



Energy efficient dishwashers

Country

South Africa

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1 Country-wide saving potential

Dishwashers

About **0.5 million** dishwashers are in use in South Africa (reference year 2010). The average annual consumption of each of these dishwashers amounts to about **329 kWh**. In total, this causes an annual electricity consumption of **0.16 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 dishwasher 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, even an absolute decoupling of the annual energy consumption and the increasing stock of dishwashers can be achieved. While the stock is expected to grow by 47 % between 2010 and 2020, in the efficiency scenario the energy consumption can be reduced by 25 %. Although the stock is expected to grow by another 48 % until 2030, in the efficiency scenario the growth of the energy consumption can be mitigated to 11 % (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 16 % by 2020 and 25 % between 2020 and 2030.

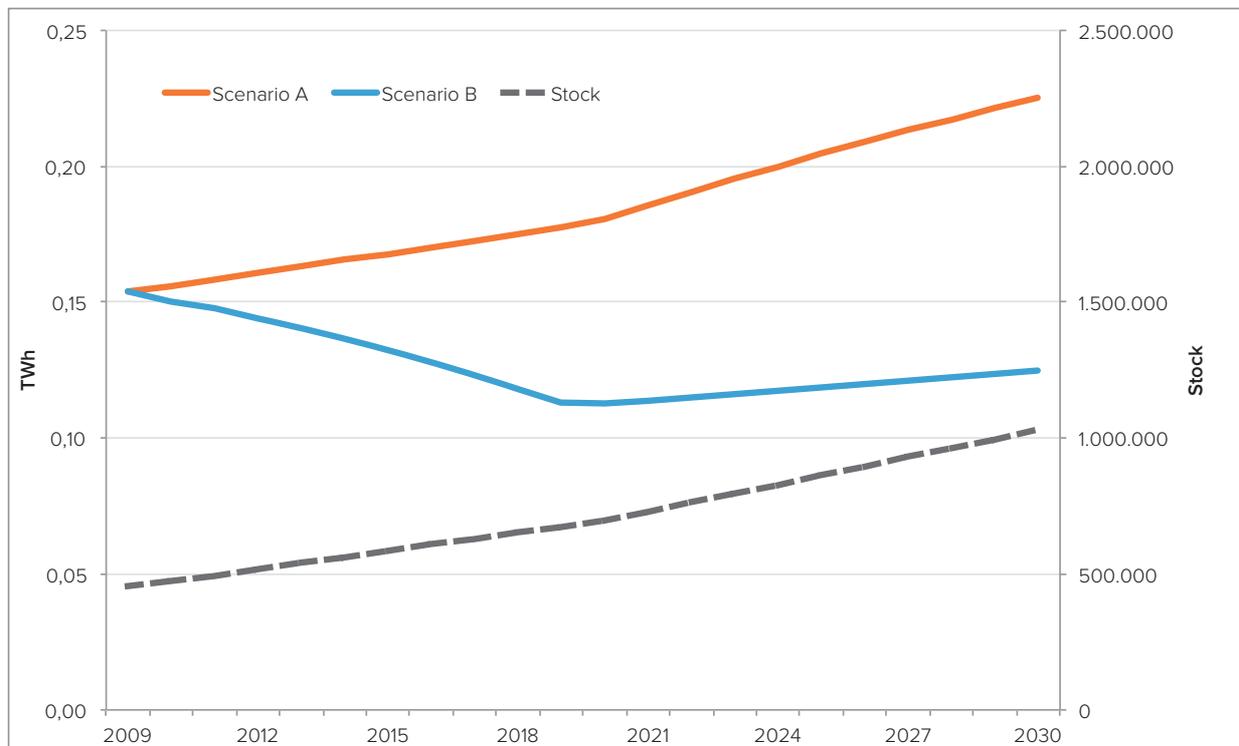


Figure 1: Electricity consumption dishwashers, Baseline Scenario (A) vs. Efficiency Scenario (B)

Source: Wuppertal Institute (2015)

Table 1: Country-wide saving potential 2010 - 2030: Dishwashers

Base year 2010	Total energy consumption of Dishwashers per year [TWh/year]	0.16
	Stock number Dishwashers	473,000
	Average annual energy consumption of Dishwashers in the stock [kWh/year]	329
	Total annual CO ₂ eq emissions related with Dishwashers [Mt/year]	0.11
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	0.07
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	-0.04
	CO ₂ eq emission reduction potential vs. baseline development [Mio.t/year]	0.04
	Stock number of Dishwashers in 2020	697,000
	Average annual energy consumption of new Dishwashers (all BAT) in 2020 [kWh/year]	137
	Total incremental investment costs [not discounted] until 2020 (end-user perspective) [€]	54,112,737
	Total incremental investment costs [not discounted] until 2020 (societal perspective) [€]	47,467,313
	Total economic benefit until 2020 [not discounted] (end-user perspective) [€] scenario B vs. scenario A	-20,698,740
Total economic benefit until 2020 [not discounted] (societal perspective) [€] scenario B vs. scenario A	-35,009,820	

