Appliances Guide
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Energy efficient Fans

Country

South Africa

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1 Country-wide saving potential

Fans

About **5,000,000** Fans are in use in South Africa (reference year 2010). The average annual consumption of each of these Fans amounts to about **90 kWh**. In total, this causes an annual electricity consumption of **450 GWh**. 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 Fan 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 Fans can be achieved. While the stock is expected to grow by 50 % between 2010 and 2020, in the efficiency scenario the energy consumption can be reduced by 37 %. Although the stock is expected to grow by another 83 % until 2030, in the efficiency scenario (B) the increase of the energy consumption can be mitigated to 23 % (Figure 1). Thereby, higher living standards (e.g. increasing appliance ownership rates and household numbers) have been anticipated. In contrast, in the baseline scenario (A) with moderate efficiency gains the energy consumption would increase by 5 % 2010-2020 and by 49 % between 2020 and 2030.

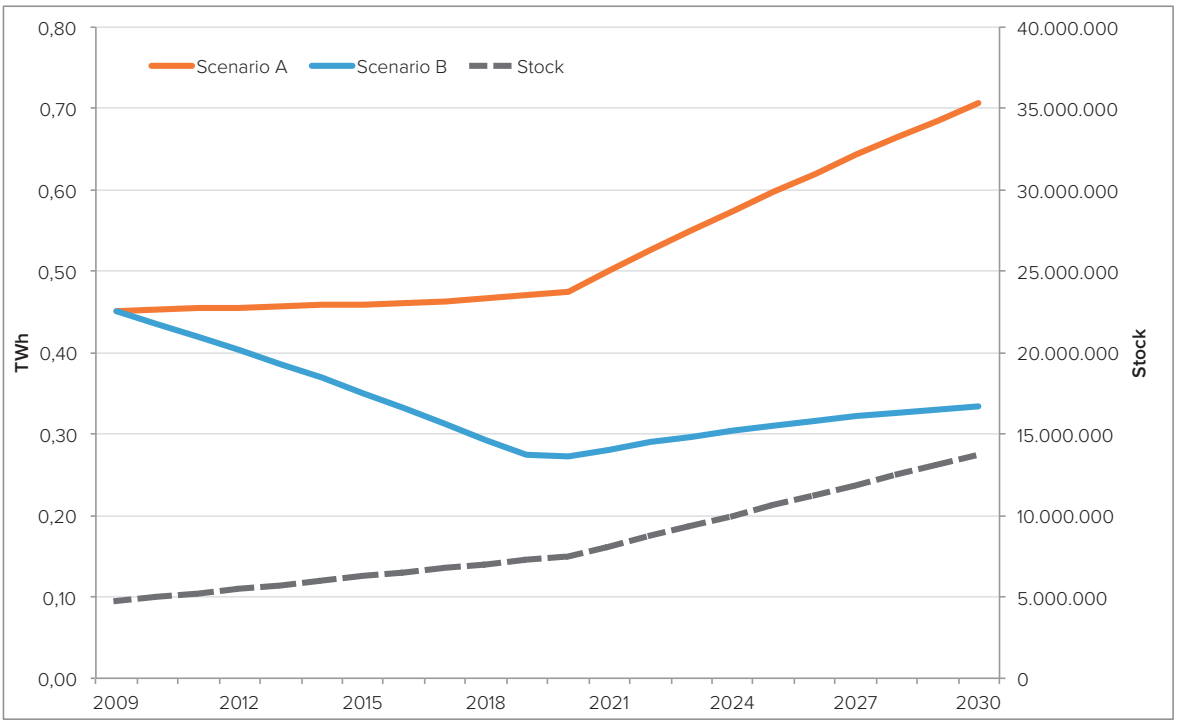

Figure 1: Electricity consumption Fans, Baseline Scenario (A) vs. Efficiency Scenario (B)
Source: Wuppertal Institute (2015)

