DEMAND SIDE MANAGEMENT OF THE STANDBY POWER CONSUMED BY TELEVISION SETS

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ABSTRACT
Demand-side management (DSM) has become an invaluable tool for utilities to manage consumer electricity demand. Existing strategies targeting inefficient appliances such as geysers and light bulbs has produced some savings.
This paper proposes that more targeted DSM strategies could be developed by more closely scrutinising consumer appliances purchase and usage patterns.

1. INTRODUCTION

Demand-side management (DSM) is the planning and implementation of those electric utility activities designed to influence customer uses of electricity in ways that will produce desired changes in a utility's load shape [1]. DSM activities can include the reduction of peak demand during periods when energy-supply systems are stressed. Peak demand management does not decrease total energy consumption but can reduce or delay the need for investments in the power grid.[2]

2. RESEARCH STATEMENT

Swisher and Orans, proposed the use of an intensive DSM campaign with limited geographical coverage. [25] They addressed the problem that many DSM strategies are designed to cover a large portion of the customer base resulting in poor participation, minimal energy savings per customer and high administrative costs. The rational for their strategy was that some geographical areas within a utility's service territory are more expensive to serve than others. [25]. They realised that DSM programs in some areas have higher avoided costs and therefore higher cost-effectiveness thresholds compared to other areas. Swisher and Orans demonstrated the increased effectiveness of targeted DSM strategies.
This study will attempt to produce a methodology by which targeted DSM strategies can be created. The shortcomings in current DSM strategies will be investigated. Appliance purchase patterns will be investigated and the potential power savings determined should a targeted DSM strategy be implemented.

3. THEORETICAL BACKGROUND

The term DSM was first used in the broader context of energy demand management during the 1970s. During 1973 and also 1979, political upheaval in the Middle East resulted in a sudden increase in the price of oil. During the same time it was also suggested that some of the most convenient fossil fuel energy reserves, such as crude oil, were approaching exhaustion. [2] [3]. These factors necessitated a mechanism for controlling or managing the demand for energy by the use of certain interventions.
Ideally the demand for energy would be optimised or regulated by supply and demand in the market. Figure 1 illustrates the supply and demand model. The price P of a product is determined by a balance between production at each price (supply S) and the desires of those with purchasing power at each price (demand D). The graph depicts an increase in demand from D1 to D2, along with a consequent increase in price and quantity Q sold of the product. [4]
The model demonstrates how in a competitive market, price will function to equalize the quantity of a product demanded by consumers and the quantity of that product supplied by producers, resulting in an economic equilibrium of price and quantity. This model, however, does not apply to electricity demand and production.[4]
The reason is that the price paid on the market for electricity in particular, is often regulated or fixed and often does not reflect the true cost of producing said electricity. Electricity demand can also vary greatly during the course of a day and the pricing system may not reflect the instantaneous cost of electricity production as more expensive peak electricity sources are brought online. Also, consumers often do not have the capacity or the willingness to reduce their demand as electricity prices increase or as production decrease resulting in a situation where supply cannot keep up with demand. DSM activities attempt to bring the demand and supply for electricity closer to a perceived optimum.

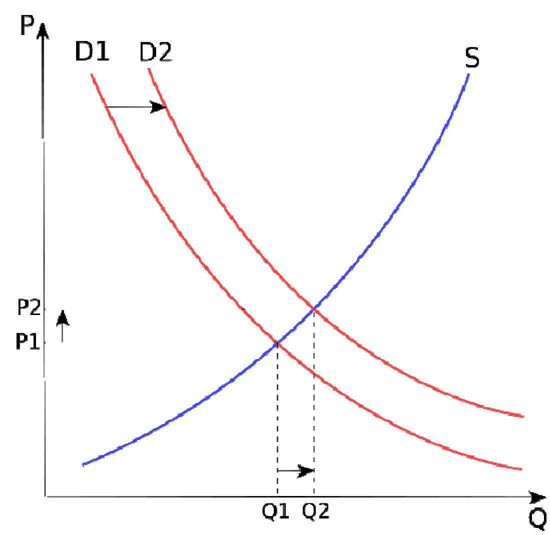

Figure 1.The supply and demand model [4]

3.1 Methods of Demand Side Management
DSM programs, as implemented by electricity utilities, involve a call for the application and usage of more efficient appliances and also to change the demand profile. [5] A number of such DSM strategies exist.