2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	0.10
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	-0.03
	CO ₂ eq emission reduction potential vs. baseline development [Mio.t/year]	0.07
	Stock number of Dishwashers in 2030	1,030,000
	Average annual energy consumption of new Dishwashers (all BAT) in 2030 [kWh/year]	110
	Total incremental investment costs [not discounted] between 2021 and 2030 (end-user perspective) [€]	73,974,600
	Total incremental investment costs [not discounted] between 2021 and 2030 (societal perspective) [€]	64,890,000
	Total economic benefit until 2030 [not discounted] (end-user perspective) [€] scenario B vs. scenario A	-17,756,817
	Total economic benefit until 2030 [not discounted] (societal perspective) [€] scenario B vs. scenario A	-64,157,658
Lifetime data for Dishwashers purchased in the analysed timeframe	Total electricity savings, scenario B compared to scenario A [TWh]	1.73
	Total GHG emission reductions scenario B compared to scenario A [Mt]	1.13
	Total incremental investment costs [not discounted] (end-user perspective) [€] scenario B vs. scenario A	128,087,337
	Total incremental investment costs [not discounted] (societal perspective) [€] scenario B vs. scenario A	112,357,313
	Total economic benefit [not discounted] (end-user perspective) [€] scenario B vs. scenario A	19,873,264
	Total economic benefit [not discounted] (societal perspective) [€] scenario B vs. scenario A	-46,586,146

Source: Wuppertal Institute (2015)

2 Subtypes and markets

Dishwashers in South Africa are almost exclusively used in upper income family households who buy full size units with 12 or more place settings. Consequently, dishwashers have a household penetration rate of only 4%. Sales of dishwashers experienced growth in the period 2003 – 2007 but the economic recession resulted in a drop in annual sales from 2008. The market consolidated within two years with sales not dropping below 2003 levels. This inelastic development demonstrates that a specific segment of the market considers dishwashers as essential appliances. However, manufacturers have not been able to penetrate into new market segments, such as upper middle income and single/double occupancy households. This is evidenced by full size units consistently having over 80% market share.

South Africa has a long history of appliance manufacturing and the first large appliances (electric stoves) were manufactured in 1932. Refrigeration came soon after and other domestic appliances such as gas stoves, washing machines, tumble dryers followed. Historically there was a limited number of locally manufactured mass produced appliances 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 appliances manufacturing plants but still two remain in 2014. However, there has never been any local manufacture of dishwashers and these products have always been imported largely due to low penetration rates and low annual sales relative to the number of households. Imported models are targeted to the upper income families. As there is no local manufacture, dishwashers are not subject to any import duties [1].

As recently as the late 1980's the country's electrification rate for residential households was around 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% [2] and by 2011 it was 83% [3]. By the late 1990's the country's electrification programme expanded the market for electrical appliances by an estimated 50% [4], but this has not influenced the dishwasher market to the same extent as other appliances such as refrigerators, televisions and to a lesser extent washing machines.

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. This income inequality also means that the middle to lower income groups categorise their appliances as ‘essential’ and ‘non-essential’.

All dishwashers sold in South Africa must comply with the South African National Standard (SANS) 50242:2010. This standard conforms to the International Electrotechnical Commission IEC 50242/60436:2008.

Market Characteristics

The extent to which the full size models dominate the market means that the most appropriate categorisation is “full size” (12 place settings or more) and “small” with less than 12 place settings.

Two factors in South Africa result in dishwashers being a niche product. The first is that to the majority of the households dishwashers are unaffordable and therefore categorised as non-essential; and second within the target market of upper middle to high income earners these households have access to domestic workers to maintain their households and this includes the washing of dishes, meaning that households are less inclined to mechanise this function than would normally be the case. Even the expected uptake by affluent single and two person households has apparently not materialised as full size dishwashers with 12/14 place settings make up more than 80% of the market.

The market is dominated by freestanding machines (99%) with built-in units making up the balance. Over the past few years there has been a shift towards high-end or even so-called “smart technology” machines which offer features such as automatic sensors which adjust water and temperature settings automatically to suit load and dirt content. Machines with reduced noise levels are also growing in popularity. With increasing water and electricity tariffs there has been a shift towards machines being used less frequently and households ensuring that machines are fully loaded before running a cycle [5].

