Appliances Guide
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Energy efficient refrigerators

Country

South Africa

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1 Country-wide saving potential in South Africa

Fridge/freezers

About **7.4 million** Fridge/freezers are in use in South Africa (reference year 2010). The average annual consumption of each of these Fridge/freezers amounts to about **472 kWh**. In total, this causes an annual electricity consumption of **3.5 TWh**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new Fridge/freezer is bought, the most efficient "Best Available Technology" (BAT) model is chosen and that the improvements of the most efficient models over the years are taken into account. By this means, an absolute decoupling of the annual energy consumption and the increasing stock of Fridge/freezers can be achieved. While the stock is expected to grow by 55 % between 2010 and 2020, in the efficiency scenario the energy consumption can be reduced by 21 %. Although the stock is expected to grow by another 41 % until 2030, in the efficiency scenario the energy consumption would further decrease by 20 % (Figure 1). Thereby, higher living standards (e.g. increasing appliance ownership rates and household numbers) have been anticipated. In contrast, in the baseline scenario with moderate efficiency gains the energy consumption would increase by 17 % by 2020 and 7 % between 2020 and 2030.

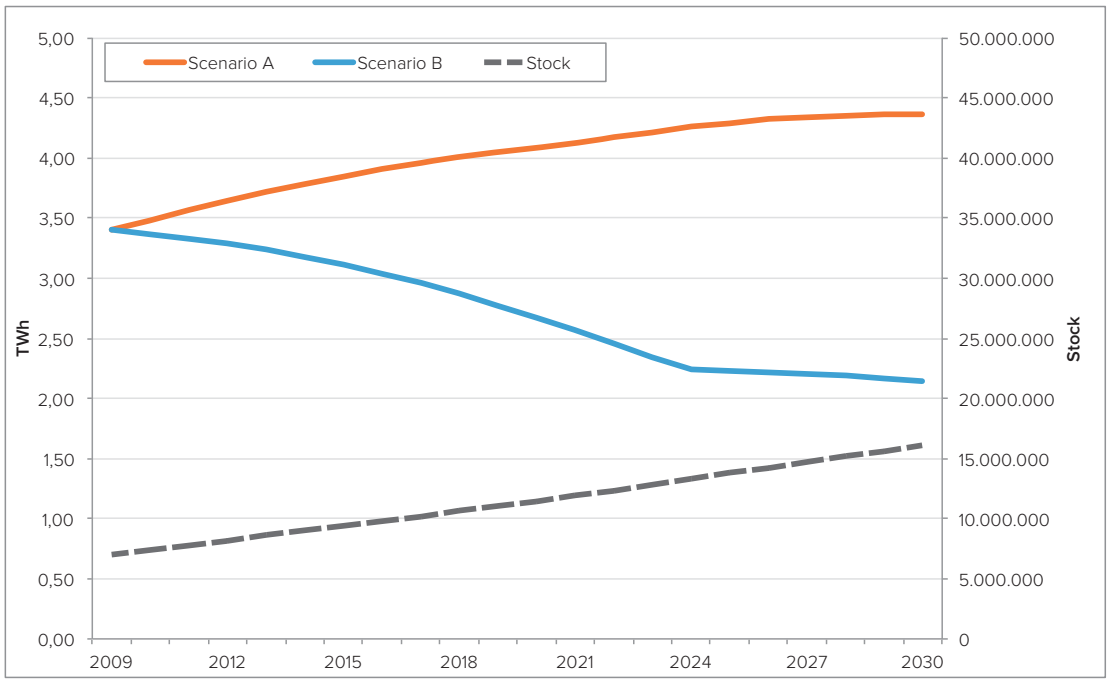

Figure 1: Total electricity consumption Fridge/freezers, Baseline Scenario (A) vs. Efficiency Scenario (B)

Source: Wuppertal Institute (2014)

Table 1: Country-wide saving potential 2010 - 2030: Fridge/freezers

Base year 2010	Total energy consumption of Fridge/freezers per year [TWh/year]	3.48
	Stock number Fridge/freezers	7,370,000
	Average annual energy consumption of Fridge/freezers in the stock [kWh/year]	472
	Total annual CO_2eq emissions related with Fridge/freezers [Mt/year]	2.35
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	1.41
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	-0.81
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0.93
	Stock number of Fridge/freezers in 2020	11,440,000
	Average annual energy consumption of new Fridge/freezers (all BAT) in 2020 [kWh/year]	150
	Total incremental investment costs [not discounted] until 2020 (end-user perspective) [€]	740,377,005
	Total incremental investment costs [not discounted] until 2020 (societal perspective) [€]	649,453,513
	Total economic benefit until 2020 [not discounted] (end-user perspective) [€] scenario B vs. scenario A	7,871,343
	Total economic benefit until 2020 [not discounted] (societal perspective) [€] scenario B vs. scenario A	-319,108,323

2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	2.2
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	-1.33
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	1.45
	Stock number of Fridge/freezers in 2030	16,120,000
	Average annual energy consumption of new Fridge/freezers (all BAT) in 2030 [kWh/year]	100
	Total incremental investment costs [not discounted] between 2021 and 2030 (end-user perspective) [€]	958,803,031
	Total incremental investment costs [not discounted] between 2021 and 2030 (societal perspective) [€]	841,055,291
	Total economic benefit until 2030 [not discounted] (end-user perspective) [€] scenario B vs. scenario A	708,029,063
	Total economic benefit until 2030 [not discounted] (societal perspective) [€] scenario B vs. scenario A	-256,450,414
Lifetime data for Fridge/freezers purchased in the analysed timeframe	Total electricity savings, scenario B compared to scenario A [TWh]	44.32
	Total GHG emission reductions scenario B compared to scenario A [Mt]	28.7
	Total incremental investment costs [not discounted] (end-user perspective) [€] scenario B vs. scenario A	1,699,180,037
	Total incremental investment costs [not discounted] (societal perspective) [€] scenario B vs. scenario A	1,490,508,804
	Total economic benefit [not discounted] (end-user perspective) [€] scenario B vs. scenario A	1,850,450,279
	Total economic benefit [not discounted] (societal perspective) [€] scenario B vs. scenario A	366,431,714

Source: Wuppertal Institute (2014)

Freezers

About **3.5 million** Freezers are in use in South Africa (reference year 2010). The average annual consumption of each of these Freezers amounts to about **473 kWh**. In total, this causes an annual electricity consumption of **1.6 TWh**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new Freezer is bought, the most efficient "Best Available Technology" (BAT) model is chosen and that the improvements of the most efficient models over the years are taken into account. By this means, an absolute decoupling of the annual energy consumption and the increasing stock of Freezers can be achieved until 2030. While the stock is expected to grow by 55 % between 2010 and 2020, in the efficiency scenario the rise of the energy consumption can be mitigated to 11 %. Although the stock is expected to grow by another 44 % until 2030, in the efficiency scenario the energy consumption would even decrease by 19 % (see Figure 2). Thereby, higher living standards, represented by increasing appliance ownership rates and household numbers, have been anticipated. In contrast, in the baseline scenario with moderate efficiency gains the energy consumption would increase by 26 % by 2020.

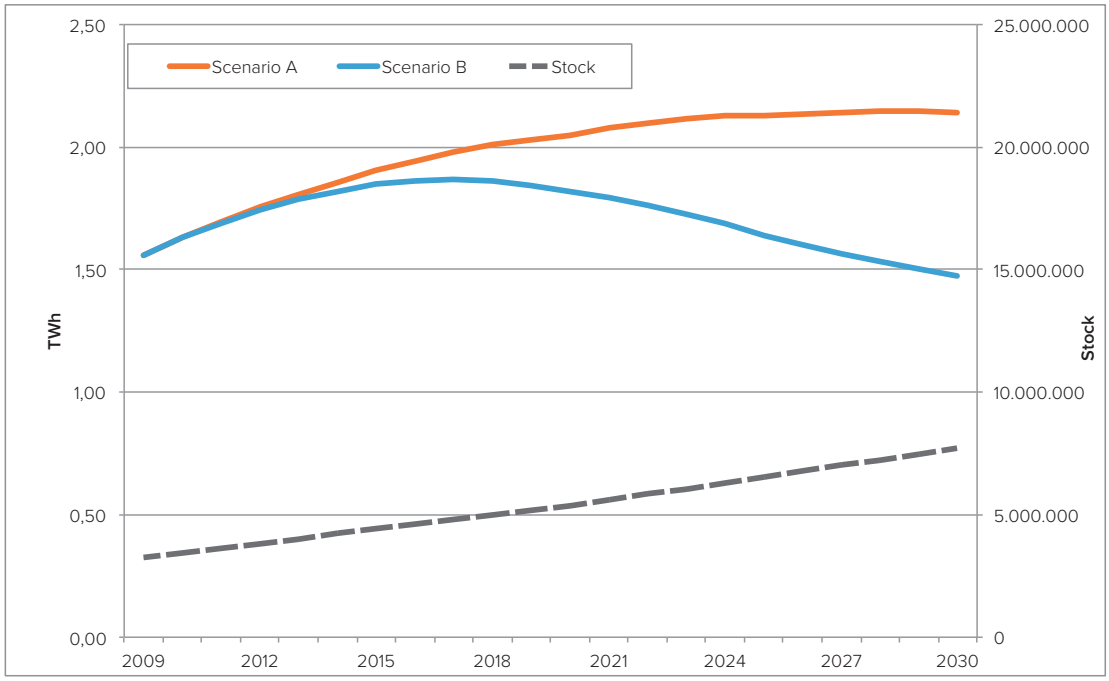

Figure 2: Total electricity consumption Freezers, Baseline Scenario (A) vs. Efficiency Scenario (B)

