Appliances Guide
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Energy efficient Ovens

Country

South Africa

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1 Country-wide saving potential

Electric Ovens

About **9 million** electric Ovens are in use in South Africa (reference year 2010). The average annual consumption of each of these Ovens amounts to about **702 kWh**. In total, this causes an annual electricity consumption of **6.3 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 Oven 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 Ovens can be achieved. While the stock is expected to grow by 40 % between 2010 and 2020, in the efficiency scenario the energy consumption can be reduced by 4 %. Although the stock is expected to grow by another 49 % until 2030, in the efficiency scenario the energy consumption can be further reduced (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 11 % by 2020 and 19 % between 2020 and 2030.

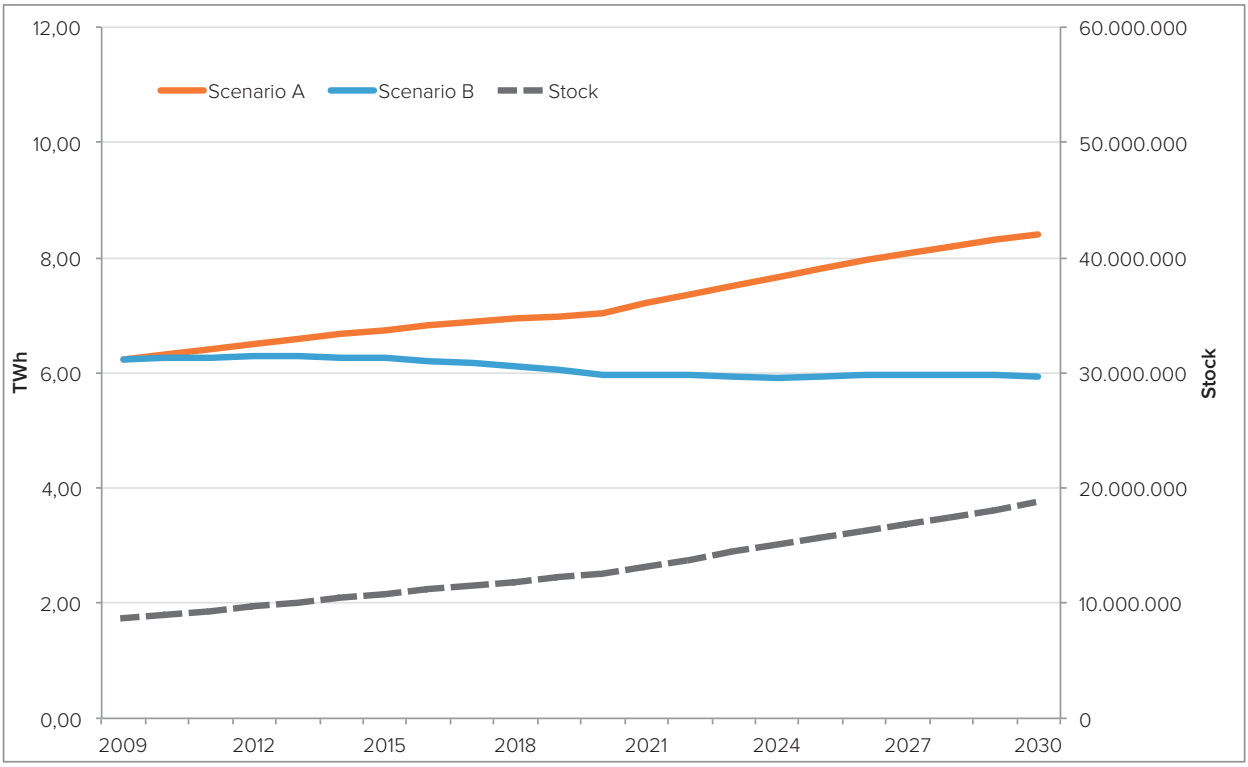

Figure 1: Electricity consumption Ovens, Baseline Scenario (A) vs. Efficiency Scenario (B)
Source: Wuppertal Institute (2015)

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

Base year 2010	Total energy consumption of Ovens per year [TWh/year]	6.32
	Stock number Ovens	9,000,000
	Average annual energy consumption of Ovens in the stock [kWh/year]	702
	Total annual CO_2eq emissions related with Ovens [Mt/year]	4.27
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	1.06
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	-0.34
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0.70
	Stock number of Ovens in 2020	12,600,000
	Average annual energy consumption of new Ovens (all BAT) in 2020 [kWh/year]	360
	Total incremental investment costs [not discounted] until 2020 (end-user perspective) [€]	600,668,170
	Total incremental investment costs [not discounted] until 2020 (societal perspective) [€]	526,901,904
	Total economic benefit until 2020 [not discounted] (end-user perspective) [€] scenario B vs. scenario A	-83,140,333
	Total economic benefit until 2020 [not discounted] (societal perspective) [€] scenario B vs. scenario A	-309,808,819

2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	2.47
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	-0.39
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	1.61
	Stock number of Ovens in 2030	18,750,000
	Average annual energy consumption of new Ovens (all BAT) in 2030 [kWh/year]	240
	Total incremental investment costs [not discounted] between 2021 and 2030 (end-user perspective) [€]	861,300,190
	Total incremental investment costs [not discounted] between 2021 and 2030 (societal perspective) [€]	755,526,482
	Total economic benefit until 2030 [not discounted] (end-user perspective) [€] scenario B vs. scenario A	757,058,521
	Total economic benefit until 2030 [not discounted] (societal perspective) [€] scenario B vs. scenario A	-145,615,285
Lifetime data for Ovens purchased in the analysed timeframe	Total electricity savings, scenario B compared to scenario A [TWh]	44,51
	Total GHG emission reductions scenario B compared to scenario A [Mt]	28,65
	Total incremental investment costs [not discounted] (end-user perspective) [€] scenario B vs. scenario A	1,461,968,360
	Total incremental investment costs [not discounted] (societal perspective) [€] scenario B vs. scenario A	1,282,428,386
	Total economic benefit [not discounted] (end-user perspective) [€] scenario B vs. scenario A	2,273,406,282
	Total economic benefit [not discounted] (societal perspective) [€] scenario B vs. scenario A	740,421,826

Source: Wuppertal Institute (2015)

2 Subtypes and markets

Ovens have a high penetration rate in South African households and are one of the first appliance groups purchased. Ovens experienced strong growth in the late 1990s and early 2000s, averaging close to 7 %. The market is dominated by large (>65 L) models but the medium sized built-in models are gaining in popularity as consequence of the trend towards smaller average household sizes. Nevertheless, small Ovens (<35 L) still make up only a very small percentage of the market.