As the Government’s water and electrification programme continues to develop coupled with increasing income it is expected that the penetration of kitchen appliances will experience growth. But with electricity tariffs increasing by as much as 300% since 2007, rising national concern regarding water availability in a water scarce country and as the economy continues to remain subdued, Euromonitor (2014) reports that manufacturers and consumers are also more and more moving towards energy and water efficient appliances.

Penetration Rates and Sales

Figure 2 shows the household penetration rate of dishwashing machines since 2000, which has remained relatively stable. Since 2003 annual sales have gone from 72,000 to 89,000 in 2013, an increase of 23%. This increase has not been linear as can be seen in Figure 3. Sales increased by 70% for the period 2003 to 2006 but could not be sustained and have consolidated at around 90,000 units per annum [5]. The post 2009 figures remain well above the 2003 levels, what shows that there is strong support for dishwashers in households which have become accustomed to them and now view them as essential. Euromonitor has forecasted a CAGR of 3.8% up until 2018, and expects annual sales to increase to about 110,000 units per annum.

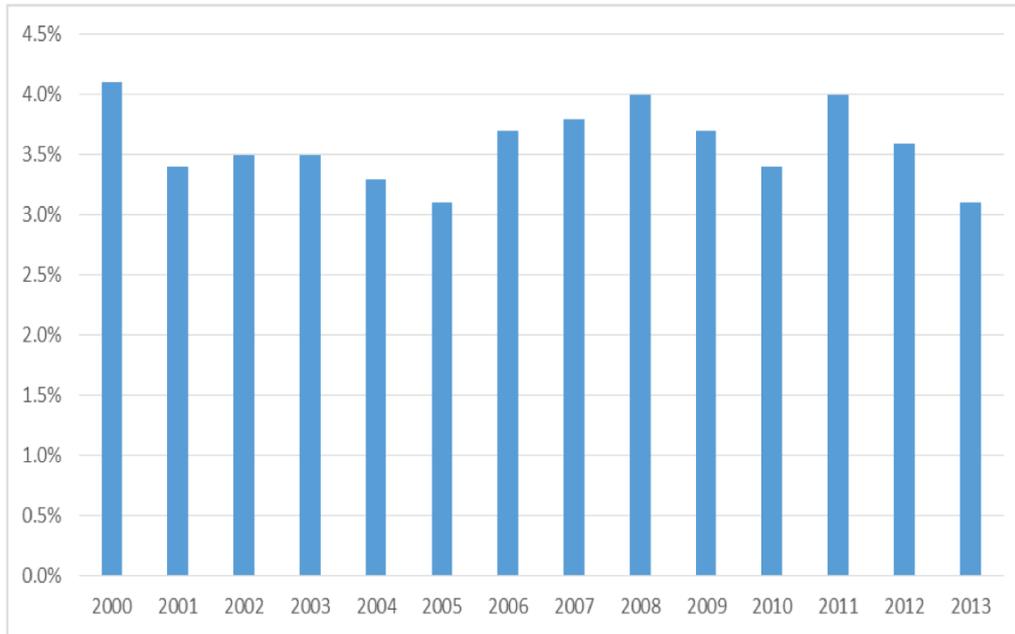


Figure 2: Penetration rate of dishwashers in SA households (HH) 2000-2013 (%)

Source: AMPS (2000-2013)



Figure 3: Annual sales by sub-category 2003-2013

Source: Euromonitor (2014)

Figure 4 shows the total number of dishwasher units in South African households. In 2013 there were 14,977,633 households in the country. In 2010, 91% of dishwashers were found in the highest income households and this increased to 96% in 2013. This demonstrates the extent to which this appliance group is categorised as non-essential in South Africa.