Source: Wuppertal Institute (2014)

Table 2: Country-wide saving potential 2010 - 2030: Freezers

Base year 2010	Total energy consumption of Freezers per year [TWh/year]	1.63
	Stock number Freezers	3,450,000
	Average annual energy consumption of Freezers in the stock [kWh/year]	473
	Total annual CO_2eq emissions related with Freezers [Mt/year]	1.10
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	0.23
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	0.19
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0.15
	Stock number of Freezers in 2020	5,360,000
	Average annual energy consumption of new Freezers (all BAT) in 2020 [kWh/year]	200
	Total incremental investment costs [not discounted] until 2020 (end-user perspective) [€]	300,507,436
	Total incremental investment costs [not discounted] until 2020 (societal perspective) [€]	263,603,014
	Total economic benefit until 2020 [not discounted] (end-user perspective) [€] scenario B vs. scenario A	-258,272,841
	Total economic benefit until 2020 [not discounted] (societal perspective) [€] scenario B vs. scenario A	-274,350,690

2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	0.67
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	-0.16
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0.44
	Stock number of Freezers in 2030	7,710,000
	Average annual energy consumption of new Freezers (all BAT) in 2030 [kWh/year]	150
	Total incremental investment costs [not discounted] between 2021 and 2030 (end-user perspective) [€]	405,124,530
	Total incremental investment costs [not discounted] between 2021 and 2030 (societal perspective) [€]	355,372,394
	Total economic benefit until 2030 [not discounted] (end-user perspective) [€] scenario B vs. scenario A	-271,625,123
	Total economic benefit until 2030 [not discounted] (societal perspective) [€] scenario B vs. scenario A	-463,474,630
Lifetime data for Fridge/freezers purchased in the analysed timeframe	Total electricity savings, scenario B compared to scenario A [TWh]	10.89
	Total GHG emission reductions scenario B compared to scenario A [Mt]	7.0
	Total incremental investment costs [not discounted] (end-user perspective) [€] scenario B vs. scenario A	705,631,966
	Total incremental investment costs [not discounted] (societal perspective) [€] scenario B vs. scenario A	618,975,409
	Total economic benefit [not discounted] (end-user perspective) [€] scenario B vs. scenario A	56,699,971
	Total economic benefit [not discounted] (societal perspective) [€] scenario B vs. scenario A	-305,593,817

Source: Wuppertal Institute (2014)

2 Subtypes and markets

The refrigerator market in South Africa is dominated by double door fridge/freezers. The top-freezer configuration is the most popular model, followed by bottom-freezer configuration and then side-by-side units. French formats remain niche, as do wine coolers, although they are growing in popularity. Frost-free formats make up 69% of the market, while the share of cheaper static formats at the lower end of the market decreases every year. The weak economic conditions and the depreciation of the currency means that the market in South Africa is likely to remain under pressure in the near future.

South Africa has a long history of appliance manufacturing and the first large appliances (electric stoves) were manufactured in 1932. Refrigeration followed soon after. Historically there was a limited number of locally manufactured mass produced models available to the middle to lower income groups while the high income groups were serviced by European imports. With the new democratic Government and the onset of globalisation in the mid-1990s several South African companies have shut down their manufacturing plants but still two remain in 2014. The one company manufactures all of its refrigerators locally while the other imports and manufactures. In 2011, approximately 65% of the market was controlled by the two local companies, with almost all their refrigerators (>95%) being locally manufactured. The local manufacture of refrigerators has dropped significantly from 2011 to 2014 and it is currently estimated that although the local manufacturing companies still control a similar market share (65%), locally manufactured refrigerators make up only around 70% of their sales.

As recently as the late 1980's the country's electrification rate for residential households was low (35%), whereby almost all white households had electricity and the electrification rate of non-white households was extremely low. An electrification programme was implemented in the early 1990's and by 2001 the electrification rate had increased to 61% [1] and by 2011 it was 83% [2]. By the late 1990's the country's electrification programme had expanded the market for electrical appliances by an estimated 50% [3]

The country's significant income inequality means that the middle to lower end of the market chooses appliances almost exclusively based on price and brand. These appliances generally have less functionality and are higher consumers of electricity. Conversely, upper income households choose their appliances based on functionality, design, brand, guarantees and after sales service, aesthetics and to a lesser extent and only more recently on their energy consumption. Consequently, South Africa has a two-tier consumer base, with each group supporting different brands and models.

All refrigerators sold in South Africa must comply with the South African National Standard (SANS) 62552:2008. This standard conforms to the International Electrotechnical Commission IEC 62552:2007.

Refrigeration appliances conforming to the SANS 62552 standard are classified into four classes, shown in Table 3: subtropical (ST), tropical (T), sub-temperate (SN) and temperate (N). These provide the range of temperatures in which the refrigerators are intended to be used and for which the required storage temperatures are to be met. Most refrigerators in South Africa fall under SN, although it is not uncommon to find N climate class refrigerators in the market.

Table 3: Climate classes

Class	**Symbol**	**Ambient Temperature Range °C**
Extended Temperate	SN	+10 to +32
Temperate	N	+16 to +32
Sub-Tropical	ST	+16 to +38
Tropical	T	+16 to +43

Market Characteristics

The refrigeration market in South Africa is characterised by three sub-categories*:

Refrigerators (Fridges), Freezers and Fridge/Freezers. Each sub-category is broken down further into size or carrying capacity. These measures are listed below and for the purposes of this report these categories will henceforth be referred to “small”, “medium” and “large”:

- < 340 litres (<5 cubic feet): **Small**;
- 341 - 510 litres (5 - 12 cubic feet): **Medium**; and
- >511 litres (>12 cubic feet): **Large**.

** Please note: Wine coolers / chillers and other specialised residential refrigeration are present in the market but remain niche products with small volumes. They have therefore been excluded from this report. However, the sales of these products increased by 13% in 2013.*

The fridge/freezer, double door (top freezer) remains the preferred choice of South African consumers, followed by the double door (bottom freezer) and then side by side formats. French format fridges, which have one or two bottom freezer drawers for easier access, are a niche product and make up a small share of the market. Frost-free fridges continue to grow in popularity (69%) up from 40% in 2008. Static fridges are chosen by the lower, mass-market end of the market due to their affordability.

Penetration Rates and Sales

Figure 3 illustrates the household penetration rate of refrigerators in South Africa since 2000. It is one of the few large appliances, which continued to show growth during the economic downturn the country has experienced since 2009/10. Sales of refrigerators grew by 6% in 2013 and are expected to show a compound annual growth rate (CAGR) of 7% in 2014 [4]. *(Please note: Euromonitor figures are total sales of refrigerators and not just to households).*

Figure 3 shows how the penetration rate has increased since 2000. Figure 4 shows the penetration rate by sub-category with a forecast up to 2018. South African chest freezers can be operated alternatively as freezers or refrigerators and are therefore a popular choice amongst lower income groups who have limited funds. So although these products are categorised as freezers they may be actually operating as fridges for long periods. This is more than likely the reason for the discrepancy between the percentages shown in Figure 3 and Figure 4.