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 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 a few companies continue to manufacture Ovens locally. At least three appliance manufacturers use Ovens from local OEMs (Original Equipment Manufacturers) but in recent years there has been a trend to use increasingly international OEMs.

As recently as the late 1980's the country's electrification rate for residential households was 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 expanded the market for electrical appliances by about 50 % [3], which has been very relevant for the market as Ovens are the first large appliance which also informal dwellers buy, followed by refrigerators. They are also the first appliances to be purchased or replaced when moving into a new household or renovating an existing kitchen [4].

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 often 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 categorize their appliances as 'essential' and 'non-essential'. Cooking is deemed essential and takes on different guises in the low-income groups. At the very low end of the scale, cooking appliances may be limited to a coal or wood fire or where there is electricity a hot plate. Electric Ovens are purchased at the first available opportunity.

All Ovens sold in South Africa must comply with the South African National Standard (SANS) 50340:2010. This standard conforms to the International Electrotechnical Commission standard IEC 50304/60350:2009.

Market Characteristics

Ovens are broken down according to carrying capacity, which is the usable volume in litres. There are three categories, which are listed below and for the purposes of this report these categories will henceforth be referred to “small”, “medium” and “large”:

- < 35 litres: **Small**;
- 35 - 65 litres: **Medium**; and
- > 65 litres: **Large**.

Traditionally most middle and upper income households made use of electrical Ovens, with the low income groups (who did not have access to electricity or could not afford to buy and operate an electric Oven) opting for gas or coal Ovens. With the high electricity tariff increases experienced since 2007 and uncertainty of electricity supply there has been also a shift by high income households towards gas for cooking and space heating. This is addressed by manufacturers who are introducing products that offer consumers new and energy efficient technology. Although the mass market is still dominated by electric units, upper income households are choosing combination units with a gas hob and electric Ovens. Interestingly South Africa has not followed the international trend where the demand for packaged food drives the demand for microwaves and this category saw even a decline in annual sales. Microwaves are generally used to heat food or for defrosting and standard microwaves make up 91 % of the market and combination microwaves the other 9 % [4]. As a result Ovens are used more frequently in South African households and can contribute as much as 7 % [5] to the monthly electricity bill and the country’s peak demand profile. This paper only covers Ovens and does not consider hobs or cooktops.

The market is evenly split between freestanding and built-in appliances. A built-in appliance means that the Oven and hob are split and comprise of two separate units, which can be installed in different locations, which also allows the consumer to choose different brands. A freestanding unit, or ‘cooker’, is a single unit with Oven and hobs combined. Historically there has been an equal split between built-in and cookers but since 2003 there is a move towards cookers, which is now entrenched. Cookers are especially popular with the mass market and the upper end of the market. Built-in units are typically found in smaller households (especially in flats and townhouse units) where space is usually limited.

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 further growth. But with electricity tariffs increasing by as much as 300 % since 2007 and increasing national concern regarding security of electricity supply and water availability in a water scarce country, Euromonitor (2014) reports that increasingly manufacturers and consumers are moving towards more energy and water efficient appliances as the economy continues to remain subdued and the prices of water and electrici-

ty continue to rise. This is certainly also the case for cookers where sales of electric models have gone from > 80 % to < 70 % since 2007 (Figure 2) and which coincides with the start of the steep electricity tariff increases and electricity blackouts at the time. The shift to gas for cooking is also supported by the government, which has recently adopted gas cooking as policy target. Multifunction Ovens, although electric, offering energy saving features such as 'thermofan' (principle of forced convection) and multiple settings, are also growing in popularity but at a slower rate (Figure 3).

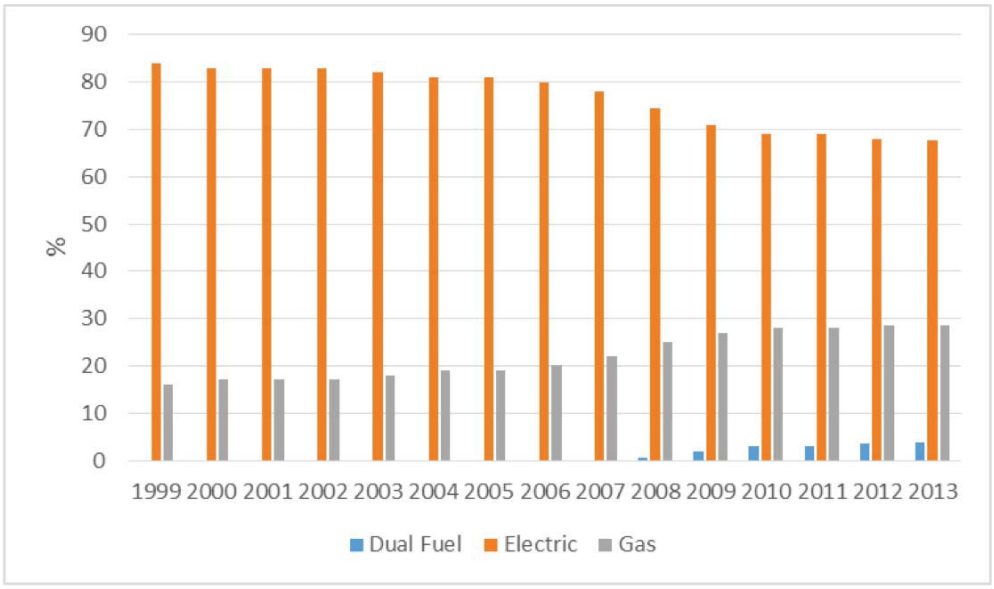

Figure 2: Market share of cookers by fuel type

Source: Euromonitor (2014)