3.2 Compact Fluorescent light bulbs (CFLs)
Incandescent light bulbs have remained very much unchanged since their invention in the 19th century. Incandescent light bulbs operate by passing a current through a thin filament of metal, usually tungsten. The filament has a certain resistance and the current passing through the filament causes it to glow white hot, producing heat and light. This process, however, is very inefficient as the bulk of the electricity used by such a bulb is converted to heat and not light. According to Dr Matt Prescott, director of banthebulb.org, incandescent light bulbs waste so much energy that if they were invented today, it is highly unlikely they would be allowed onto the market.[7] South African retailers Pick 'n Pay and Clicks are following the lead of many retailers across the world and have voluntarily removed all incandescent light bulbs from their shelves and will no longer be selling them.
CFLs operate by passing a current through a gas inside a sealed tube. The excited gas emits ultraviolet light which causes phosphor on the inside of the glass tube to glow. CFLs use less electricity than an incandescent lamp to produce the same light output. A 100W incandescent light bulb produces about the same light output as a 20W CFL. With lighting making up 5-10% of the typical electricity bill in the developed world, potential savings in electricity consumption can really add up. [7]
In 2006 CFLs, which have a lifespan of between three and five years, accounted for 15 percent of residential lamp sales. In 2005 and 2006 Eskom distributed over 8-million CFLs, with 5-million issued in the Western Cape. A further 4-million were issued in KwaZulu-Natal and Gauteng. In 2006 Eskom's efficient lighting project in the Western Cape, including a door-to-door campaign, saved 229 MW of electricity. [8] Plans are already underway to produce CFLs locally in an attempt to reduce the price. This would be a prelude to an outright ban on incandescent light bulbs in South Africa. [8] Current CFLs are imported mostly from China and Indonesia.

3.3 Appliance efficiency labelling
Internationally manufacturers are now applying energy efficiency labels to their products.
Figure 2 shows a typical EU energy efficiency label on appliances in a store in Fribourg, Switzerland[12]. The author also observed similar energy efficiency labels on cars at a car dealership in Fribourg, Switzerland in December of 2007. The author observed no such labels on appliances in local stores. In South Africa, draft regulations on energy efficiency would stipulate that all imported appliances must have labels indicating their energy efficiency. [8] The National Energy Efficiency Agency (NEEA) was established recently as a division of the Central Energy Fund to advise the government on energy efficiency policy. According to a newspaper article from June 2007, a tender has already been issued to buy equipment to enable the SA Bureau of Standards to test locally made appliances.[8]

4.DOMESTIC DEMAND PROFILE STRATEGIES

The most important method to achieve DSMs objectives is to change the pattern of electricity usage or the daily demand profile.

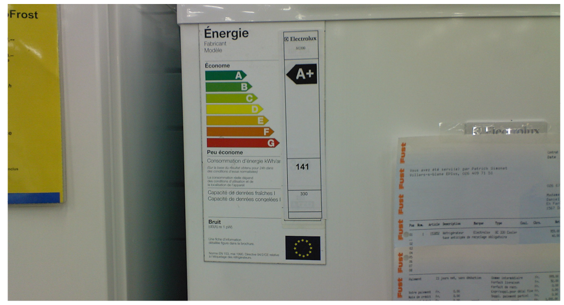

Figure 2. Energy efficiency label on a refrigerator, Switzerland [photo by AJ Bredekamp]

4.1 Hot water cylinder control
A typical geyser can consume approximately 3kW in an hour, re-heating water that was actually still warm enough for bathing. Many consumers do not notice the difference between 56 degree Celsius and 60 degree Celsius water. It is therefore not necessary for a hot water cylinder to reheat the water as soon as the thermostat detect that the temperature has dropped below the preset level. [5] One cannot rely on (or expect) consumers to manually switch off their hot water cylinders during peak demand periods.
The solution lies in making the switching on-and-off of hot water cylinders automatic. Automatic control of hot water cylinders is achieved by the installation of so called ripple control devices. Ripple control devices allow the electric utility to remotely switch off a consumers hot water cylinder during peak demand periods. This often has no perceptible impact on the consumer. Calculations performed by electric utilities have determined how long a typical hot water cylinder can be switched off before a household would notice a discernable drop in water temperature. [5]
Figure 3 shows how peak demand can be shifted. Switching off all the geysers in a residential area during times of peak demand will result in a demand reduction. During that time though the water in the hot water cylinders will be used up or cool down. Once the period of peak demand has passed the hot water cylinders can be switched on again.