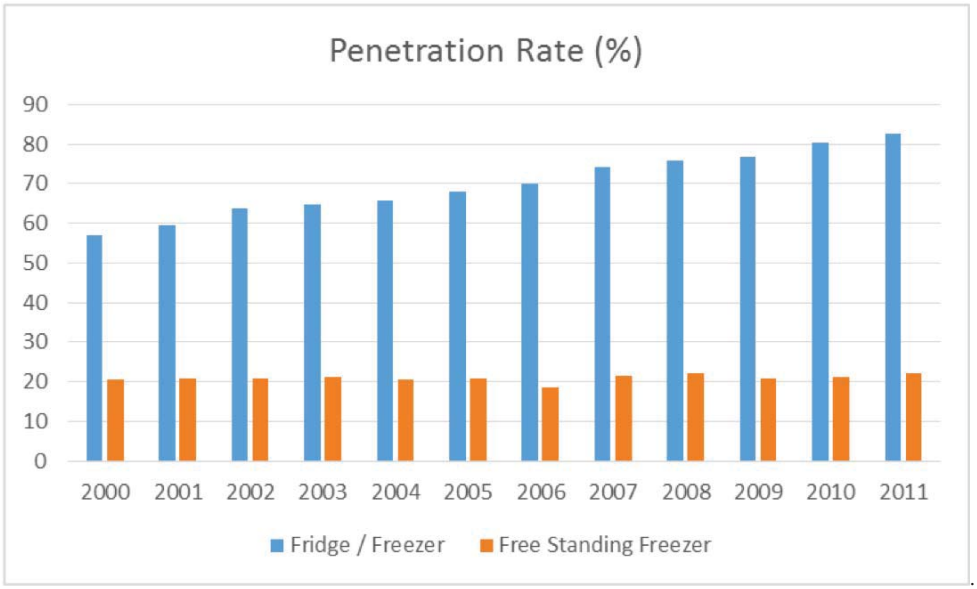

Figure 3: Penetration rate of refrigerators in SA HH 2000-2011 (%)

Source: Own illustration, based on AMPS (2011) data

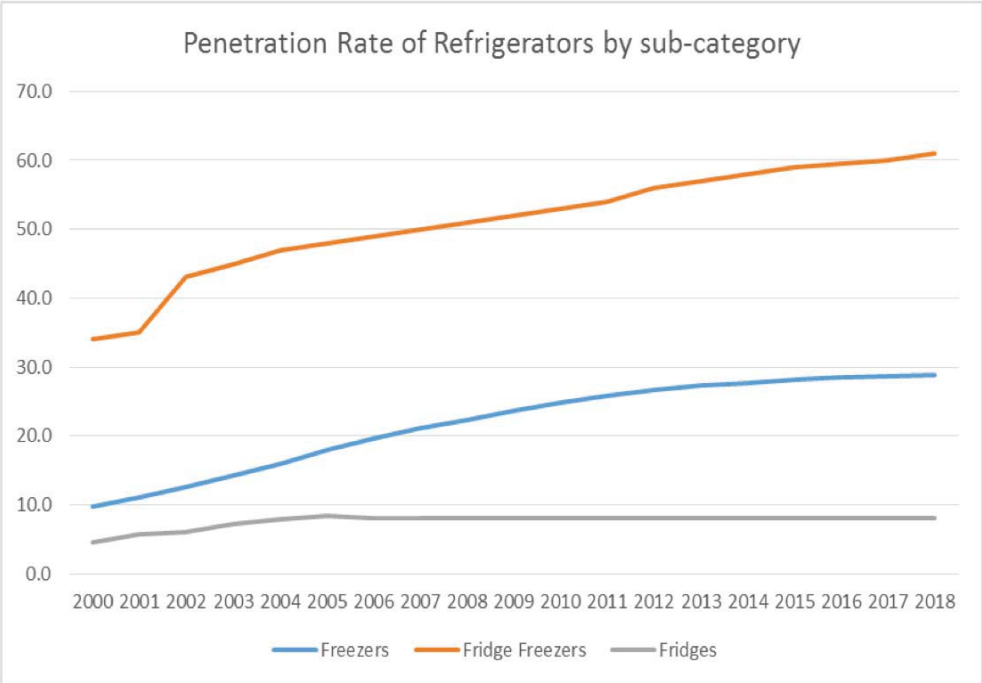

Figure 4: Penetration rate in SA HH by sub-category 2000-2013 and forecast 2014-2018 (%)

Source: Own illustration, based on Euromonitor (2014) data

Figure 5 shows the percentage of households who purchased a refrigerator or freezer in the preceding 12 months for each year from 2000 to 2011. In 2011 there were 14,074,000 households in South Africa.

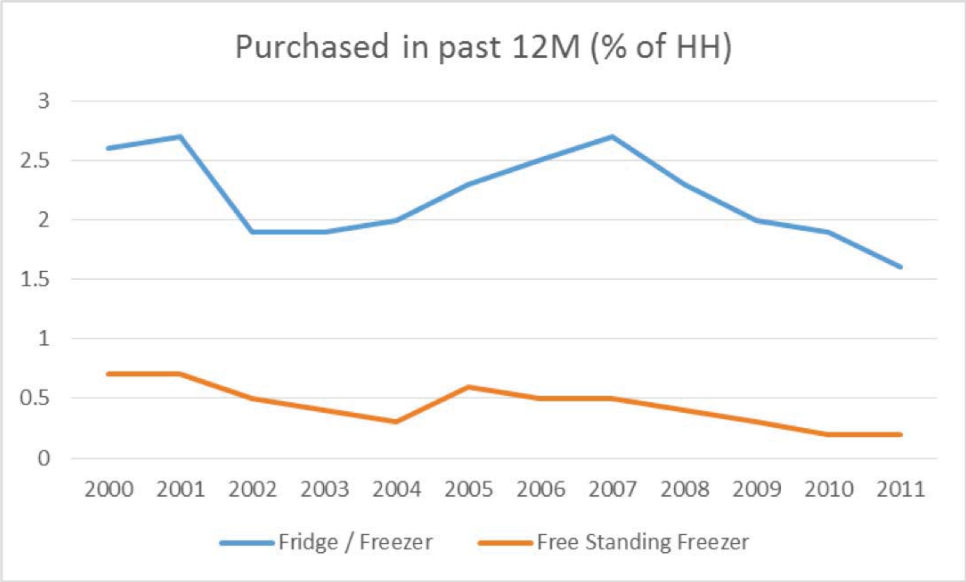

Figure 5: Annual sales as a percentage of HH (2001-2011)

Source: Own illustration, based on AMPS (2011) data

Unit sales by sub-category are shown in Table 4 and Table 5 shows the percentage sales by sub-category.

Table 4: Unit sales by sub-category ('000 units)

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Freezer	Small	107	109	117	119	118	112	106	114	118	126	134
	Medium	65	78	88	95	98	90	85	85	89	95	101
	Large	38	50	55	59	63	48	39	38	40	36	35
	Total	210	237	259	272	279	250	229	237	246	257	270
Fridge/ Freezer	Small	392	416	443	488	434	395	366	410	440	470	503
	Medium	208	251	287	327	303	282	263	289	311	335	357
	Large	94	118	139	161	167	129	102	104	112	99	99
	Total	695	785	869	976	904	806	732	803	863	904	958
Fridges	Small	16	16	17	18	16	15	14	16	17	18	19
	Medium	8	9	9	11	11	10	9	9	9	10	12
	Large	5	5	6	7	7	6	5	5	5	6	5
	Total	28	30	32	35	34	31	28	30	31	33	35

Table 5: Sales by sub-category (in %)

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Freezer	Small	51	46	45	44	43	45	46	48	48	49	50
	Medium	31	33	34	35	35	36	37	36	36	37	38
	Large	18	21	21	22	23	19	17	16	16	14	13
Fridge/ Freezer	Small	57	53	51	50	48	49	50	51	51	52	53
	Medium	30	32	33	34	34	35	36	36	36	37	37
	Large	14	15	16	17	19	16	14	13	13	11	10
Fridges	Small	55	53	52	50	47	49	50	53	53	54	54
	Medium	28	29	29	30	31	33	32	30	30	29	33
	Large	17	18	19	20	22	18	18	17	17	17	13

Refrigerator Market – 1995

First interest in energy efficient appliances in South Africa dates back to 1995, when a cost benefit analysis [6] was undertaken by the Department of Minerals and Energy. The study analysed the typical consumption figures of three major groups of refrigerators: Single door refrigerators [refrigerators and fridge/freezers]: 588 kWh per year, two door refrigerators [side by side/double door]: 1,284 kWh per year and freezers: 540 kWh per year. Existing refrigerators and freezers would be replaced after a typical lifetime of 15 years.