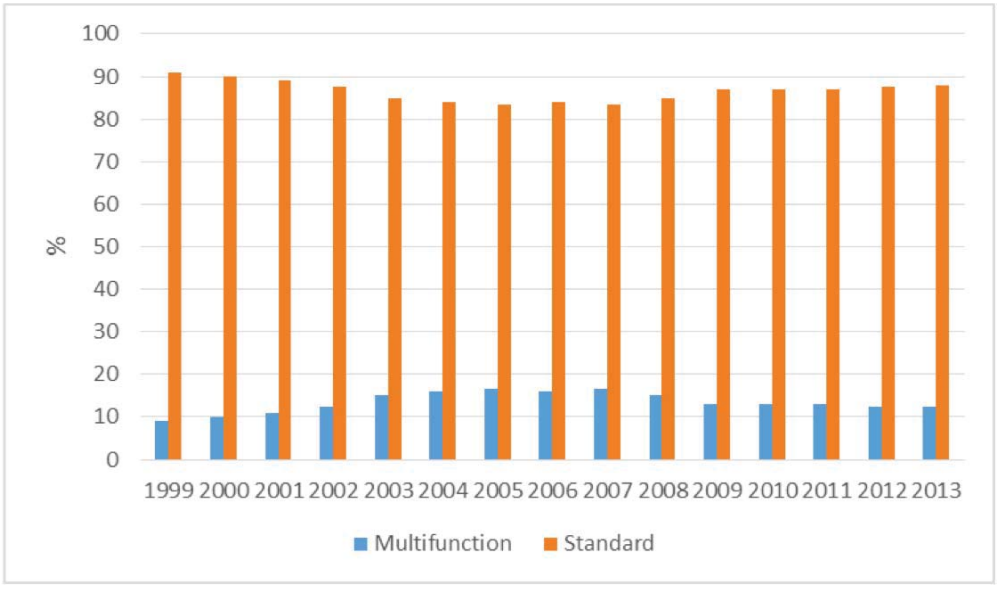

Figure 3: Market share of electric Ovens by functionality

Source: Euromonitor (2014)

Penetration Rates and Sales

Figure 4 shows the penetration rate of electric stoves and demonstrates how sales have increased in line with the country's electrification programme and the high priority they enjoy.

Please note: The rates for 'Other Stove – Gas and Coal' show that sales for this category are decreasing. This is due to long standing Government efforts to migrate low income and indigent households away from coal and traditional biomass with high emissions. This decrease is greater than the increase in gas usage and thus this figure masks the move by many higher income households to gas.

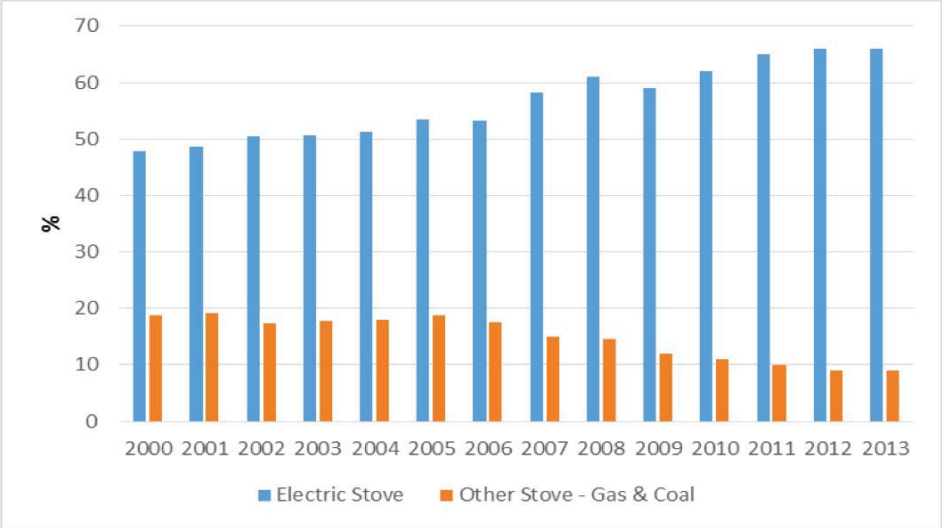

Figure 4: Penetration rates of electric stoves and 'other stove – gas and coal'

Source: Euromonitor (2014)

Figure 5 shows annual sales of all formats and Figure 6 the annual sales of Ovens and cookers only. Ovens experienced strong growth in the late 1990s and early 2000s (6.8 % average) but were affected during the economic downturn of 2007 - 2009, when the market actually contracted. Their high priority status amongst consumers resulted in growth resuming in 2010 and is currently averaging around 3.5 % per annum. The narrative is similar for cookers, which had an average growth of 9.5 % for the period 1999 - 2007, a contraction of 5.0 % for two years and then grew at just over 4.0 % from 2010. Euromonitor has forecasted compound annual growth rates (CAGR) of 2.8 % and 4.0 % for Ovens and cookers respectively for the period 2013 - 2018.