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

Base year 2010	Total energy consumption of Fans per year [TWh/year]	0.45
	Stock number Fans	5,000,000
	Average annual energy consumption of Fans in the stock [kWh/year]	90.5
	Total annual CO_2eq emissions related with Fans [Mt/year]	0.31
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	0.20
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	-0.18
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0.13
	Stock number of Fans in 2020	7,500,000
	Average annual energy consumption of new Fans (all BAT) in 2020 [kWh/year]	30
	Total incremental investment costs [not discounted] until 2020 (end-user perspective) [€]	416,711,576
	Total incremental investment costs [not discounted] until 2020 (societal perspective) [€]	365,536,471
	Total economic benefit until 2020 [not discounted] (end-user perspective) [€] scenario B vs. scenario A	-368,536,863
	Total economic benefit until 2020 [not discounted] (societal perspective) [€] scenario B vs. scenario A	-383,026,683

2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	0.37
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	-0.12
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0.24
	Stock number of Fans in 2030	13,750,000
	Average annual energy consumption of new Fans (all BAT) in 2030 [kWh/year]	20
	Total incremental investment costs [not discounted] between 2021 and 2030 (end-user perspective) [€]	705,375,000
	Total incremental investment costs [not discounted] between 2021 and 2030 (societal perspective) [€]	618,750,000
	Total economic benefit until 2030 [not discounted] (end-user perspective) [€] scenario B vs. scenario A	-934,882,017
	Total economic benefit until 2030 [not discounted] (societal perspective) [€] scenario B vs. scenario A	-1,014,064,365
Lifetime data for Fans purchased in the analysed timeframe	Total electricity savings, scenario B compared to scenario A [TWh]	5.91
	Total GHG emission reductions scenario B compared to scenario A [Mt]	3.85
	Total incremental investment costs [not discounted] (end-user perspective) [€] scenario B vs. scenario A	1,122,086,576
	Total incremental investment costs [not discounted] (societal perspective) [€] scenario B vs. scenario A	984,286,471
	Total economic benefit [not discounted] (end-user perspective) [€] scenario B vs. scenario A	-853,922,075
	Total economic benefit [not discounted] (societal perspective) [€] scenario B vs. scenario A	-1,020,549,604

Source: Wuppertal Institute (2015)

2 Subtypes and markets

Cooling applications has not been a priority for residential appliances in South Africa but in recent years the demand for Air Conditioners (AC) has grown in high income households, and with the country's electrification programme Fans are especially present in a growing number of low and middle income homes. The most popular format is the standing fan, followed by desktop and then ceiling fans.

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 typically 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.

Fans are not classified under large residential appliances and fall under 'small household appliances'. This sector of the market is dominated by distribution companies who carry a large number of different brands. Many of them are 'value' or second-tier brands, which are not household names. This is certainly the case for fans in the South African market. All table, floor, wall, window, ceiling or roof fans, with a self-contained electric motor of an output not exceeding 125 W are subject to a 5 % import duty. Products from the EU are exempt [1]. Due to the large number of brands available it is likely that there are fans available which may be locally manufactured or assembled but the majority of the market is made up of imported products. Euromonitor (2009) [2] notes, '*although Nu-World Holdings and Amalgamated Appliance can be considered domestic players, and held over 50 % of the share sales category in 2008, all the brands they stock are from multinational companies. Air treatment products are completely dominated by multinationals.*'

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 % [3] and by 2011 it was 83 % [4]. By the late 1990's the country's electrification programme expanded the market for electrical appliances by an estimated 50 % [5], but this is unlikely to have benefitted the fan market to the same extent as other more essential 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 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 categorise their appliances as 'essential' and 'non-essential'.

If AC are viewed as a luxury item and targeted to the upper income families and commercial properties then fans serve the middle to lower income segment of the market. The sub-tropical climate on the east coast and the hot interior Figure 2 can see temperatures reaching upwards of 35°C in summer for lengthy periods making living and working conditions uncomfortable. The majority of inhabitants in these areas are not able to afford the capital or operating costs of AC and turn to fans for cooling.