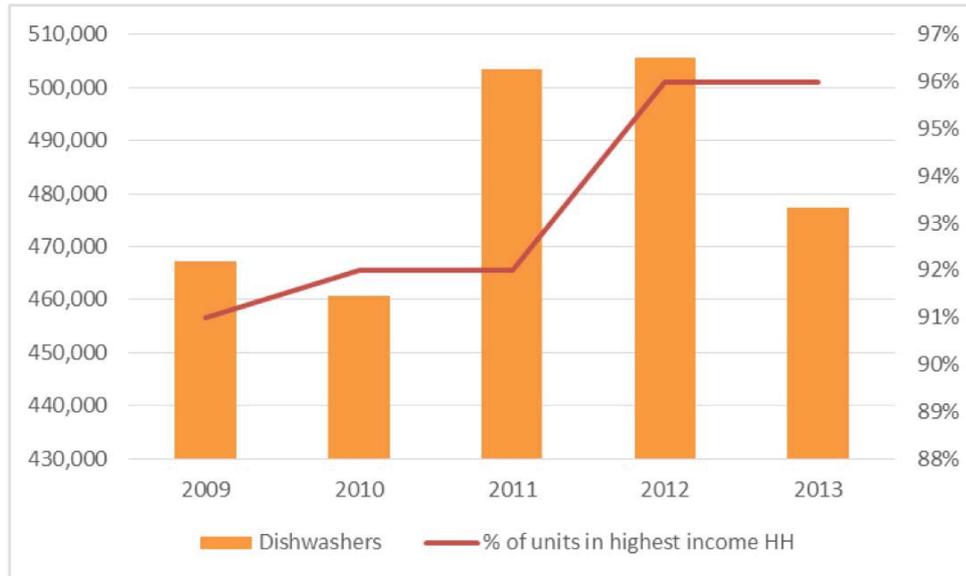


Figure 4: Total number of dishwashers in SA and percentage of units in highest income households

Source: Own illustration, based on AMPS (2009-2013)

Table 2 provides a breakdown of sales by sub-category type.

Table 2: Unit sales by sub-category ('000 units)

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Dishwashers	Full Size	59	69	79	90	87	75	72	77	72	72	73
	Compact	13	15	18	20	19	17	16	18	16	17	17
Total Sales		72	84	97	110	106	92	88	95	88	89	90

Source: Euromonitor (2014)

Dishwasher Market – 1995

Electricity tariffs in South Africa were amongst the lowest in the world in 1995. Nevertheless, first interest in energy efficiency in the appliances sector dates back to this year, when a cost benefit analysis [6] was undertaken by the South African Department of Minerals and Energy. The study analysed the typical consumption figures of dishwashers using a standard cycle, which came to 300 kWh per annum. Existing appliances would be replaced after a typical lifetime of 10 years [7].

Dishwasher Market – 2010

Another study undertaken by the Department of Trade and Industry [8] in 2011 surveyed the top 5 manufacturers and distributors of dishwashers in South Africa. Jointly, these companies accounted for more than 80% of annual sales in 2010 and 2011. This study found 56 dishwasher models available in the market, whereby the lowest energy class for dishwashers was an A, which was also the majority. For an appliance category with such limited sales there was a surprisingly large number of models available.

51 of which were full size models (Figure 5). Dishwashers target the affluent sector of the population where style, finish and features play a major role. This would explain the apparently disproportionate large number of models available in the market, relative to the number of units sold annually. It is believed that a reasonable percentage of the models are effectively the same machine but with different finishes, such as metallic, white or even other colours. All models had good or even very good energy class ratings with not a single model in category B.

Please note: The number of models and the energy class levels were provided voluntarily by the five manufacturers for the study undertaken by the Department of Trade and Industry [8] 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.

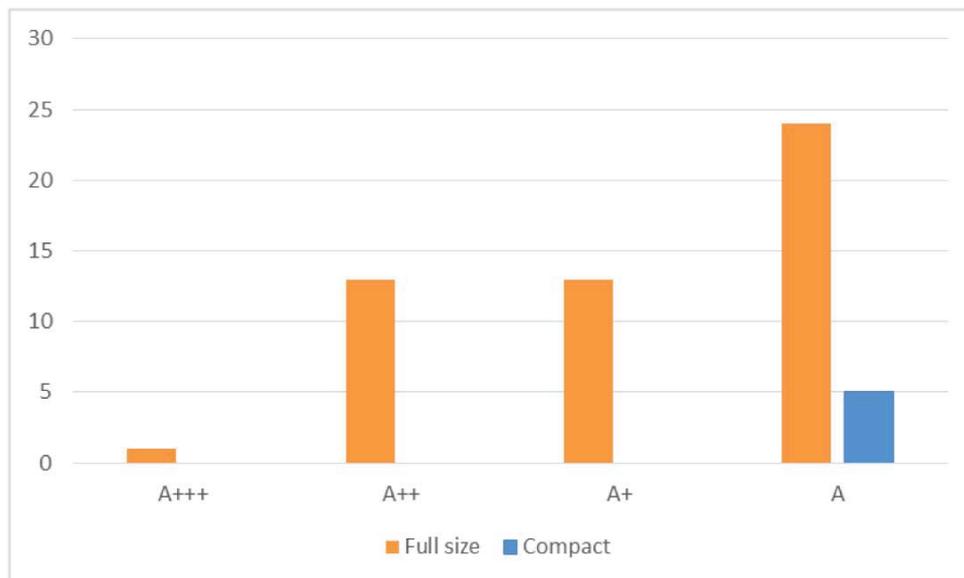


Figure 5: Energy class distribution of dishwasher models (2010)