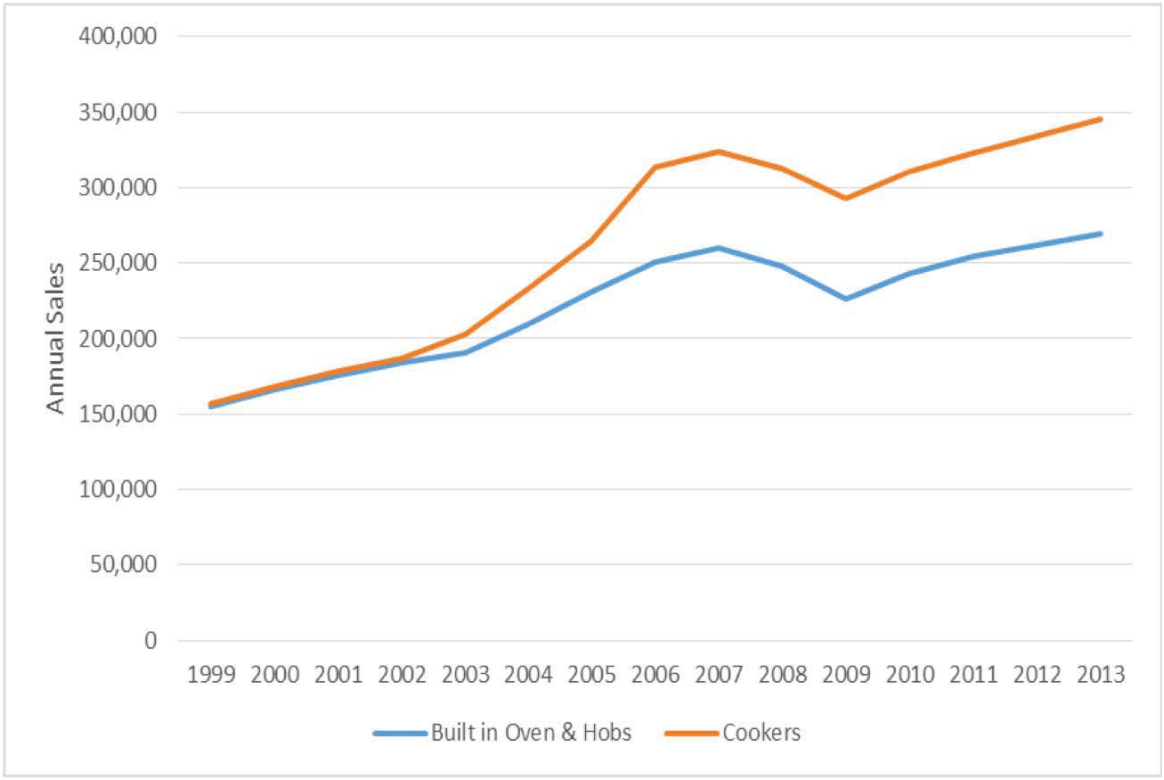

Figure 5: Annual sales - all formats

Source: Euromonitor (2014)

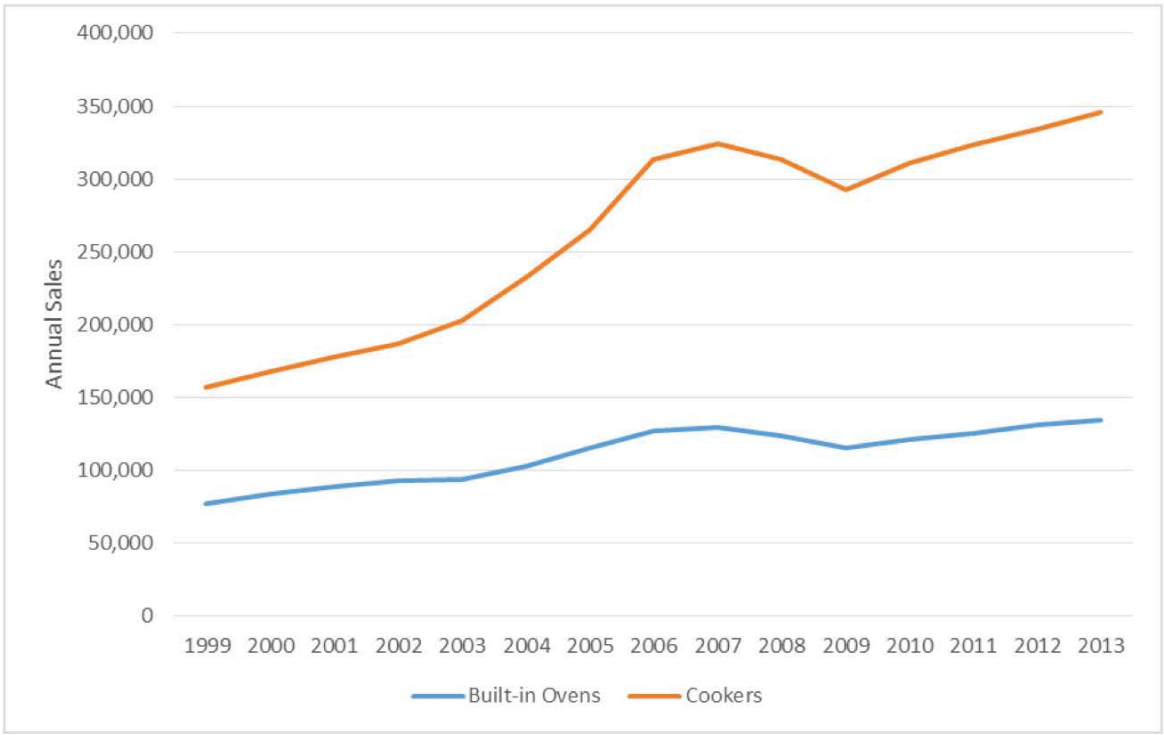

Figure 6: Annual sales – Built-in Ovens and cookers

Source: Euromonitor (2014)

Table 2 provides a breakdown of sales by sub-category type, which excludes built-in hobs and cooker hoods.