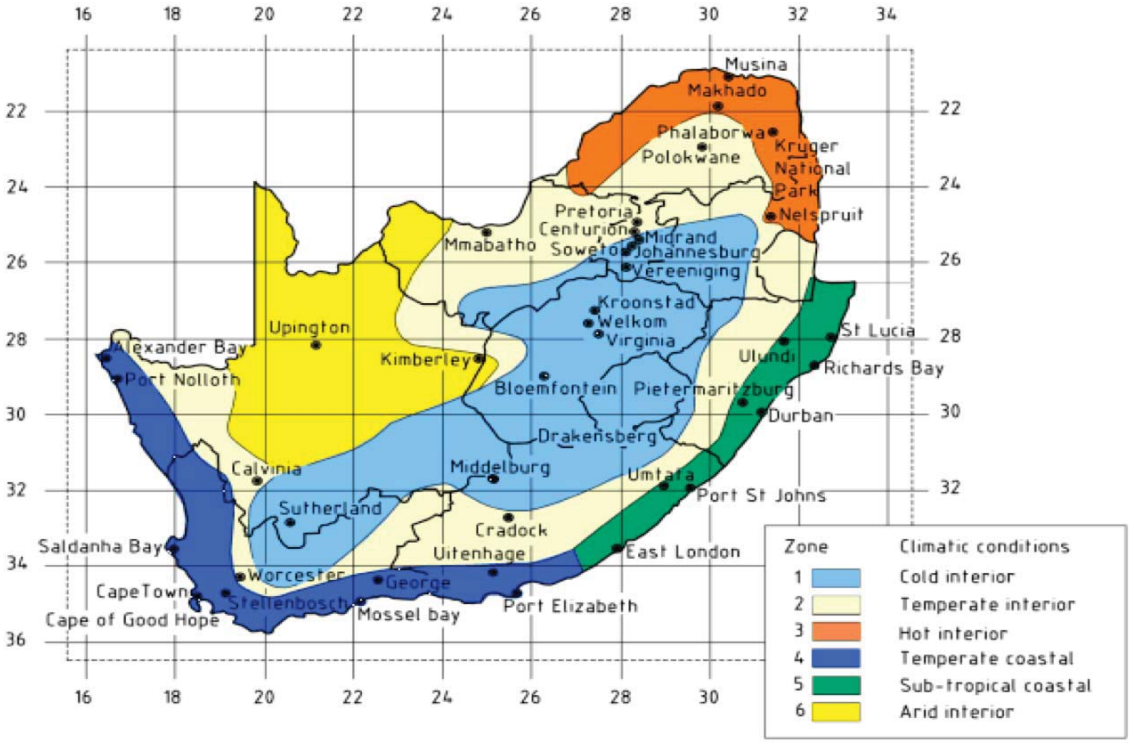

Figure 2: Climatic Zones in South Africa

Source: Thermal Insulation Association of Southern Africa (TIASA), www.tiasa.org.za/Map.htm

All fans must comply with the South African National Standard (SANS) 60335-2:2009. This standard conforms to the International Electrotechnical Commission IEC 60335-3:2008. However this standard only covers safety requirements and does not address minimum energy performance requirements.

Market Characteristics

The market in South Africa can be broken down into three sectors: ceiling, desk and standing fans. All three types are available in different shapes and sizes and serve a specific function. The most popular format, by some margin, is the standing fan.

Fans are ubiquitous and can be purchased from appliance stores, large supermarkets, hardware stores and general retailers. This makes them easy to access and as they serve the lower to middle income market perhaps the major decision making criteria are size and price. The large number of brands and models available on the market means that fans are very competitively priced and relatively affordable. However, Euromonitor (2014) [6] indicates that rising utility costs, particularly electricity, may be relevant to air treatments products and most especially non-AC segments, as consumers from these segments are far more cost sensitive than those that demand AC.

Penetration Rates and Sales

As mentioned, fans are generally purchased by middle to low-income households. Ceiling fans are popular with the hospitality industry in game lodges, smaller hotels as well as bed and breakfasts, which are located in or near game parks as well as on the coast. High-end fans are also available but this is a niche market, which services higher income households and cost as much as two to three times more as they have besides energy efficient technology in particular more design-related highlights (e.g. steel frames) as well as additional comfort features (remote control, timer, etc.).

Figure 3 shows the annual sales of fans by category type. The graph shows a very sharp decline in 2007 where sales dropped by over 34%. The factors that contributed to this were [2]: 1) the introduction of a national credit act, which made access to credit more difficult; 2) the onset of the economic downturn; 3) the building market stalled and went into decline. Ceiling fans in particular are typically installed during renovations or in new houses. It would be expected that these factors would have also a greater impact on higher priced AC units, but it demonstrates mainly how sensitive the middle to lower income groups are to general declines in disposable income and credit.

Figure 4 gives the penetration rate per household, which is not available by category type. Fans show a steady, but unspectacular, increase in penetration rate going from 28% in 1999 up to 37% in 2013. Table 2 provides a breakdown of fan unit sales by format.