Refrigerator Market – 2010

A study undertaken by the Department of Trade and Industry [7] surveyed the Top 5 manufacturers and distributors of refrigerators in South Africa for further product details. Jointly, these companies accounted for more than 80% of annual sales in 2010 and 2011. Table 6 gives the breakdown for the number of models per category and sub-category. The small fridge/freezer is the most popular model in the country evidenced by the number of models and confirmed with discussions held with the manufacturers. Figure 6, Figure 7 and Figure 8 (one for each sub-category) show the distribution of each product category by the stated energy rating. It is interesting to note the concentration of models being at A and better or D and worse, with few models being found in the B and C categories. This is explained by imported models, making up the A and better energy classes and locally manufactured models at the other end of the scale, which were only sold in SA. Up till now, the absence of mandatory performance standards and little interest from consumers meant that no energy performance improvements were made to these models.

Please note: The number of models and the energy class levels were provided by the five manufacturers with no additional research. It is thus not the full list of models available (per manufacturer) in 2011 as each manufacturer may have interpreted the request for data differently. For example, product ranges which were coming to an end or which had been discontinued may have been excluded even though they were still widely available. At the time of the study, GFK market research confirmed that there were approximately 850 different refrigerator models, across the three categories, available in the South African market and that only 25% came with an energy class rating.

Table 6: Models per category (2011)

Category	Fridge	Fridge/Freezer	Freezer
Small	40	91	36
Medium	15	60	7
Large	0	45	3
Total	55	196	46
Total number of models	297		

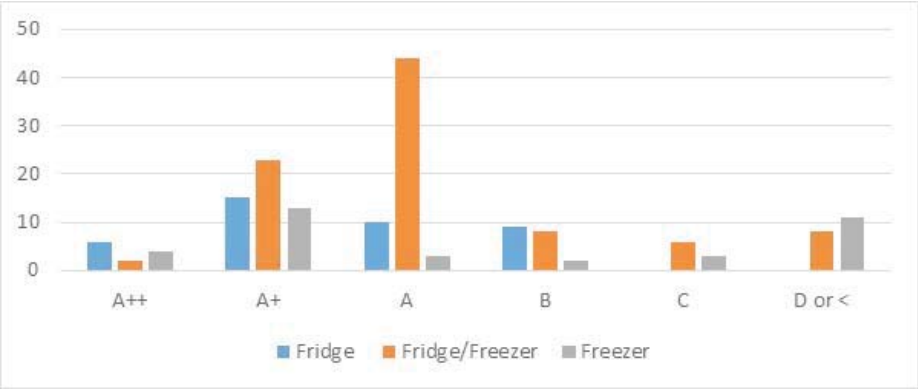

Figure 6: Distribution of models by energy rating (Category: Small)

Source: Own illustration

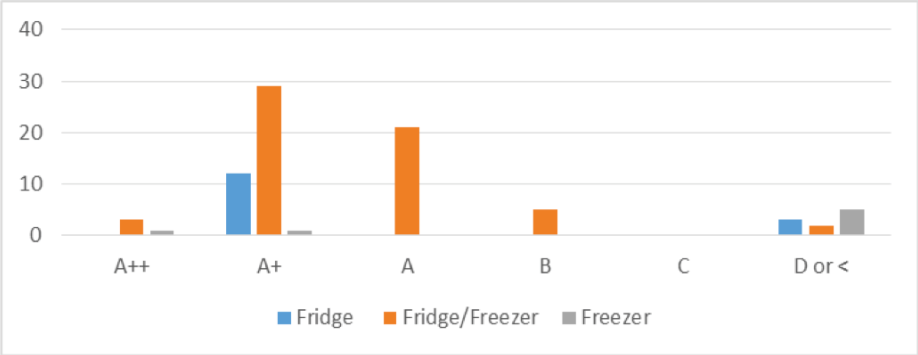

Figure 7: Distribution of models by energy rating (Category: Medium)

Source: Own illustration

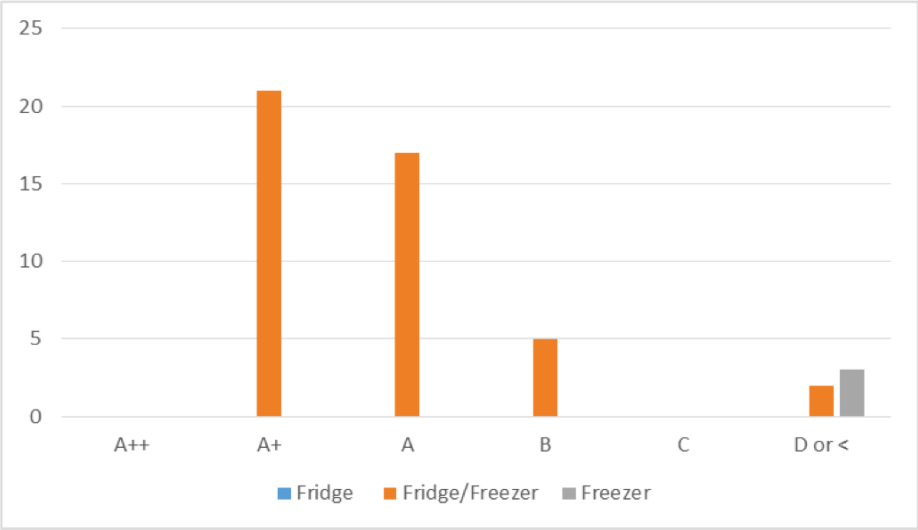

Figure 8: Distribution of models by energy rating (Category: Large)

Source: Own illustration

Refrigerator Market – 2014

Table 7 gives the number models available in the South African market. The data was sourced from popular online shopping websites[1]; manufacturer websites and data supplied by manufacturers themselves. Although it is not a complete list, with almost 900 models it covers the majority of the market in South Africa. With such a large number of models to choose from, the market is very competitive and consumers are spoiled for choice. The most popular categories remain the small fridge/freezer units, followed by the large fridge/freezer combination models, which are popular with families.

Table 7: Numbers of models available in the South African market, per category (2014)

Category	Fridge	Fridge/Freezer	Freezer
Small	126	369*	83
Medium	48	93	23
Large	3	145*	4
Total	177	607	110
Total number of models	894		

* = most popular categories

South Africa has been in an economic downturn since 2008 and continues to experience sluggish growth. In October 2014 the Minister of Finance revised annual economic growth down to 1.4% from a forecast of 2.7% in February 2014 [8]. The duration of these tight economic conditions and the steep rise in electricity tariffs, over the same period, has had a significant impact on household disposable income. Electricity tariffs more than tripled over the four-year period 2008-2012 and will continue to rise at an average of 12% per year from 2014 to 2018. The consequence is that consumers of household appliances look for '*value offerings*' and it is unclear whether consumers have understood the '*value proposition made by energy efficient appliances'* [4]. The traditional decision making criteria - price, brand, guarantees, after sales service, design and aesthetics - still dominate. However, the combination of the Government's intention to introduce a mandatory Standards & Labelling (S&L) programme in 2015 and manufacturers realising that consumer awareness and understanding of energy efficiency is growing has elicited a response. Manufacturers surveyed have confirmed that - for the appliances that are to be included in the Government's S&L programme - their products meet the MEPS and would like to see the programme to come into effect as soon as possible. It is with the retailers where the uncertainty continues as the delayed implementation of the mandatory S&L programme means that stores remain unclear on what labelling is required and where.

[1] www.pricecheck,co,.za and www.shopmania.co.za

This has resulted in a situation where it is left up to the individual store managers to decide as to whether appliances labels are displayed and how to best deal with appliances where the energy efficiency rating is not supplied by the manufacturer. The result is that some appliances have labels, others do not and labels are also not standardised, as shown in Figure 9. This makes it difficult for consumers to interpret and compare them.