Table 2: Unit sales by format ('000 units)

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ovens	Built-in	94	103	115	127	130	124	115	121	126	131	135
	Cookers	202	232	265	313	324	313	293	311	323	334	346
Total Sales		**296**	**335**	**380**	**440**	**454**	**437**	**408**	**432**	**449**	**465**	**481**

Source: Euromonitor (2014)

Oven 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 fixed electric stoves as these were seen to have the greatest influence on the use on electrical energy by all income groups. The study found that savings would be achieved in improved plate design and the Oven insulation. The monthly energy consumption was estimated at 279 kWh. Existing fixed electric stoves had a life expectancy of 15 years. [7]

Oven Market – 2010

A study undertaken by the Department of Trade and Industry [8] in 2011 surveyed the Top 5 manufacturers and distributors of Ovens in South Africa. Jointly, these companies accounted for more than 80 % of annual sales in 2010 and 2011. The study found that there were 129 models available in the market. The Ovens had a mixed spread of energy class categories but the majority were either A or 'not specified' (Figure 7). An interesting characteristic of the market is that although cookers are more popular than built-in Ovens, there are far fewer cooker models for consumers to choose from. The reason for this is that the mass market is dominated by local manufacturers, with one local manufacturer controlling 51 % of the market as they have established models over many decades which are well known and trusted [4]. Although additional features have been added, fundamentally they are the same cookers used already by their parents and grandparents, making them tried and broadly trusted. A further observation is that compared to other appliance categories with similar sales volumes there is overall a surprisingly large number of models available. This is explained by the top end of the market, which is very niche and provides highly customised models, which must be ordered.

Please note: The number of models and the energy class levels were provided voluntarily by the top 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.

Table 3: Numbers of models available in the South African market, per (sub-) category (2010)

Category / Sub-Category	Built-In Ovens	Cookers
Small	5	0
Medium	53	15
Large	40	16
Total	**98**	**31**
Total number of models	**129**	

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

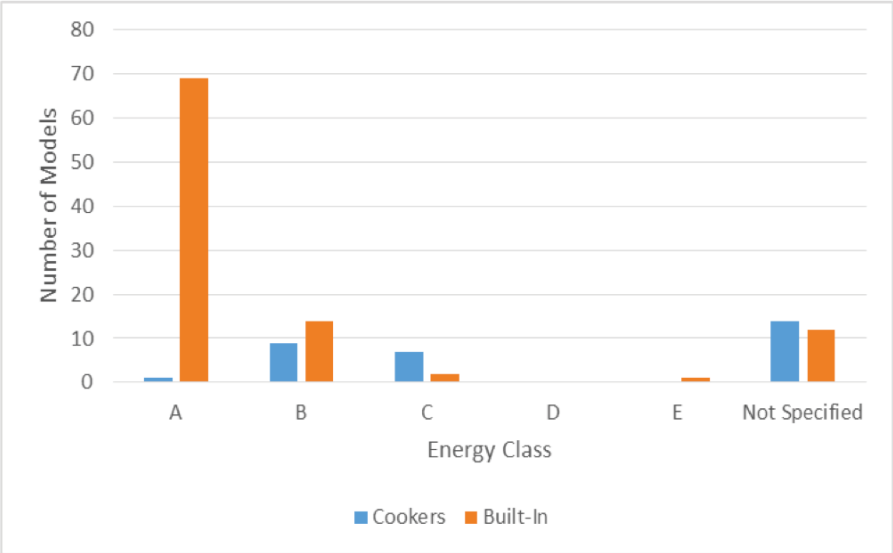

Figure 7: Energy class distribution of cookers and built-in Ovens (2010)

Source: Own illustration

Oven Market – 2014

Table 4 lists the number of models available in the South African market in 2014. The data was sourced from popular online shopping websites[1]; 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 8. A comparison of Table 3 and Table 4 confirms that the full size models continue to dominate the market and also the large available number of Built-In Oven models compared to Cookers. Desktop research confirms that many of the models are actually the same appliance but with different finishes. Although there is a greater number of models in 2014 where the energy class has not been specified the cause is believed to result from the absence of requirements to do so rather than the models having a poor performance. This is explained further in the next section.

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

The 2015 MEPS have been set at energy class A for small and medium Ovens and at energy class B for large Ovens. It can therefore be concluded that the introduction of a MEPS for Ovens is unlikely to yield any real energy saving as the market-average - according to this standard - was already relatively efficient by 2011.

Table 4: Numbers of models available in the South African market, per (sub-) category (2014)

Category / Sub-Category	Built-In Ovens	Cookers
Small	10	14
Medium	78	22
Large	106	74
Total	**194**	**110**
Total number of models	**304**	

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

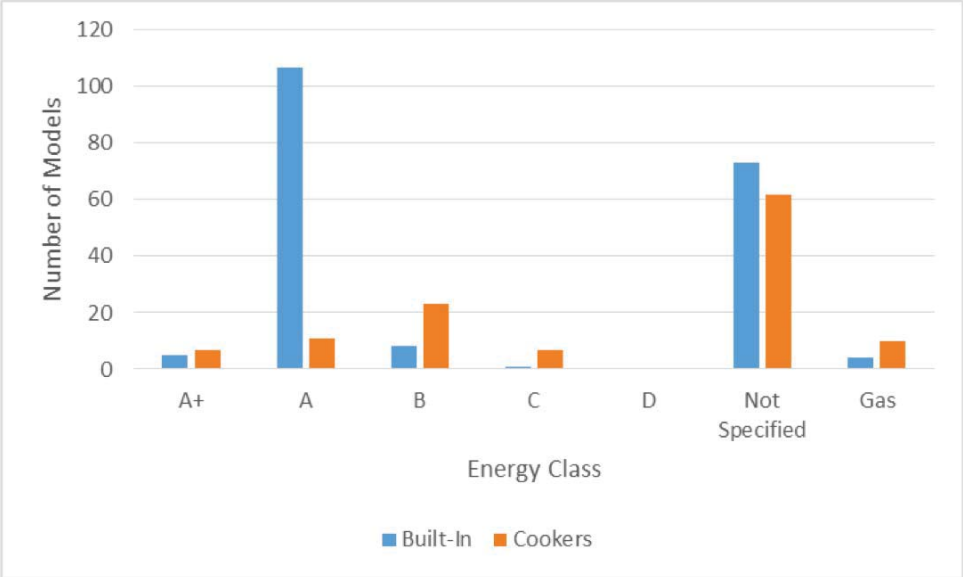

Figure 8: Energy class distribution for 'Built-in' and Cookers (2014)

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. Ovens were also impacted by the economic downturn and sales dropped as shown in Figure 5 and Table 2. However, as with refrigerators, Ovens are the first or second appliances sought when moving into a new residence, renovating and purchasing appliances for the first time. This makes them more resilient to economic downturns as evidenced by the returning growth of the Oven market after just two years of interruption.

