small/medium: A Large ovens: B	• Leave MEPS at Class A for small and medium ovens	• Rectify the typo on oven sizes in VC9008

Appliance	MEPS		
	Current	Proposed	Additional recommendations
		• Increase MEPS for larger ovens to Class A by 2020	
Dishwashers	A	• Leave MEPS for dishwashers at Class A	• Specifying MEPS with a benchmark for cleaning and drying performance for new dishwashers • Adopt a more up to date test method with the new reference machine and the measurement of low power modes • Labelling requirements should be realigned to include low power mode energy
Air conditioners	B	• Increase MEPS levels for split systems from the current EER/COP of 3.0 (Class B) to a level of 3.2 (current Class A)	• Set up a local testing facility at the sea level • Lift the exemption applied to window and portable systems • Label grades should allocate an efficiency class based on an absolute EER/COP value across all air-conditioning types (i.e. window, wall split, portable) • Suppliers should include low power mode energy into the annual energy consumption value displayed on the energy label and adjust the operating EER and COP to give an annual value for rating purposes (to determine the efficiency class) • Include heating energy for 500 hours use on the energy label for reverse cycle model • The wording in the regulations (i.e. VC9008) should be revised as it automatically excludes other type of residential air-conditioners e.g. the under-ceiling split-type

It should be noted that the proposed improvements of MEPS and recommendations have been discussed only with a limited number of stakeholders and will require a workshop with representatives of all interested and affected parties. Therefore, **the next step in the study with respect to the proposed improvement of MEPS will be to conduct an industry-wide workshops** to gather feedbacks from various groups of stakeholders, i.e. government, testing laboratories, the regulator, the suppliers, the manufacturers, the distributors, and the retailers.

REFERENCES

AMPS. (2010-2016). Eighty20.

bigEE. (2015). *Energy efficient air conditioners (AC).*

bigEE. (2015). *Energy efficient clothes dryers and washer dryers.*

bigEE. (2015). *Energy efficient dishwashers.*

bigEE. (2015). *Energy efficient ovens.*

bigEE. (2015). *Energy efficient refrigerators.*

bigEE. (2015). *Energy Efficient Washing Machines.*

DoE. (2016). *Draft Post-2015 National Energy Efficiency Strategy.* Department of Energy (DoE).

dti. (2013). *Technology study on consumer energy devices.*

Euromonitor. (2017a). *Consumer Appliances in South Africa.*

Euromonitor. (2017b). *Home Video in South Africa.*

FRIDGE. (2012). *Energy Performance and Labelling Requirements for Specific Electrical Appliances and Equipment.* Fund For Research into Industrial Development, Growth and Equity (FRIDGE).

NRCS. (2014). *Compulsory specification for energy efficiency and labelling of electrical and electronic apparatus (VC 9008).* National Regulator for Compulsory Specitions (NRCS) .

Stats SA. (2016). *Household Survey .* Statistics South Africa(Stats SA).

ANNEXURE A: LIST OF CONSULTATIONS

Stakeholder group	Interviewed person	Position	Date	Interview means
Defy – Brand manufacturer	Sharice	Head of Marketing Department	December 2017, January 2018	Email and Telephone conversation
Electro Technical Industry Alliance	Erik Visser	Chairman	14 February 2018	Meeting
Whirlpool – Brand Manufacturer	Trevor Graham	Plant Director, Isithebe	February, 2018	Email and Telephone conversation
Air-con Industry association	Marco Ferdinandi	Marketing Director at *M.S Air conditioning,*	4 May 2018	Meeting
	Richard Llewellyn	*GMC Air conditioning*	7 May 2018	Meeting