Source: Own illustration, based on Department of Trade and Industry [8]

Dishwasher Market – 2014

Table 3 lists the number of models available in the South African market in 2014. The data was sourced from popular online shopping websites¹; manufacturer websites and data supplied by manufacturers themselves. Again, it is not a complete list, but it is believed to cover the majority of the market in South Africa. The same data is represented graphically in Figure 6. A comparison of Figure 5 and Figure 6 confirms that the full size models continue to dominate the market and also the large number of models available in one of the smaller appliance categories by volume sales. Desktop research confirms also that many of the models are the same machine but with different finishes. Although there is a greater

¹ www.pricecheck.co.za and www.shopmania.co.za

number of models where the energy class has not been specified the cause is believed to be a result of missing mandatory requirements to do so rather than the models having a poor performance.

The MEPS for dishwashers (see Chapter 4) has been set at energy class A, which is the current baseline. It can therefore be concluded that the introduction of the new MEPS for dishwashers is unlikely to yield any real energy savings and possibly could have been set one level higher.

Table 3: Numbers of models available in the South African market, per energy class (2014)

Category	Full Size	Compact
A+++	14	
A++	32	
A+	34	10
A	19	3
Not specified	10	1
Total number of models	123	

Source: Own analysis, based on data from www.pricecheck.co.za and www.shopmania.co.za

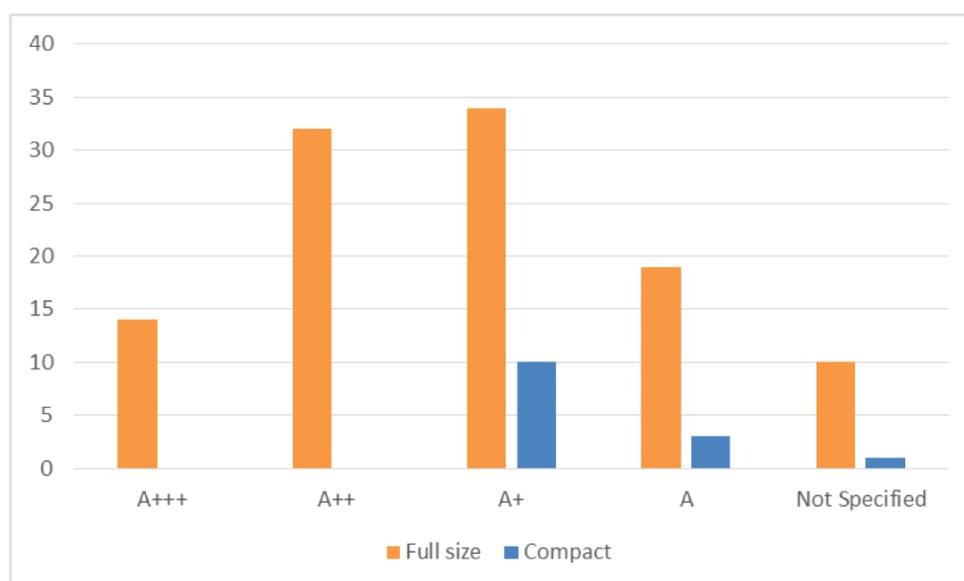


Figure 6: Energy class distribution of dishwashers (2014)

Source: Own illustration

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 [9]. 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. These events have had a somewhat different effect on dishwashers compared to other non-essential appliances such as washing machines and dryers, and have shown resilience in a similar fashion as washer dryers. Euromonitor [5] notes that *‘the mass markets “luxury” perception of dishwashers is likely to result in growth arising mainly from replacement purchases, with those that have previously owned dishwashers perceiving the appliance as a necessary household item and therefore replacing them when necessary’*. On the other side, the impact that the economic downturn has had on dishwashers is that they are unable to penetrate new markets such as upper middle income and households suited to compact size machines.

In terms of energy efficiency, when the economy starts to grow again and consumers are willing to purchase dishwashers for the first time, they will be buying appliances with increased efficiency and by default will participate in the *‘value proposition made by energy efficient appliances’* [5]. The traditional decision making criteria: price; brand; guarantees; after sales service; design and aesthetics – will still dominate, but the water and energy consumption of these units will be at an efficient level and compliant at least with the MEPS.

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 *‘come into effect as soon as possible’*². It is with the retailers where the uncertainty continues as the delayed implementation of the mandatory S&L programme means that stores, where there is very limited understanding of how S&L programmes are applied, remain unclear on what labelling is required and where. 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 the following Figure 7 and Figure 8. This makes it difficult for consumers to interpret and compare them. For an appliance, which is purchased by a consumer segment that is likely to understand and demand energy and water saving features, labelling is necessary and performance can be a differentiator.