At the top end of the market consumers are also willing to spend large amounts of money on cookers, especially for retro designs, not least due to strong marketing from the manufacturers. Annual food exhibition shows are also well attended in South Africa, as well as popular TV shows related to cooking. Consumers are thereby also moving to a certain degree to gas as it offers a more responsive experience compared to electricity, which takes much longer to heat and cool down. In addition to clean lines and new designs, new models are coming with improved energy performance such as fan assisted cooking, improved insulation and other features. This is also true for the mass-market models, where manufacturers have kept the existing models but modified them e.g. with improved insulation in order to meet the forthcoming 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 they would like to see the programme to 'come into effect as soon as possible'[2]. It is with the retailers where the major uncertainty continues as a delayed implementation of the mandatory S&L programme means that stores, where 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 was 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. An interesting phenomenon of the Oven market is that on-site visits to several South African mainstream retailers found that only 2 or 3 models made any mention of potential energy savings, whereas this practise was already far more prevalent with cooling and laundry products (please see bigEE South Africa reports on other appliances for details). Figure 9 shows a selection of cookers and built-in Ovens from a mainstream shop floor in South Africa.

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

Figure 9: Built-in and cooker models on shop floor in South Africa – no energy labels are shown

Source: Photos taken by Theo Covary (2015)

It is unclear why manufacturers and retailers are not putting more effort into placing energy efficiency information and related energy labels also on these products given the fact that they are included in the mandatory S&L programme which comes into effect in 2015. A possible consequence may be that consumers start to believe that energy efficiency is generally not viable for Ovens, which of course is not the case.

Summary of the Oven 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. However, tariffs have tripled over the four years period 2008-2012 and households paid EUR 0.10/kWh in 2014. The South African electricity regulator has also 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.

- Ovens are a priority appliance when buying / renovating a house or purchasing appliances for the first time. As such they are more resilient to recessions that other products.

- There are very wide variations in prices due to the status Ovens have amongst high income earners, with entry level products starting at less than EUR 200 and going up to EUR 6,000 or more.

- There is a strong local manufacturing presence in the South African market and most of the available models are also expected to meet the 2015 MEPS of energy class A for small and medium and energy class B for large products.

- Replacement cycles of Ovens are generally higher than for other appliances with a typical life cycle of 12 years or more. Furthermore, replaced units often find themselves in lower income households where they start a new life. Therefore a conservative lifetime of 15 years is not uncommon.

3 Efficiency range and user savings

The Oven market was historically evenly split between freestanding and built in units and shows a move towards cookers since 2003. As the South African households tend to prefer to cook with Ovens and to use microwave Ovens only to heat and defrost food, meaning that the usage Ovens is very high. High-end consumers are also moving increasingly to gas cooking because of the temperature control functionality, lower running costs and energy security, but for now this is generally limited to hobs and all baking and grilling continues to be dominated by electric Ovens. Ovens and refrigerators are the two appliances purchased with highest priority by new households, renovations and first time buyers.

The following assumptions were used: 20 standard load cycles per month

Table 5: Efficiency range and user savings of Ovens, 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	> 65 L				
Category	Large	Large	Large	Large	Large
Type	Freestanding electric Oven	Freestanding electric Oven	Freestanding Oven with thermofan	Built-in Oven convection + multifunction	Convection + multifunction Oven
Lifetime (years)	15	15	15	15	15
Qualitative	☐ Poor	☐ Poor	☐ Poor	☐ Poor	☐ Poor

performance classification of the provided service:	☐ Low ☒ Average ☐ Good ☐ Excellent ☐ No information	☐ Low ☒ Average ☐ Good ☐ Excellent ☐ No information	☐ Low ☒ Average ☐ Good ☐ Excellent ☐ No information	☐ Low ☐ Average ☒ Good ☐ Excellent ☐ No information	☐ Low ☐ Average ☐ Good ☒ Excellent ☐ No information
Yearly energy consumption: *electricity (kWh)*	702	850	600	360	240
Yearly energy cost (ZAR)	1053	1275	900	540	360
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
Yearly water cost (ZAR)	N/A	N/A	N/A	N/A	N/A
Purchase cost in (ZAR)	3,000	2,500	4,500	8,000	15,000
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 the 28 November 2014 sets a date for the start of S&L programme. For Ovens this is the 28 August 2015 and the MEPS has been set at level A for small and medium and at level B for large Ovens.

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 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 appliances imported in South Africa's originated from Europe. A South African label was designed (see Figure 10), 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.

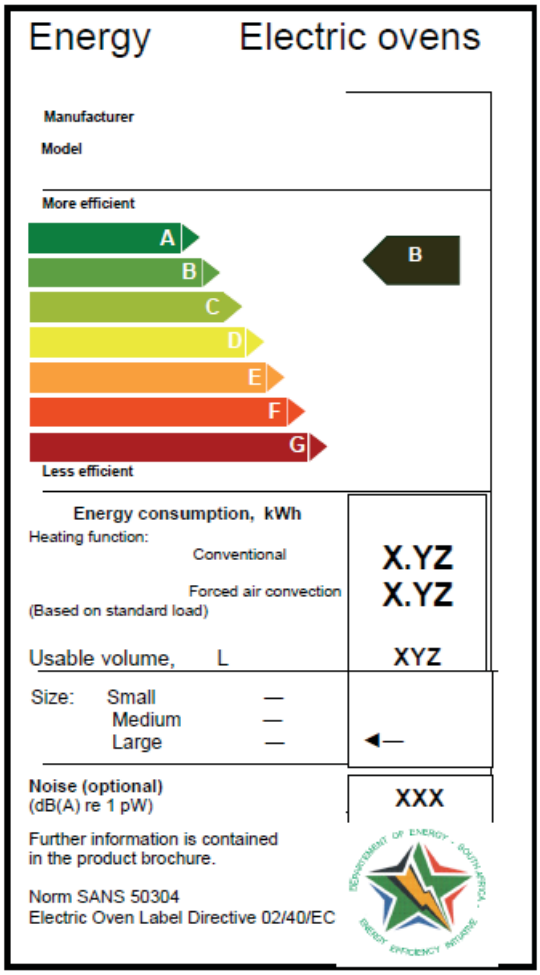

Figure 10: Energy Label for Ovens (SANS 50340:2010)