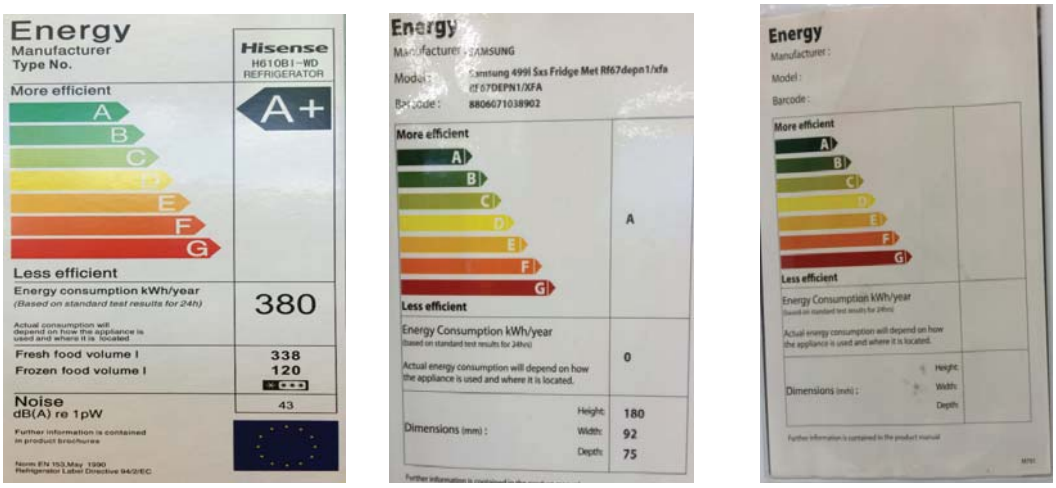

Figure 9: Examples of EE labels found on different cooling appliances in South Africa (2014)

Source: Photos by Theo Covary

Figure 10, Figure 11 and Figure 12 show the results of the market survey and the move towards energy efficient appliances by the manufacturers. Of course, it is not known to what extent the unspecified models are poor performing models, i.e. C class or worse, or whether these models have not been labelled, as there is no requirement to do so. In all likelihood it is a combination of both.

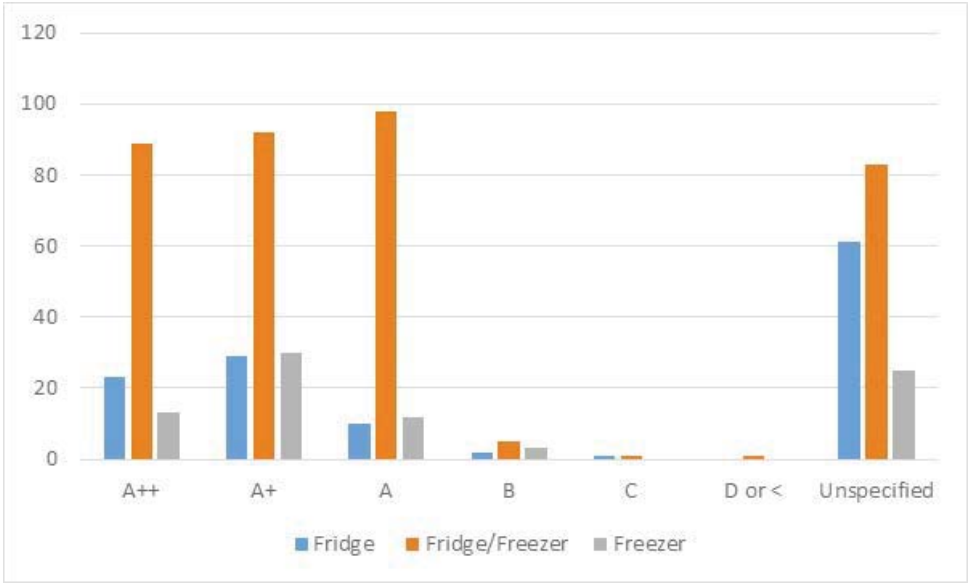

Figure 10: Distribution of models by energy rating (Category: Small)

Source: Own illustration

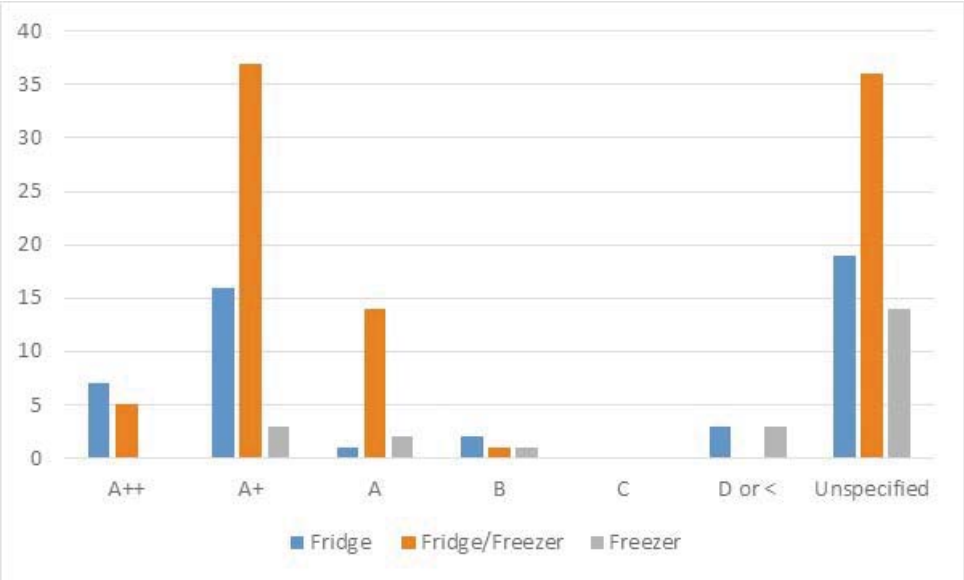

Figure 11: Distribution of models by energy rating (Category: Medium)

Source: Own illustration

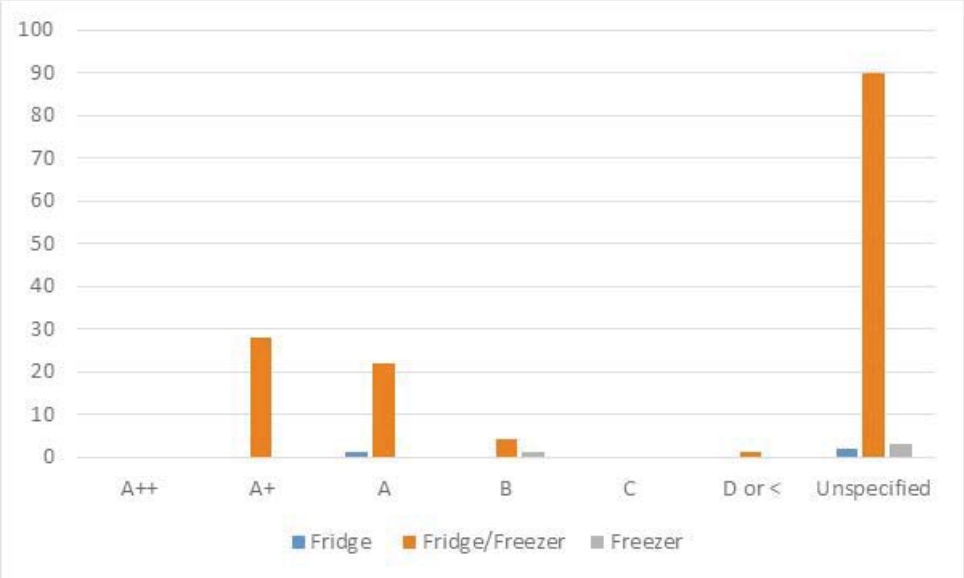

Figure 12: Distribution of models by energy rating (Category: Large)

Source: Own illustration

Summary of the refrigerator market in South Africa:

- Electricity tariffs in South Africa were amongst the lowest in the world in 1995, thus there was little demand for energy efficient appliances. Tariffs have tripled over the four years period 2008-2012 and households are currently paying EUR 0.10/kWh (2014). The South African electricity regulator has agreed to a further annual 12% tariff increase for the period 2014-2018.

- During the 1990's South Africa had low electrification rates. A priority of the new Government was to electrify all households, which it has largely achieved. The percentage of households that used electricity for lighting went from 58% (1996) to 80% (2007). This programme created a new market for manufacturers of electric appliances and the growth rates were high for the period 1995-2005. It is unlikely that these growth rates are sustainable for the period 2014-2030.

- The freezer market in South Africa was almost exclusively supplied by local manufacturers up until 2010. These products were built exclusively for the South African market and had very poor energy efficiency ratings compared to international norms. Many of these products had never been tested so there is no official record of electricity consumption available. More recently, local manufacturers have upgraded their production lines and improved the performance of their freezers. International companies, whose products are more efficient, have also increased their market share.

- A large percentage of the country's appliances are imported. This makes them very susceptible to currency fluctuations. On 1 January 2011 the Rand was valued at 8.76 to the Euro and on 8 November 2014 it was valued at 13.94, which equals a drop of 59%.

- Double door fridge/freezers (top freezer configuration) are the most popular models followed by bottom freezer configuration and then side-by-side units.

- French formats remain niche, as do wine coolers, although they are growing in popularity with an 11% growth in 2013.

- Frost-free formats make up 69% of the market. The static format remains popular at the lower end of the market because they are cheaper, but every year their market share decreases.