Figure 7 shows exemplary entry-level dishwashers on the shop floor. Both have the EU energy label but the left one uses an old version and the other the updated label that uses mostly pictograms. The unit on the left has additional marketing material, which promotes its energy saving credentials. In Figure 8 there are two exemplary high-end machines, which (as can be seen from the operation panel) offer additional programmes and so-called ‘smart features’. Only one has an energy label (EU).

² Discussion held with technical manager of Defy appliances September, 2014



Figure 7: Entry level dishwashers using the old (left) and new EU label (right) as well as other labels
 Source: Photos taken by Theo Covary (2014)



Figure 8: High-end dishwashers: Extensive functionality, but one with and one without an energy label
 Source: Photos by Theo Covary

Summary of the dishwasher 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.
- Dishwashers continue to serve mainly the highest income earners in the country and have not penetrated new user groups, such as single occupancy or middle-income households. All models are imported and since 2010 they have a minimum energy class of A. All models in the market will comply with the South African MEPS when it comes into effect in 2015.
- Imported models are susceptible to currency fluctuations. On 1 January 2011 the Rand was valued at 8.76 to the Euro and on 13 December 2014 it was valued at 14.47, which equals a drop of 65%. This is not expected to affect sales adversely, as the existing affluent client base is generally inelastic regarding such price effects but this situation will continue to retard the appliance group to find first-time buyers.
- In its 2014 market analysis Euromonitor reported that the South African market is well aligning with the international trends and increasing its product ranges that are both energy and water efficient, which are marketed to the upper end of the market.
- With 10 years or more, replacement cycles of dishwashers are typically higher than for other appliances. This is largely due to them servicing high-end consumers who buy higher quality products and also use them until the end of the product lifetime. It is unlikely that dishwashers will find themselves as second-hand products in lower income households and thus the life expectancy assumption for these appliances is fixed at 10 years.

3 Efficiency range and user savings

The dishwasher market in South Africa is characterized by high-end machines, which are often already water and energy efficient. Buyers of this appliance group are usually more likely to consider the general performance of dishwashers, including noise levels and other so-called ‘smart features’ (Euromonitor, 2014). Thereby, since 2010 all products including entry-level machines in South Africa are energy class of A or better. This is possible as all machines are imported from world regions with already regulated markets (e.g. EU), but it can be also inferred that manufacturers have recognised the relevance for the buyer’s decision-making process.

The following assumptions for Table 4 were based on the assumption of 280 standard cleaning cycles per annum or 5.3 per week [16]

Table 4: Efficiency range and user savings of washing machines, based on 2010 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	12 place settings				
Category	N/A	N/A	N/A	N/A	N/A
Type	Standard 12 place setting	Standard 12 place setting	Standard 12 place setting	Smart Technology 12 place setting	Smart Technology 12 place setting
Lifetime (years)	10	10	10	10	10

Qualitative performance classification of the provided service:	<input type="checkbox"/> Poor	<input type="checkbox"/> Poor	<input type="checkbox"/> Poor	<input type="checkbox"/> Poor	<input type="checkbox"/> Poor
	<input type="checkbox"/> Low	<input type="checkbox"/> Low	<input type="checkbox"/> Low	<input type="checkbox"/> Low	<input type="checkbox"/> Low
	<input type="checkbox"/> Average	<input type="checkbox"/> Average	<input type="checkbox"/> Average	<input type="checkbox"/> Average	<input type="checkbox"/> Average
	<input checked="" type="checkbox"/> Good	<input checked="" type="checkbox"/> Good	<input checked="" type="checkbox"/> Good	<input type="checkbox"/> Good	<input type="checkbox"/> Good
	<input type="checkbox"/> Excellent	<input type="checkbox"/> Excellent	<input type="checkbox"/> Excellent	<input checked="" type="checkbox"/> Excellent	<input checked="" type="checkbox"/> Excellent
	<input type="checkbox"/> No information	<input type="checkbox"/> No information			
Yearly energy consumption: <i>electricity (kWh)</i>	300	300	280	220	200
Yearly energy cost (ZAR)	450	450	420	330	300
If applicable: yearly energy consumption for further energy carriers	N/A	N/A	N/A	N/A	N/A
If applicable: yearly water consumption (Litres)	5,000	5,000	4,000	3,500	3,000
Yearly water cost (ZAR)	150	150	130	100	90
Purchase cost in (ZAR)	3,500	4,000	4,600	7,000	8,500
Operation & Maintenance cost (ZAR)	1,000 (lifetime)	1,000 (lifetime)	1,000 (lifetime)	1,000 (lifetime)	1,000 (lifetime)

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 but this did not materialise. National Standards for appliances were issued in 2009. VC 9008 published by the Minister of Trade and Industry on 28 November 2014 sets a date for the start of the S&L programme. For dishwashers this is 28 August 2015 and the MEPS has been set at level A.