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. SANS 941 created the basis for the development of national testing standards in South Africa, which adopted the existing International Electrotechnical Commission (IEC) standards. The derived testing standard for Ovens is SANS 50304:2010 (IEC 50304:2009). 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, and 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). The South African S&L project team is currently (2015) 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, potential changes discussed in meanwhile for the label for refrigerators are shown in Figure 11 below:

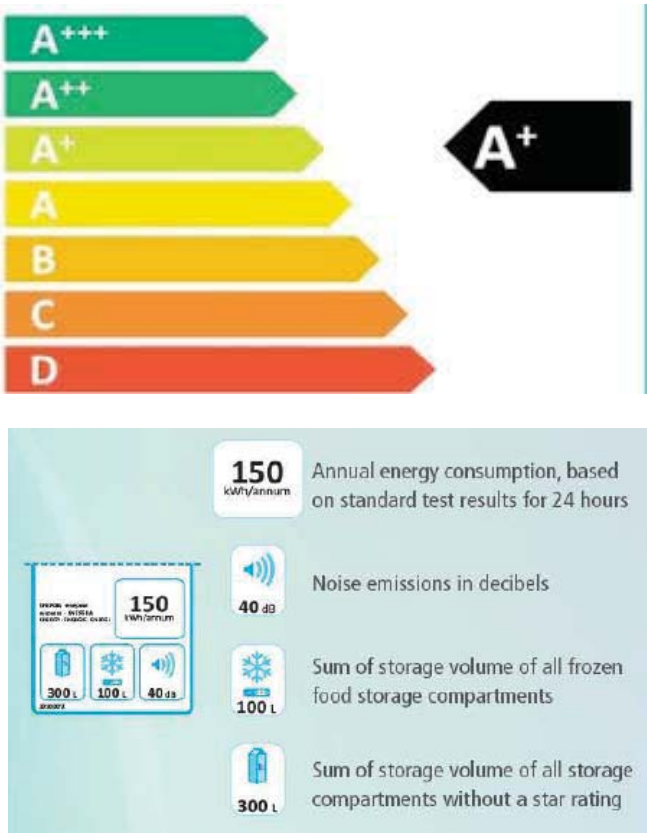

Figure 11: Exemplary draft for a new South African Energy Label (for refrigerators)

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:

- Small / Medium Electric Ovens: A
- Large Electric Ovens: B

The intention to introduce MEPS allowed for a mandatory two-month period for public comments. After this time had elapsed and comments were dealt with, the Minister introduced the regulations at his / her discretion. On 28 November 2014 the Department of Trade and Industry published notification that the VC 9008 will come into effect for Ovens 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 Ovens, the applicable standard is SANS 50304:2010 “Edition 1 SOUTH AFRICAN NATIONAL STANDARD - Electric cooking ranges, hobs, Ovens and grills for household use - Methods for measuring performance. The standard does not apply to:

- microwave combination Ovens;
- small cavity Ovens;
- Ovens without adjustable temperature control;
- heating functions other than defined in paragraph 3.16 to 3.18 of the standard.

The following definitions are set out in SANS 50304:

Oven:
Appliance or compartment of a cooking range in which food is cooked by radiation, by natural convection, by forced-air circulation or by a combination of these heating methods.

Heat transmission function (heating mode):
An Oven’s method of heat transmission (heating mode) is classified and defined as follows:

- **Conventional heating function (“ic”)**
  Heat transmission to the food by radiation and natural convection only. (This does not include Ovens that have a top heating element only, i.e. for the grilling function).
- **Forced air circulation function (“if”)**
  Heat transmission to the food by forced air convection, i.e. circulating the air with the help of a fan. (This does not include circulated air functions which operate a grill element only.)
- **Hot steam function (“ih”)**
  Heat transmission to the load is done with hot steam (temperature >> 100°C) at ambient pressure.

Energy efficiency class
The Energy efficiency class of an Oven is determined based on the Oven size/usable volume. The size of the Oven is determined in accordance with usable volume in litres as follows in Table 6:

Table 6: Size classification of Ovens

Category	Usable volume in Litres
Small	12 L ≤ volume < 35 L
Medium	35 L ≤ volume < 65 L
Large	65 L ≤ volume

The Energy Efficiency Classes of Ovens are determined for each usable volume category (Table 6), based on the rated Energy consumption, *E*, in kWh, for a standard load as set out in Tables AA.1 to AA.3 of the standard and as shown subsequently in Table 7, Table 8 and Table 9:

Table 7: Energy Efficiency Class - Category: Small

Small volume (in litres): 12 ≤ volume < 35	
Energy Efficiency Class	**Energy Consumption, *E, in kWh based on standard load***
A	E < 0.60
B	0.60 ≤ E < 0.80
C	0.80 ≤ E < 1.00
D	1.00 ≤ E < 1.20
E	1.20 ≤ E < 1.40
F	1.40 ≤ E < 1.60
G	1.60 ≤ E

Table 8: Energy Efficiency Class - Category: Medium

Medium volume (in litres): 35 ≤ volume < 65	
Energy Efficiency Class	**Energy Consumption, *E, in kWh based on standard load***
A	E < 0.80
B	0.80 ≤ E < 1.00
C	1.00 ≤ E < 1.20
D	1.20 ≤ E < 1.40
E	1.40 ≤ E < 1.60
F	1.60 ≤ E < 1.80
G	1.80 ≤ E

Table 9: Energy Efficiency Class - Category: Large

Large volume (in litres): 65 ≤ volume	
Energy Efficiency Class	**Energy Consumption, *E, in kWh based on standard load***
A	E < 1.00
B	1.00 ≤ E < 1.20
C	1.20 ≤ E < 1.40
D	1.40 ≤ E < 1.60
E	1.60 ≤ E < 1.80
F	1.80 ≤ E < 2.00
G	2.00 ≤ E