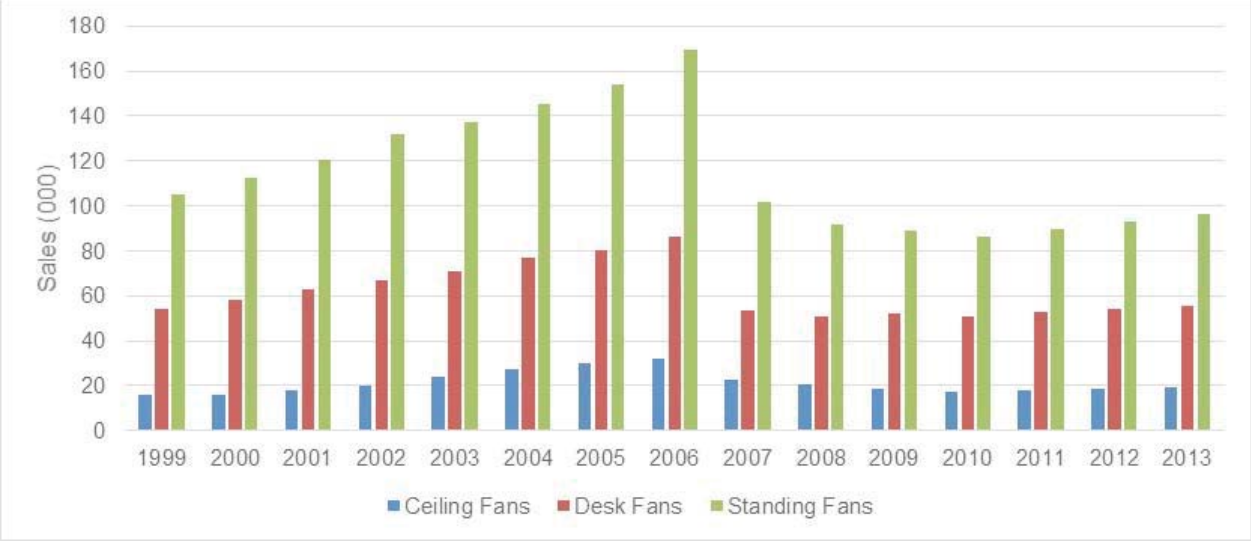

Figure 3: Annual sales of Fans by Category Type 1999-2013

Source: Euromonitor (2014)

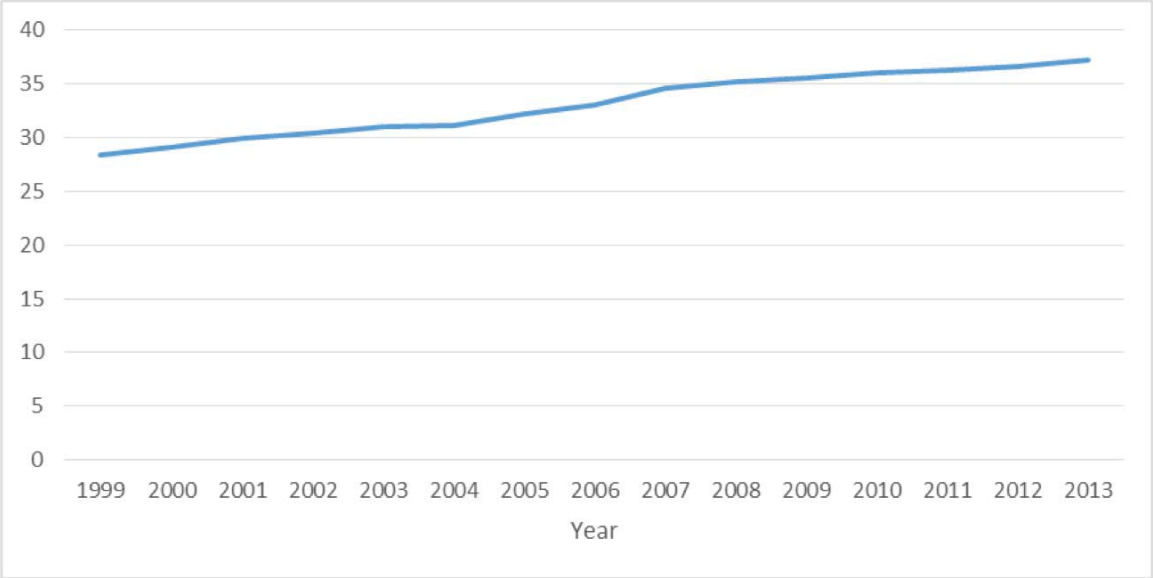

Figure 4: Penetration rates of Fans in South African households 1999-2013

Source: Euromonitor (2014)