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 South African label was designed (Figure 9), 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.

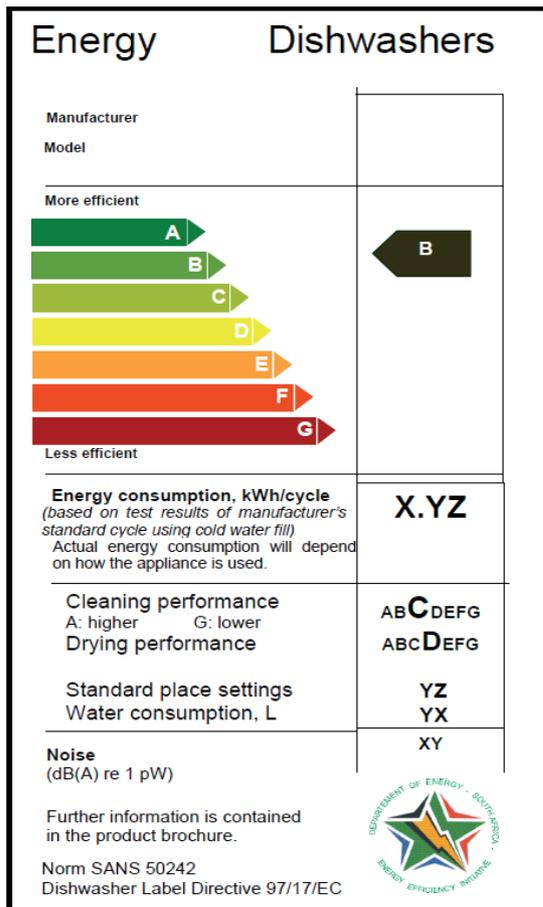


Figure 9: Energy Label for dishwashers

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 [10]. 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. It created also the basis for the development of national testing standards in South Africa, which adopted the existing International Electrotechnical Commission (IEC) standard. The derived testing standard for dishwashers is SANS 50242:2010 (IEC 50242:2008). 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 words used 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). At the end of 2014 the South African S&L project team was 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. Exemplarily, the proposed changes to the label for refrigerators are shown in Figure 10 below:

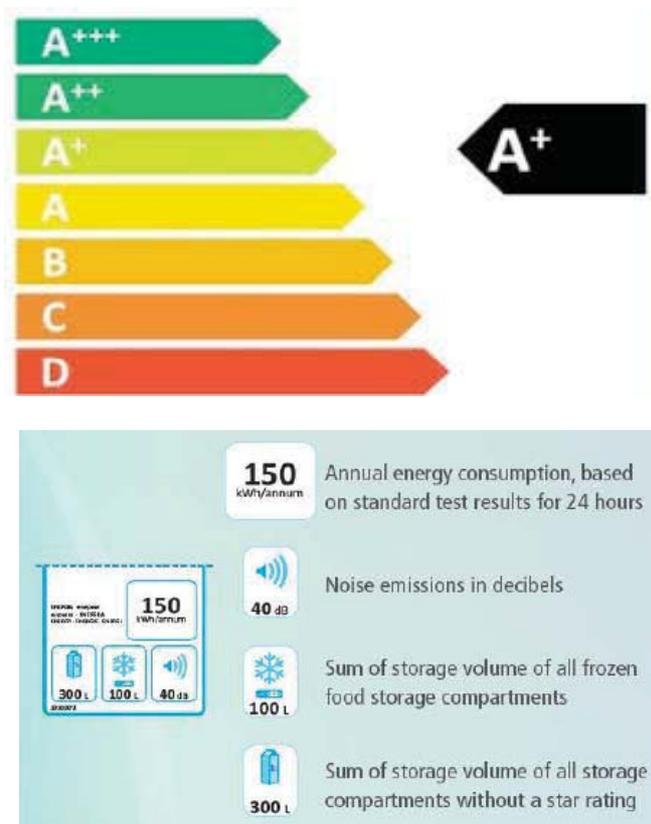


Figure 10: Draft for a new South African Energy Label (Example for refrigerators)

Source: South Africa Bureau of Standards

Minimum Energy Performance Standards (MEPS)