Electric Energy Consumption

Electric energy consumption, *E*, in kWh, for heating a load depends on the heating/heat transmission function and temperature rise, ΔT, from a reference temperature, using linear regression based on measured data points (Equation in paragraph 8.3.3.1 of the standard):

The energy consumption $E^{i...}_{\Delta T0}$ for the reference temperature rise $\Delta T^{i...}_{0}$ is calculated using the linear regression based on the measured data points $\Delta T^{i...}_{k} / E^{i...}_{k}$, according to the equation

$$E^{i...}_{\Delta T0} = S^{i...} \cdot \Delta T^{i...}_{0} + B^{i...} \quad (1)$$

Where:

$E^{i...}_{\Delta T0}$ is the calculated normal energy consumption in kWh for heating a load for the various heating functions **“ic”, “if” or “ih” at ΔT i.../0**

$\Delta T^{i...}_{0}$ = 180K for conventional heating function and 155K for both forced air circulation and hot steam function

$S^{i...}$ is the slope related to the different heating functions **“ic”, “if” or “ih”** which is calculated according to equation (2)

$B^{i...}$ is the intercept which is calculated according to equation (3)

$$S^{i...}=\frac{n\sum_{k=1}^{n}\left(\Delta T_k^{i...}\cdot E_k^{i...}\right)-\left(\sum_{k=1}^{n}\Delta T_k^{i...}\right)\left(\sum_{k=1}^{n}E_k^{i...}\right)}{n\sum_{k=1}^{n}\left(\Delta T_k^{i...}\right)^2-\left(\sum_{k=1}^{n}\Delta T_k^{i...}\right)^2} \quad (2)$$

$$B^{i...}=\frac{\sum_{k=1}^{n}E_k^{i...}-S^{i...}\cdot\sum_{k=1}^{n}\Delta T_k^{i...}}{n} \quad (3)$$

The value of ΔT depends on the method of heat transmission. ΔT is greater for a conventional heating function as opposed to forced air convection and hot steam.

During heating, the value of $\Delta T =$

- **180 K** for **conventional heating function**, and
- **155 K** for both **forced air circulation** and **hot steam function**.

6 Application of the Standard

SANS 50304 formulas to derive the energy class are complicated and the practical application is difficult to understand for non-experts. To provide a reference point, a selection of Ovens for which actual data was publicly accessible was chosen and 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.

Available actual datasets for small, medium and large cavity Ovens yielded the following volume and operating power (Watt rating) ranges as summarised in Table 10:

Table 10: Actual data for all Oven classes

Category	Capacity *C* in Litres	Operating Power rating, *P (*in Watt)
Small	$20 \leq C \leq 34$	$1{,}500 \leq P \leq 3{,}400$
Medium	$37 \leq C \leq 60$	$2{,}900 \leq P \leq 3{,}300$
Large	$67 \leq C \leq 115$	$1{,}800 \leq P \leq 4{,}100$ [3]

Only the available data set for large Ovens specified heating function information, i.e. conventional and forced air convection. For small and large Ovens, Energy efficiency class A and B product data was available; for medium Ovens class A product data.

A sample from the publicly accessible actual data set for large Ovens is included in Table 11. However, since detailed temperature conditions, such as ambient and reference temperatures are not specified for a ΔT value, nor information regarding the time taken to cook a standard load in accordance with the standard, a meaningful comparison of the publicly accessible actual values against the standard test condition values could not be performed.

[3] Watt rating range is not directly proportional to volume.

Table 11: Publicly accessible actual dataset for large Ovens

Product Name	Capacity (L)	Energy Consumption in kWh / cycle		Operating Power Rating (W)	Energy Class
		Conventional	Forced Air		
Bosch HBG23B520J	67	0.89		2,850	A
SMEG SE995XR8	70	1.14	0.99	3,300	A
SMEG SE995XR8	72	1.15	0.99	3,000	A
Smeg SUK81MBL5	78.5	1.15	0.99	3,000	A
Smeg Ssa91mrw1	115	1.19	1.25	4,100	B

7 References

[1] NER (2001): Lighting up South Africa, National Energy Regulator, Pretoria.

[2] StatsSA (2011): Statistics South Africa, General Household Survey 2011, www.statssa.gov.za/publications/p0318/p0318april2012.pdf

[3] Bezuidenhout, A. (2002): Overview of the South African White Goods Market, University of the Witwatersrand.

[4] Euromonitor International (2014): Consumer Appliances in South Africa.

[5] Eskom (2011b): Trimming 10% is easier than you think. http://www.eskom.co.za/sites/idm/Documents/2011_12_20_ESKD_Trimming_10percent_Brochure.pdf

[6] Marbek Resources (1997): Appliance energy labelling program: Activity report: results of the benefit-cost analysis; Department of Minerals and Energy, South Africa.

[7] DME (2005): Appliance Labelling Study, 2003; Department of Minerals and Energy, South Africa.

[8] FRIDGE (2012): Energy Performance and Labelling Requirements for Specific Electrical Appliances and Equipment, 2012. Fund for Research into Industrial Development, Growth and Equity (FRIDGE).

[9] www.biznews.com/budget/2014/10/south-african-economic-growth-plummet-1-4-nene-warns-country-turning-point-mtbps/

[10] http://undp-ccmap.org/projects/market-transformation-through-energy-efficiency-standards-labelling-appliances-south-africa

[11] Compulsory specification for Energy Efficiency and Labelling of electrical and electronic apparatus (VC9008). Government Gazette Number 37288. 7 February 2014

[12] Compulsory specification for Energy Efficiency and Labelling of electrical and electronic apparatus (VC9008). Government Gazette Number 38232. 28 November 2014

[13] SANS 50304:2010 Edition 2 SOUTH AFRICAN NATIONAL STANDARD “Electric cooking ranges, hobs, ovens, and grills for household use — Methods for measuring the performance standard”

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