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

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Fans	Ceiling	24	27	30	32	23	21	19	17	18	19	19
	Desk	71	77	81	87	54	51	52	51	53	54	55
	Standing	137	145	154	170	102	92	89	86	90	93	97
		232	**249**	**264**	**288**	**178**	**163**	**160**	**154**	**160**	**166**	**171**

Source: Euromonitor (2014)

Fan Market – 1995

First interest in energy efficient appliances in South Africa dates back to 1995, when a cost benefit analysis [8] was undertaken by the Department of Minerals and Energy. The study grouped space heating and cooling into one category but did not consider fans specifically. Thus no electricity consumption figures were included also in the appliance labelling study undertaken by the Department of Minerals and Energy in 2003 [9].

Fan Market – 2010

A study undertaken by the Department of Trade and Industry [7] in 2011 aimed to quantify the impact that a mandatory standards and labelling programme would have on the local manufacturing industry.

The study surveyed the market and identified the number of models and where possible each models energy class for 12 appliances that were selected for the upcoming S&L programme. AC were part of the appliances identified by the Government but fans were not. As a result these products were not considered in the study and no data is available from this time period.

Fan Market – 2014

As fans do not form part of the country's S&L programme, which is due to come into effect in 2015, a study undertaken by the Department of Energy did not include this appliance group. For this reason the only detailed and available reliable data relating to fans is shown in Figure 3, Figure 4 and Table 2.

Market Trends

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 [10]. 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.

Sales of fans were hit particularly hard and dropped from 288,000 units per year in 2006 to 154,000 in 2010. The market has started to recover and sales in 2013 were around 172,000, which is nevertheless still well below the 2006 peak. Euromonitor (2014) predicts that the market for ceiling and standing fans will continue to grow at 2-3 % per annum for the next 5 years. The report goes on to note that informal dwellings tend to purchase cooling owing mainly to the portability of such appliances as well as the fairly affordable prices of such products, which can cost as little EUR 15 - 20. Most informal settlements are composed of materials such as corrugated metal and scraps that tend to retain heat, making living in such dwelling unbearable during summer months and as a result such dwellings continue to demand cooling fans. But the increasing costs of electricity may reduce the running time of fans in indigent households.

Visits to several major retail stores in South Africa found all three formats readily available in large stock quantities and in many different shapes and sizes as shown in Figure 5. Figure 6 shows the technical specifications of several fans. No evidences for energy saving functions are featured on any of the displayed products.

Figure 5: Fans of all formats on display in various retail stores

Source: Euromonitor (2014)

Figure 6: Technical Specifications of exemplary ceiling and floor fans

Source: Euromonitor (2014)

Summary of the fan 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. Additionally, 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 country's electrification programme is particularly relevant to the fan market as it has a high penetration rate in low-income houses, which are often insufficiently constructed and need cooling.

- Most - if not all - units are imported and introducing a MEPS will have no impact on the local manufacturing industry.

- Replacement cycles of fans are estimated to be every 10 years.

3 Efficiency range and user savings

The fan market in South Africa is dominated by standing fans (56 %), followed by desk fans (32 %) and ceiling fans make up the balance (22%).

The following assumptions were used: Fans are operated for 6 hours per day for 8 months of the year or 1,440 hours.

Table 3: Efficiency range and user savings of standing fans, 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	40 cm Standing Fan				
Category	N/A	N/A	N/A	N/A	N/A
Type	One speed setting (Plastic frame)	Three speed set-ting (Plastic frame)	Three speed setting (Plastic frame)	Eco Design (Steel frame)	Eco Design (Steel frame)
Lifetime (years)	10	10	10	10	10
Qualitative perfor-mance classifica-tion 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)*	115	75	75	45	30
Yearly energy cost (ZAR)	175	110	110	65	45
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)	250	250	250	1,000	1,300
Operation & Mainte-nance cost (ZAR)	0 (lifetime)	0 (lifetime)	0 (lifetime)	0 (lifetime)	0 (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. However, Fans are not included and South Africa does not have any other national standards relating to electricity consumption for electric Fans.