- Replacement cycles of refrigerators in South Africa (typically every 10 years) are coming down, especially for the most popular category fridge/freezers. The rates (in years) for 2014 (compared to 2007) for the sub-categories are: Freezers 9.5 years (9.5); Fridge/Freezers 9 years (13); and Refrigerators 9.5 years (10.8). However, the replaced units generally find themselves in lower income households where they start a new life. Therefore an average technical lifetime of 15 years is assumed.

- Nevertheless, weak economic conditions and the depreciation of the currency mean that the appliances market in South Africa is likely to remain under general pressure for the near future.

3 Efficiency range and user savings

The most popular format in South Africa is the small fridge/freezer bottom mount. Within this category consumers opt for the 250-300L sized units. This format accounts for as much as 91% of the refrigerator market. Frost-free units have grown in popularity. Small chest freezers are also popular in South Africa. As there is no mandatory MEPS in South Africa (before 2015), as recently as 2011 it was possible to find units starting A++ (139kWh/year) right through to G (>700kWh/year). As there is no enforcement, there are large discrepancies and inconsistencies between the energy consumption and the associated energy class claimed by manufacturers and retailers compared to the national standard (SANS 62552).

Table 8: Efficiency range and user savings of Fridge/freezers, based on 2012 data

Level	Typical appliance in the stock (over all appliances in use)	Typical inefficient appliance on the market.	Typical appliance purchased (BAU – Business As Usual)	Best Available Technology (BAT)	Expected future BAT (Best not yet Available Technology)
Typical Capacity / Size	250-300L				
Category	Fridge/ freezer	Fridge/ freezer	Fridge/ freezer	Fridge/ freezer	Fridge/ freezer
Type	Bottom mount, Static (300L)	Bottom mount, Static (250L)	Top mount, Frost-free (265L)	Bottom mount, Frost-free (272L)	Bottom mount, Frost-free
Lifetime (years)	15	15	15	15	15

Qualitative performance classification of the provided service:	☐ Poor ☐ Low ☒ Average ☐ Good ☐ Excellent ☐ No information	☐ Poor ☐ Low ☒ Average ☐ Good ☐ Excellent ☐ No information	☐ Poor ☐ Low ☒ Average ☐ Good ☐ Excellent ☐ No information	☐ Poor ☐ Low ☐ Average ☒ Good ☐ Excellent ☐ No information	☐ Poor ☐ Low ☐ Average ☒ Good ☐ Excellent ☐ No information
Yearly energy consumption: *electricity (kWh)*	588	528	317	219	150
Yearly energy cost (ZAR)	882	792	476	328	225
If applicable: Yearly energy consumption for further energy carriers	N/A	N/A	N/A	N/A	N/A
If applicable: Yearly water consumption	N/A	N/A	N/A	N/A	N/A
If applicable: Yearly water cost	N/A	N/A	N/A	N/A	N/A
Purchase cost in (ZAR)	2,000	3,180	3,400	7,600	N/A
Operation & Maintenance cost (ZAR)	1,000 (lifetime)	1,000 (lifetime)	1,000 (lifetime)	1,000 (lifetime)	1,000 (lifetime)
Labelling class	No rating	E	C	A+	A+++

The following Table 9 gives the example of chest freezers. Up until 2012 all chest freezers, except for a very small percentage, were manufactured locally in South Africa. As there were no MEPS requirements, these units had never been tested and all were estimated to be at an E level (430 kWh/year). So although there were multiple models for consumers to choose from they all performed similarly.

Table 9: Efficiency range and user savings of Chest freezers, based on 2012 data

Level	**Typical appliance in the stock (over all appliances in use)**	**Typical Inefficient appliance on the market.**	**Typical appliance purchased (BAU – Business As Usual)**	**Best Available Technology (BAT)**	**Expected future BAT (Best not yet Available Technology)**
Typical Capacity / Size	270-320L				
Category	Chest freezer	Chest freezer	Chest freezer	Chest freezer	Chest freezer
Type	270L-320L			327L	300L
Lifetime (years)	15			15	15
Qualitative performance classification of the provided service:	☐ Poor ☐ Low ☒ Average ☐ Good ☐ Excellent ☐ No information	☐ Poor ☐ Low ☒ Average ☐ Good ☐ Excellent ☐ No information	☐ Poor ☐ Low ☒ Average ☐ Good ☐ Excellent ☐ No information	☐ Poor ☐ Low ☐ Average ☐ Good ☒ Excellent ☐ No information	☐ Poor ☐ Low ☐ Average ☐ Good ☐ Excellent ☒ No information
Yearly energy consumption: *electricity (kWh)*	430			202	150
Yearly energy cost (ZAR)	650			300	225

If applicable: Yearly energy consumption for further energy carri-ers	N/A	N/A	N/A	N/A	N/A
If applicable: Yearly water consumption	N/A	N/A	N/A	N/A	N/A
If applicable: Yearly water cost	N/A	N/A	N/A	N/A	N/A
Purchase cost in (ZAR)	Range between 2,500 and 3500 depending on size			8,500	N/A
Operation & Mainte-nance cost (ZAR)	1,000 (lifetime)			1,000 (lifetime)	N/A
Labelling class (for the aforemen-tioned labels)	Not measured. Locally manufactured and no requirement to measure.			A++	A+++

4 Performance and information requirements

South Africa introduced a voluntary energy label for refrigerators and freezers in 2005. The label was based on the EU design and the objective was to extend this to other large appliances, such as washing machines, dishwashers and dryers. National Standards for appliances were issued in 2009. From 2015, MEPS are expected to come into force, with label class B the highest to remain on the market for refrigerators and C for freezers.

Energy Label

The South African Energy Strategy of 1998 identified residential appliances as an effective means to achieve energy savings in the residential sector in South Africa. In 2005 the country's first National Energy Efficiency Strategy (NEES) was developed and in the same year the Department of Minerals and Energy (now Department of Energy) introduced a voluntary labelling scheme, which was a precursor to a mandatory Standards and Labelling (S&L) Programme. The voluntary scheme targeted refrigerators but encouraged manufacturers to extend it to all their appliances. It was decided to use the EU designed label, largely because historically the majority of South Africa's appliances were imported from Europe. A label was designed for refrigerators (Figure 13), which included some minor changes to the EU label being used at the time, most notably a star with the colours of the South African national flag. The label was registered with all the relevant national and international authorities.

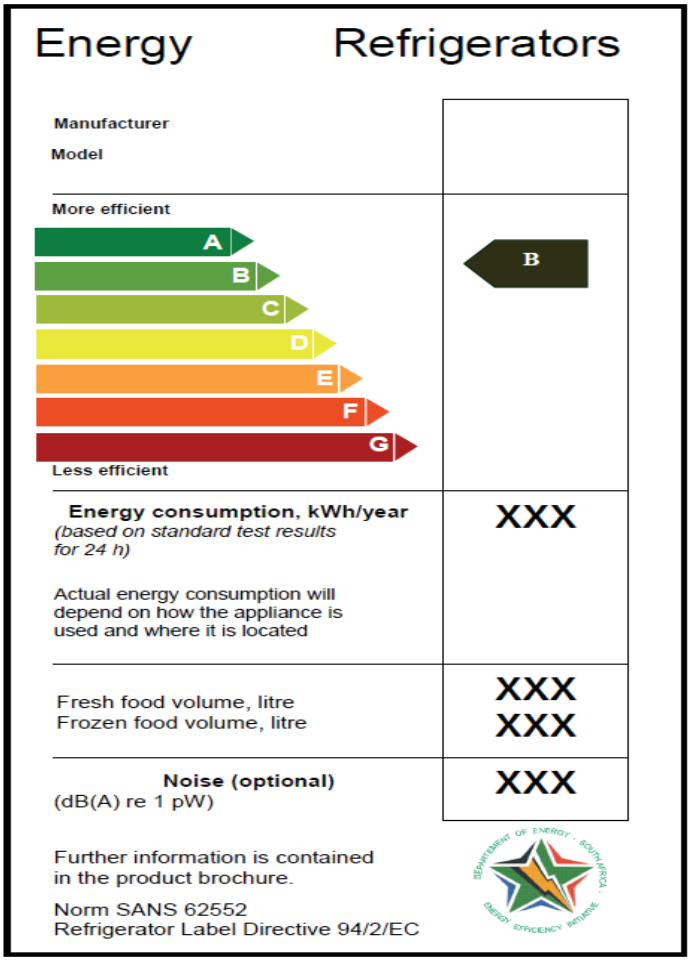

Figure 13: South African Energy Label

Source: South Africa Bureau of Standards

The voluntary programme had limited impact. With no support or signals from Government on the implementation of a mandatory programme it was soon forgotten and abandoned by manufacturers and retailers. In 2007 the South African Department Of Energy (DoE) and the United Nations Development Programme (UNDP) country office agreed to submit a joint application to the Global Environment Facility (GEF) for financial support in order to implement a mandatory S&L programme. In 2008, the South African Bureau of Standards (SABS) formed the Working Group 941 (WG941) who was mandated to develop the South African National Standard “SANS 941 - Energy Efficiency for Electrical and Electronic Apparatus”. SANS 941 identified energy efficiency requirements, energy efficiency labelling, measurement methods and the maximum allowable standby power for a set of appliances. SANS 941 created the basis for the development of national testing standards in South Africa, which adopted the existing International Electro-technical Commission (IEC) standards. The derived testing standard for refrigerators is SANS 62552:2008 (IEC 62552:2007). The proposal for the GEF funded S&L programme (submitted in 2010 and approved in 2011) selected the appliances based on SANS 941, but does not cover all the appliances listed in SANS 941.