On 7 February 2014, the “Compulsory specification for energy efficiency and labelling of electrical and electronic apparatus, VC9008” [11] was published by the South African government, which confirmed the MEPS (label class) as:

- Dishwasher: A

The intention to introduce the above-mentioned regulation allowed for a mandatory two-month period for public comments. After this time had elapsed, on 28 November 2014 the Department of Trade and Industry published the final notification that the VC 9008 will come into effect for dishwashers nine months after publication of the notice i.e.: 28 August, 2015. [12]

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

5 Test procedures and standards

For dishwashers, the Energy efficiency class can be determined based on the Energy efficiency index, E_i , as set out in Table AA.1 of SANS 50242:2010, Edition 1, South African National Standard “Electric dishwashers for household use — Methods for measuring the performance”.

According to the standard SANS 50242:2010 Edition 1 South African National Standard “Electric dishwashers for household use — Methods for measuring the performance” the following definitions and thresholds (Table 5) apply:

Cycle: Complete washing, rinsing, and drying process, as defined by the programme selected, consisting of a series of operations.

Rated dishwasher capacity (S): Whole number of place settings together with the serving pieces stated by the manufacturer, which can be cleaned and dried when loaded in accordance with the manufacturer’s instructions.

Place settings: Defined set of crockery, glass and cutlery for use by one person.

Serving pieces: Defined set of crockery and cutlery for serving.

Table 5: Energy efficiency class

Energy efficiency class	Energy efficiency index E_i
A	$E_i \leq 0.64$
B	$0.64 < E_i \leq 0.76$
C	$0.76 < E_i \leq 0.88$
D	$0.88 < E_i \leq 1.00$
E	$1.00 < E_i \leq 1.12$
F	$1.12 < E_i \leq 1.24$
G	$1.24 < E_i$

The energy efficiency index is calculated as follows:

$$E = \frac{C}{C_R}$$

Where:

- E** is the energy efficiency index;
- C** is the energy consumption of the dishwasher in kWh per cycle; and
- C_R** is the reference consumption.

The reference consumption, C_R, is calculated as follows:

$$C_R = 1,35 + 0,025S \text{ when } S \geq 10$$

$$C_R = 0,45 + 0,09S \text{ when } S < 10$$

whereby S is the capacity of the machine in standard place settings

6 Application of the Standard

The SANS 50242 formulas to derive the energy class are complicated and the practical application is difficult to understand for non-experts. To provide a reference point, for the most popular ranges of dishwashers actual product data was used to determine exemplarily the energy consumption for each of the energy classes.

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

No exemplary actual data was available for class B to G products, as all dishwashers on the South African market since 2010 have a minimum energy class of A. The capacity for the entire data set ranged from 6 to 15 place settings with the most common capacity value being 12 standard place settings.

Table 6 was compiled respectively for a capacity smaller than 10 ($S < 10$) and greater than or equal to 10 ($S \geq 10$). For two capacities that fall in the respective categories, namely 6 and 12, the kWh consumption per cycle was determined:

Table 6: Reference table - energy consumption for dishwashers

		Capacity, $S = 6$, in standard place setting	Capacity, $S = 12$, in standard place setting
Energy efficiency class	Energy Efficiency index E_I	Energy consumption, C (in kWh), per cycle	Energy consumption, C (in kWh), per cycle
A	$E_I \leq 0.64$	$C \leq 0.64$	$C \leq 1.06$
B	$0.64 < E_I \leq 0.76$	$0.64 < C \leq 0.76$	$1.06 < C \leq 1.26$
C	$0.76 < E_I \leq 0.88$	$0.76 < C \leq 0.88$	$1.26 < C \leq 1.46$
D	$0.88 < E_I \leq 1.00$	$0.88 < C \leq 0.99$	$1.46 < C \leq 1.66$
E	$1.00 < E_I \leq 1.12$	$1.00 < C \leq 1.12$	$1.66 < C \leq 1.85$
F	$1.12 < E_I \leq 1.24$	$1.12 < C \leq 1.23$	$1.85 < C \leq 2.05$
G	$1.24 < E_I$	$1.24 < C$	$2.05 < C$

In an exemplary comparison of two dishwashers with freely accessible consumption data [14, 15, 16] and a capacity of 12 standard place settings (Table 7), the energy consumption data values, in kWh/cycle, are in agreement with the claimed EE class according to reference Table 6.

Table 7: Comparison of claimed performance against reference table (exemplary dishwashers)

Product name	Energy efficiency class	Capacity (place settings)	kWh consumption / cycle
Electrolux ESF63012W	A	12	1.05 (programme Eco 50)
Smeg DI912	A	12	1.05

Source: Freely accessible product consumption data [14, 15, 16]

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