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 (Exemplary label for AC, see Figure 7), 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.

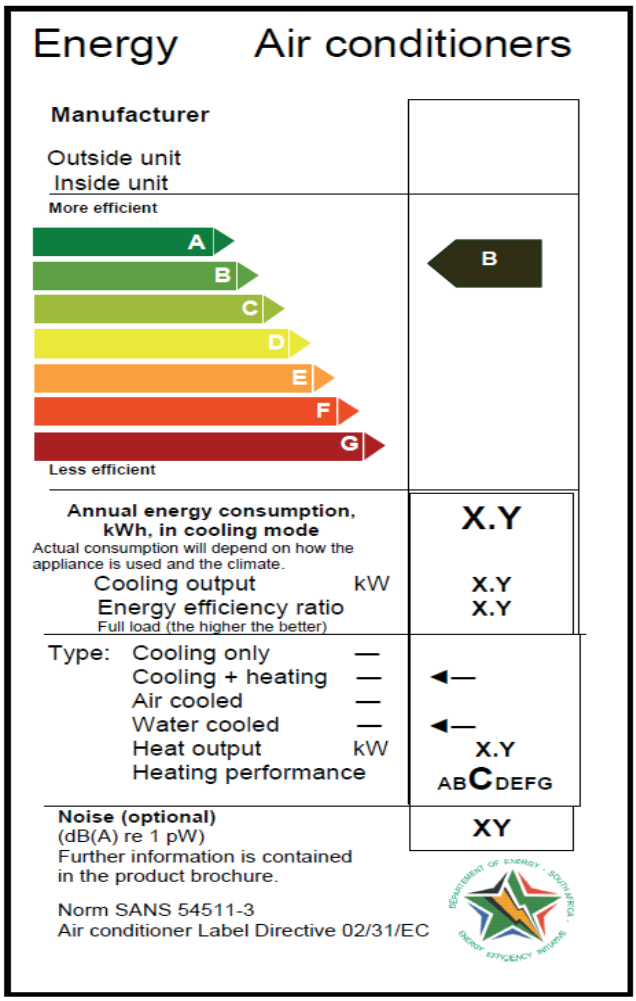

Figure 7: Exemplary Energy Label for Air Conditioners (SANS 54511-3:2011)

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 [14]. 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 also the basis for the development of national testing standards in South Africa, which adopted the existing International Electrotechnical Commission (IEC) standards.

However, fans were not included in SANS 941 and in 2015 there is also no other national South African standard addressing the electricity consumption of fans. Therefore, it is recommended to consider electric fans in the next selection round of appliances to be included in the country's S&L programme.

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

- The label designed in 2005 is obsolete, and it does e.g. 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. The proposed changes to the label (as discussed in meanwhile) are shown exemplarily for refrigerators in Figure 8 below:

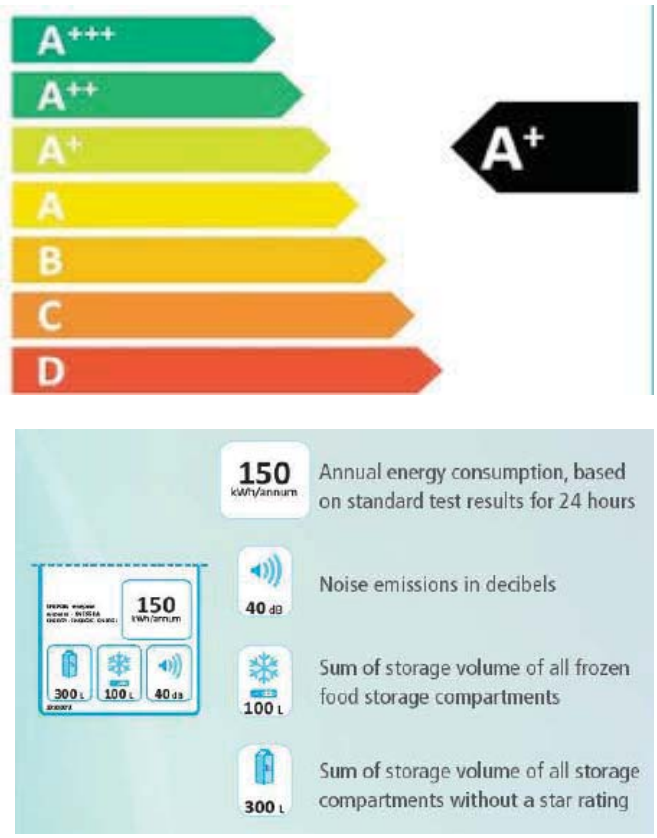

Figure 8: Exemplary draft for a new South African Energy Label (example for refrigerators)
Source: South Africa Bureau of Standards (2014)

5 Test procedures and standards

In line with the South African Bureau of Standards policy of adopting IEC standards, the relevant standard for fans is IEC 60879: “Performance and construction of electric circulating fans and regulators”. All fans must also comply with the South African National Standard (SANS) 60335-2:2009. This standard conforms to the International Electrotechnical Commission IEC 60335-3:2008 (Household and similar electrical appliances – Safety). However the latter standard only covers safety requirements. Overall, South Africa does not have any national standards relating to electricity consumption and energy performance for electric fans.

As described in ‘4 - Performance and information requirements’, 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 also the general basis for the development of national testing standards in South Africa, which adopted the existing International Electrotechnical Commission (IEC) standards.

However, fans were not included in SANS 941 and in 2015 there is also no other national South African standard addressing the electricity consumption of fans. Therefore, it is recommended to define adequate national test procedures and test standards as well as to consider electric fans also in the next selection round of appliances to be included in the country’s S&L programme.

6 Application of the Standard

Globally, fans contribute to residential electricity consumption. This is especially true in developing countries with warm climates. The diagram below shows the different fan types and the average rated capacity.

Figure 9: Fan formats and their technical characteristics

Source: Energy Efficiency Project for Lighting and Home Appliances – Egypt

An analysis of the energy flow through a fan system, shows that many opportunities exist for electricity savings. A study conducted by the Lawrence Berkeley National Laboratory [11] found that although fans consist of many components, all of which have electricity saving opportunities (Figure 10), the two most attractive for large energy savings are the blade design and the motor. For example, the best available technology for ceiling fans is as much as four times more efficient as the US Energy Star requirement. This is illustrated clearly in Figure 11, which compares the best available international technology against the Indian 1 and 5 (best) star rated ceiling fans