The South African energy label in its current format has certain shortcomings. These include:

- The label designed in 2005 is obsolete, as it does not go beyond A. The standard states 'the indicators for A+ / A+++ shall be placed at the same level as for class A';
- Focus Groups undertaken 2012 found that all consumers viewed the programme would benefit them and supported its implementation. However, reported issues concerning the label included confusion regarding the used wordings for descriptions on the label. For example, why does it say "energy" and not "electricity"? As South Africa has many languages (11 official) so this also means that certain words may be misunderstood; and
- Including extra information was also questioned. For example, why were noise levels included if it is an energy label?

Based on the above listed findings, a review and re-design of the South African label is recommended to incorporate the issues identified locally and in the EU (which has almost eliminated all text in favour of pictograms). The South African S&L project team is currently (2014) deliberating whether to make changes to the existing label in line with the upgrades made to the EU label, which makes greater use of symbols (pictograms) rather than text. The proposed changes to the label for refrigerators are shown in Figure 14 below:

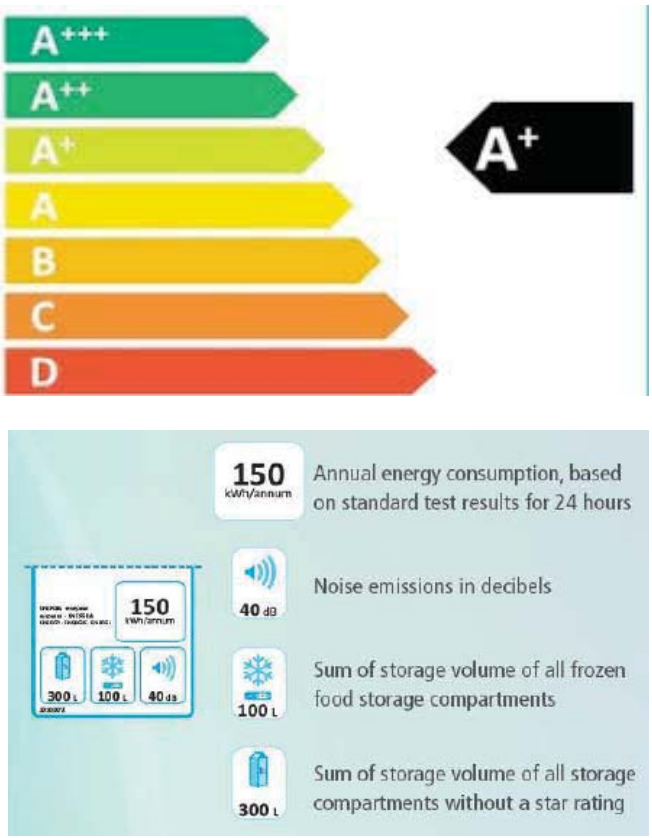

Figure 14: Draft for a new South African Energy Label

Source: South African Department of Energy, S&L Programme Office

Minimum Energy Performance Standards (MEPS)

On 7 February 2014, the “Compulsory specification for energy efficiency and labelling of electrical and electronic apparatus, VC9008” [9] was published by the South African government, which confirmed the MEPS (label class) for refrigerators and freezers as:

- Refrigerators: B
- Freezers: C

The MEPS levels were based on the findings of preceding impact assessment studies as well as consultations with manufacturers, retailers and consumer groups.

The intention to introduce the energy classes allowed for a mandatory two-month period for public comments. As last step, on 28 November 2014, the “compulsory specification for energy efficiency and labelling of electrical and electronic apparatus” for refrigerators and freezers was declared to become effective nine months later (on 28 August 2015) [10]

5 Test procedures and standards

The national standard for refrigerators in South Africa is SANS 62552:2008, which is aligned to IEC 62552:2007. Ten categories of refrigerating appliances have been defined.

Table 10: Categories of household (HH) refrigerators (SANS 62552)

No	Category	Description
1	Larder fridge:	HH refrigerator, without low temperature compartments
2	Refrigerator chiller:	HH refrigerator, with compartments at 5°C or 10°C or both
3	Refrigerator (no star)	HH refrigerator, with no star low temperature compartments
4	Refrigerator (*)	HH refrigerator, with star low temperature compartments: *
5	Refrigerator (**)	HH refrigerator, with star low temperature compartments: **
6	Refrigerator (***)	HH refrigerator, with star low temperature compartments: ***
7	Refrigerator *(***)	HH refrigerator, with star low temperature compartments: *(***)
8	Upright freezer	HH food freezer, upright
9	Chest freezer	HH food freezer, chest
10	Multi-door	HH refrigerator and freezer with more than 2 doors, or other not covered above

Method for Energy Efficiency classes A+ and A++

The energy performance of refrigerators is measured and specified in terms of an energy efficiency index (EEI). This provides an indication of the annual power consumption (AC) relative to a reference consumption that is based on the storage volume and the category of refrigerator (as defined in Table 10). The EEI (Iα) for Class A+ and A++ is calculated as follows:

$$I\alpha = \frac{AC}{SC} \text{ X } 100$$

Where:

AC is the annual energy consumption of the appliance, in kWh / year (i.e. per 24 h x 365);
SCα is the standard annual energy consumption of the appliance, in kWh per year, calculated by:

$$M\alpha \times \Sigma \left(Vc \times \frac{25\text{-}Tc}{20} \times FF \times CC \times BI\right) + N\alpha + CH$$

Where:

Vc is the net volume (in litres) and **Tc** the design temperature (in °C) of the compartment respectively;

Table 11: Values of Mα and Nα

No	Category	Temp of coldest compartment	Mα	Nα
1	Larder fridge	> -6°C	0.233	245
2	Refrigerator chiller	> -6°C	0.233	245
3	Refrigerator (no star)	> -6°C	0.233	245
4	Refrigerator (*)	≤ -6°C	0.643	191
5	Refrigerator (**)	≤ -12°C	0.450	245
6	Refrigerator (***)	≤ -18°C	0.777	303
7	Refrigerator *(***)	≤ -18°C	0.777	303
8	Upright freezer	≤ -18°C	0.539	315
9	Chest freezer	≤ -18°C	0.472	286
10	Multi-door		a	b

a= in the case of these appliances the temperature and star rating of the compartment with the lowest temperatures will determine the values of M and N

b= in the case of these appliances the values of M and N are determined by the temperature and star rating of the compartment with the lowest temperature

Table 12: Values of FF, CC, BI and CH

Correction Factor	Value	Conditions
FF (Frost Free)	1.2	For FF ventilated frozen food compartments
	1.0	Otherwise
CC (Climate Class)	1.2	For 'tropical' appliances
	1.1	For 'sub-tropical' appliances
	1.0	Otherwise
BI (Built In)*	1.2	For built-in appliances < 58cm in width
	1.0	Otherwise
CH (Chill compartment)	50 kWh/y	For appliances with a chill compartment of at least 1,5 litres
	0	Otherwise

* An appliance is 'built-in' only if it is designed exclusively for installation within a kitchen cavity with a need for furniture finishing and tested as such

Method for Energy Efficiency classes A to G:

The energy efficiency index (EEI) ***I*** for refrigerators in classes A to G is calculated as follows:

I is the annual energy consumption of the appliance in kWh / year (i.e. per 24 h x 365);

SC is the standard annual energy consumption of the appliance, in kWh per year, which is calculated by the formula:

$$SC = M \times \text{adjusted net volume} \times N$$

Where:

Adjusted net volume = the net volume of fresh food compartment + Ω × the net volume of the frozen food compartment. The values are provided in Table 13 below:

Table 13: Values on M, N and Ω

No	Category	Ω	M	N
1	Larder fridge	-	0.233	245
2	Refrigerator chiller	0.75	0.233	245
3	Refrigerator/chiller (no star)	1.25	0.233	245
4	Refrigerator (*)	1.55	0.643	191
5	Refrigerator (**)	1.85	0.450	245
6	Refrigerator (***)	2.15	0.657	235
7	Refrigerator *(***)	a	0.777	303
8	Upright freezer	2.15	0.472	286
9	Chest freezer	2.15	0.446	181
10	Multi-door	a	b	b

a= Adjusted net volume (AV) is calculated

$$\Sigma \frac{25\text{-}Tc}{20} \times VC \times FC$$

Tc is the temperature in °C, of each compartment

Vc is the net volume in litres, of each compartment

Fc is the factor which equals 1,2 for 'no frost' and 1 for other

b= in the case of these appliances the values of M and N are determined by the temperature and star rating of the compartment with the lowest temperature

Table 14: Temperature and star rating

Temperature of coldest compartment	Equivalent category	M	N
> -6°C	1/2/3 Larder fridge/no star / refrigerator/refrigerator chiller	0.233	245
≤ -6°C *	4 Refrigerator: *	0.643	191
≤ -12°C **	5 Refrigerator: **	0.450	245
≤ -18°C ***	6 Refrigerator: ***	0.657	235
≤ -18°C *(***) with freezing capacity	7 Refrigerator: *(***)	0.777	303

Energy Efficiency Classes

The energy efficiency class of the refrigerator will be determined in accordance with Table 15.

Table 15: Energy Efficiency Classes

EEI	Energy Efficiency Class
Iα < 30	A++
30 ≤ Iα < 42	A+
42 ≤ I < 55	A
55 ≤ I < 75	B
75 ≤ I < 90	C
90 ≤ I < 100	D
100 ≤ I < 110	E
110 ≤ I < 125	F
125 ≤	G

6 Application of the Standard

The SANS 62552 formulas to derive the energy class are complicated and the practical application is difficult to understand for the average consumer. To provide a reference point, the most popular fridge/freezer and chest freezer model sizes were chosen and actual data was used to determine annual energy consumption for each of the energy classes.

The calculations were done by the electrical engineering department of the University of Stellenbosch.

The Energy Efficiency Index, as the ratio of AC to SC, serves as an indicator to compare energy consumption with the appliance's internal volume, to show how efficient it is for its size.

$$I\alpha = \frac{AC}{SC} \text{ X } 100$$

Where:

I is the Energy Efficiency Index;
AC is the Annual Energy Consumption in kWh per year, and
SC is the Standard Annual Energy Consumption in kWh per year

Category: Fridge/Freezer

The results for the Fridge/freezer category given in Table 16 were derived based on input values of volume and Total Annual Consumption (in kWh/year) as well as the following assumptions:

- Frost-free compartments;
- SN climate class;
- Not built-in;
- No chill compartment; and
- Design temperatures for refrigerator and freezer compartments respectively: -6°C and -18°C

Table 16: Energy consumption for exemplary Fridge/Freezer *(***) Category

Fridge/freezer *(***) category: Energy Consumption of appliance (kWh per year) per Energy Class							
		Small (< 340 litres)		**Medium** (341 - 510 litres)		**Large** (>511 litres)	
		Freezer volume = 65 litres	Fridge vol. = 240 litres	Freezer vol. = 80 litres	Fridge vol. = 265 litres	Freezer vol. = 180 litres	Fridge vol. = 365 litres
EE Class	Index (I) range per class	AC (kWh per year)		AC (kWh per year)		AC (kWh per year)	
A++	< 30	≥ 125 < 235		≥ 225 < 255		< 360	
A+	≥30 <42	≥ 235 < 330		≥ 255 < 355		≥ 360 < 500	
A	≥42< 55	≥ 330 < 430		≥ 355 < 460		≥ 500 < 655	
B	≥55< 75	≥ 430 < 585		≥ 460 < 635		≥ 655 < 890	
C	≥75< 90	≥ 585 < 700		≥ 635 < 755		≥ 890 < 1065	

Category: Freezer

The results for the Chest freezer category are summarised in Table 17. The result set was derived based on input values of volume and Total Annual Consumption (in kWh/year) as well as the following assumptions:

- Frost-free compartment
- SN climate class
- Not built-in
- Design temperature for freezer compartment: -18°C

Table 17: Energy Consumption for exemplary Chest Freezer Category

Chest freezer category: Energy Consumption of appliance (kWh per year) per Energy Class				
		Small (< 340 litres)	**Medium** (341 - 510 litres)	**Large** (>511 litres)
		Freezer volume = 200 litres	Freezer volume = 435 litres	Freezer volume = 530 litres
EE Class	Index (I) range per class	AC (kWh per year)	AC (kWh per year)	AC (kWh per year)
A++	< 30	< 160	< 245	< 280
A+	≥ 30 <42	≥ 160 < 175	≥ 245 < 290	≥ 280 < 335
A	≥ 42 < 55	≥ 175 < 230	≥ 290 < 375	≥ 335 < 435
B	≥ 55 < 75	≥ 230 < 310	≥ 375 < 515	≥ 435 < 595
C	≥ 75 < 90	≥ 310 < 375	≥ 515 < 615	≥ 595 < 715

As guideline for the input values for the following tables, actual data sets were used. The mode and median values for fridge/freezer and freezer category were calculated for the given data sets as shown in Table 18.

Table 18: Mode and Median Value for given data sets

Mode		
Fridge/Freezer Category	Freezer Volume in Litres	Fridge Volume in Litres
Small	65	246
Medium	82	264
Large	180	365
Median		
Chest Freezer Category	Freezer Volume in Litres	N/A
Small	213	
Medium	435	
Large	533	

For the Fridge/freezer category, the freezer volume parameter is weighted compared to the fridge volume, in that a smaller data dispersion range was used. This is due to the fact that the SC value depends on a value of 'Adjusted Volume', in order to take into account the relatively high energy intensity of a Fridge/freezer's frozen food compartment compared to the fresh food compartment.

Table 19: Energy consumption for Fridge/Freezer category based on actual data

Fridge/freezer category: Energy Consumption of appliance (kWh per year) per Energy Class							
		Small (< 340 litres)		**Medium** (341 - 510 litres)		**Large** (>511 litres)	
		Freezer vol.: ≥ 55 ≤ 73	Fridge volume ≥ 116 ≤ 196	Freezer volume: ≥ 92 ≤ 138	Fridge volume ≥ 235 ≤ 364	Freezer volume: ≥ 176 ≤ 215	Fridge vol. ≥ 325 ≤ 412
EE Class	Index (I) range per class	AC (kWh per year)		AC (kWh per year)		AC (kWh per year)	
A++	< 30	≥ 124 ≤ 225		≥ 248 ≤ 325		No data available for class A++.	
A+	≥ 30 <42	≥ 256 ≤ 296		≥ 327 ≤ 371		≥ 438 ≤ 471	
A	≥ 42 < 55	≥ 302 ≤ 332		372		≥ 525≤ 573	
B	≥ 55 < 75	361		493		734	
C	≥ 75 < 90	No AC data available for classes C and D.		No data available for classes C to G.		No data available for class C.	
D	≥ 90 < 100					No AC data available for class D.	
E	≥ 100 < 110	No data available for classes E to G.				No data available for classes E to G.	
F	≥ 110 < 125						
G	≥ 125						

Table 20: Energy Consumption for Chest Freezer category based on actual data

Chest freezer category: Energy Consumption of appliance (kWh per year) per Energy Class				
		Small 210 ≤ volume ≤ 327	**Medium** (340 ≤ volume ≤ 510 litres)	**Large** (Volume >511 litres)
EE Class	Index (I) range per class	AC (kWh per year)	AC (kWh per year)	AC (kWh per year)
A++	< 30	≥ 162 ≤ 202	No data available for classes A++ and A +.	No data available for classes A++ and A +.
A+	≥ 30 <42	No data available for class A+.		
A	≥ 42 < 55	310 ≤ AC ≤ 335	≥ 372 ≤ 425	310
B	≥ 55 < 75	390	No AC data available.	634
C	≥ 75 < 90	No data available for classes C to G.		
D	≥ 90 < 100			
E	≥ 100 < 110			
F	≥ 110 < 125			
G	≥ 125			

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