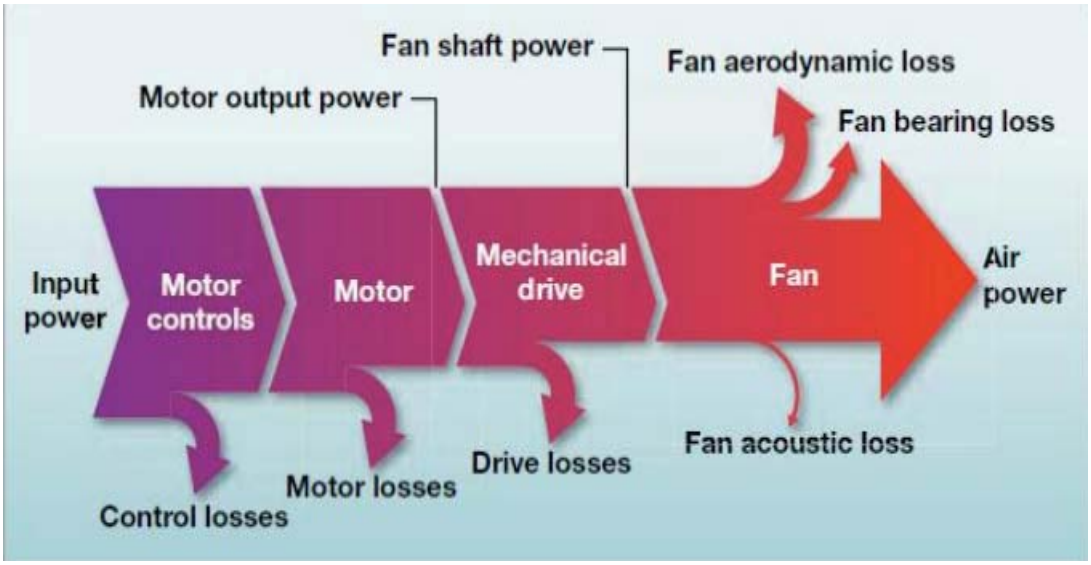

Figure 10: Energy Flow through a fan system

Source: Energy Efficiency Project for Lighting and Home Appliances – Egypt

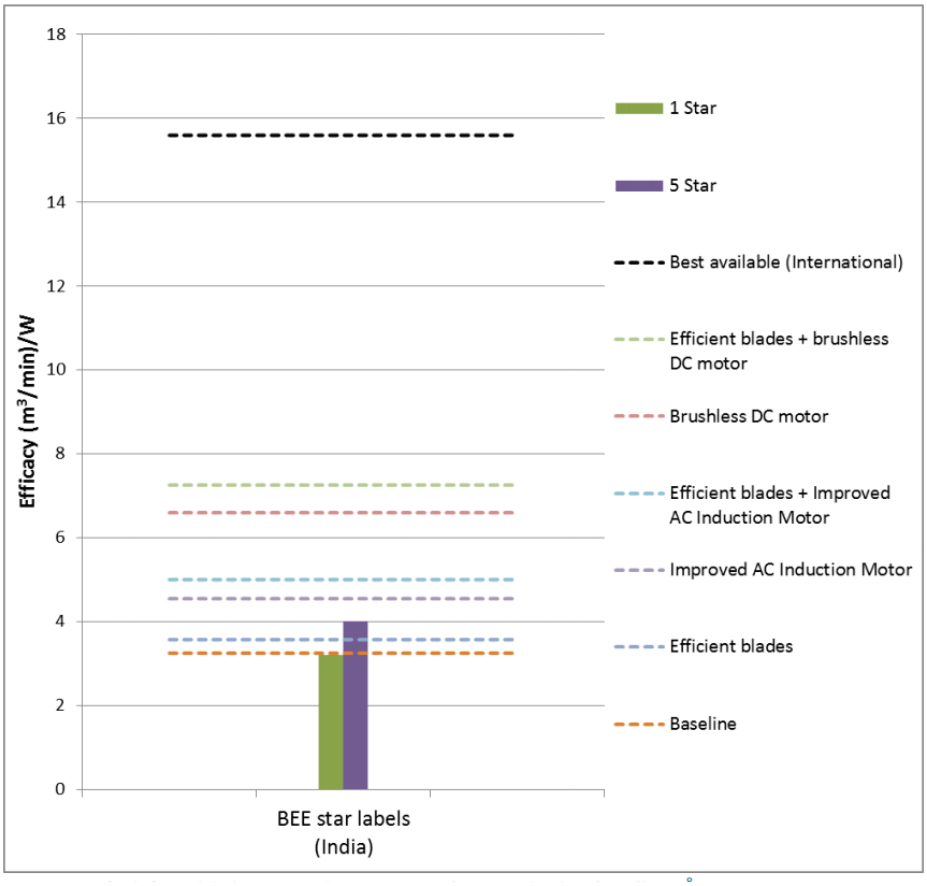

Figure 11: India Star Labels compared to estimates of potential ceiling fan efficiency

Source: [11]

These large electricity savings also mean that the energy efficiency improvements are financially viable and attractive as shown in Table 4, where the cost of conserved energy (CCE) is US$ 0.03 / kWh whereas the actual cost of electricity is >7 c/kWh (based on 2010 data). The same report argues that although the example is an Indian one it is a reasonable approximation for most countries as fans are globally traded and the technology is mature.

Table 4: Efficiency range and user savings of fans, based on 2010 data

Efficiency Improvement Option	**% reduction from baseline power**	**Average incremental manufacturing costs ($)**	**Annual energy saved per fan (kWh)**	**CCE ($/kWh)**
Improved AC induction Motor (A)	36 %	$1.50	80	$0.005
BLDC Motor (BAT) (B)	50 %	$10.50	112	$0.027
Efficient Blades (C)	15 %	$3.50	33	$0.031
A+C	**45 %**	**$5.0**	**101**	**$0.014**
B+C	**57 %**	**$14.0**	**129**	**$0.032**

Source: [11]

7 References

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The bigee.net platform informs users about energy efficiency options and savings potentials, net benefits and how policy can support achieving those savings. Targeted information is paired with recommendations and examples of good practice.

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