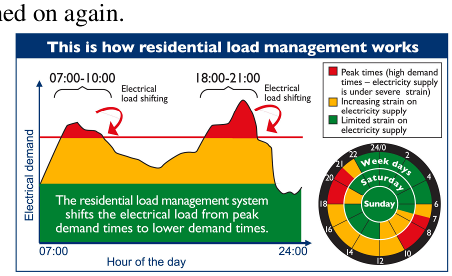

Figure 3. A diagram explaining how peak loads are shifted to times when demand is lower [5]

This has the effect of flattening out the peaks and valleys on the typical demand curve. As stated before the action of hot water cylinder control by an electric utility often has no perceptible impact on the consumer. Eskom South Africa has dubbed their hot water cylinder control program Residential Load Management (RLM).[5]

4.2 Monetary Incentives

Monetary incentives for demand management can be either punitive or rewarding. Punitive incentives seek to punish consumers who use an excessive amount of electricity while rewarding incentives seek to reward consumers who reduce their demand. Such rewards can take the form of discounts on energy efficient appliances and devices such as solar hot water heaters. Eskom are already subsidising solar hot water heaters in South Africa with anything from R2 100 to R12 500. [9]

Punitive incentives usually involve charging a higher tariff for electricity based on demand. A time-of-use based tariff structure is also being discussed for the residential sector. This tariff structure will charge the consumer more for electricity during peak times [10]. A general increase in the price charged for electricity will also serve to reduce demand.

4.3 Load Shedding

Load shedding is by far the most extreme form of load management. Load shedding is seen as a last resort option only to be used when all other forms of load management has failed to reduce demand. In many African countries, for example South Africa, Cameroon, Democratic Republic of the Congo, Nigeria and Zimbabwe, a combination of aging electricity generation infrastructure, and the inadequacy of the supply of electricity to the ever increasing demand, has made load shedding a regular occurrence.[6]

Load shedding involves interrupting supply to consumers on a rotating basis. In this way the limited supply is shared amongst all consumers. It is an effective, albeit unpopular, method of reducing demand. It is also an effective way to avoid blackouts as extreme demands on the electricity grid can cause instability that can lead to grid collapse. [5]

Internationally load shedding is also referred to as rolling blackouts. In the United States, rolling blackouts almost always occur during hot weather due to increased air conditioner use by consumers. Rolling blackouts occur often during the summer months in states like California and Texas. In states such as New York and New Jersey "brownouts" instead of blackouts are implemented. A brownout involves a reduction in the mains voltage by a certain percentage. The resulting dimming of lights gave rise to the term "brownout". [6]

In South Africa Eskom has embarked on a system of load shedding since 2006. This system was introduced to the public with an advertising and PR campaign.

A dial, shown on SABC TV as well as Eskoms' website, indicates the status of the national electricity grid and the likelihood that load shedding will take place. It is often accompanied by a request to switch off unnecessary appliances.

5. TARGETED DSM STRATEGIES

Implementing a successful DSM strategy requires that electric utilities know not just the usage patterns of electricity consumers, but also what appliances these consumers own or are planning to buy. Appliance ownership and usage patterns in South Africa will be studied to determine whether it is possible to predict future standby power consumption use from appliance purchase patters. If particularly strong growth in the number of a particular appliance is detected, it may serve as a means to target DSM strategies. South Africa will be used as an example of a developing nation.

5.1 Appliance distribution in South Africa

Shuma-Iwisi et al. [13] extensively studied the distribution of appliances in the greater Johannesburg area. It was found that the saturation rates of televisions and cellphones were particularly high at greater than 80%. 96% of households surveyed owned a television set with 88% of households owning a cell phone. Saturation rate refers to the number of households who owned an item out of all households surveyed.

It is evident that a DSM strategy targeted at televisions, cellphone chargers, microwave ovens, Hi-Fi's and DVD players could have the greatest potential impact due to their high saturation levels. It is however important not just to know how many of a particular appliance is present, but also how fast the number of a particular appliance is increasing. This in turn requires the use of historical data.

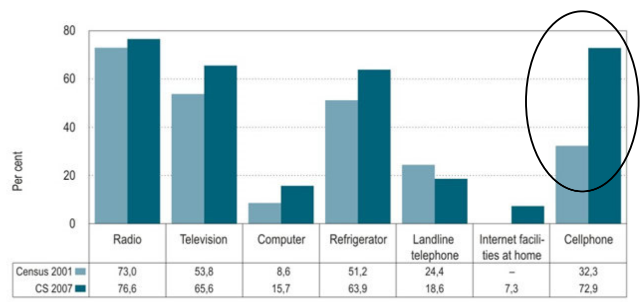

Figure 4. Considerable growth in the number of cellphones present between 2001 and 2007

Figure 4 shows census data for 2001 and 2007. Notice the substantial increase in the number of cellphones present, an increase of 40% in 6 years. Notice also the rather small increase in the number of televisions present, a mere 11.8%. This small increase is mostly due to the high saturation rates that televisions enjoy.

In order for a targeted DSM strategy to succeed one must know how many of a particular appliance is present, how fast the number of a particular appliance is increasing and also how the appliance is being used. Figure 5 shows the four data elements that must be known in order for a targeted DSM strategy to be developed. These are saturation rate, level of growth, usage pattern and power consumption.

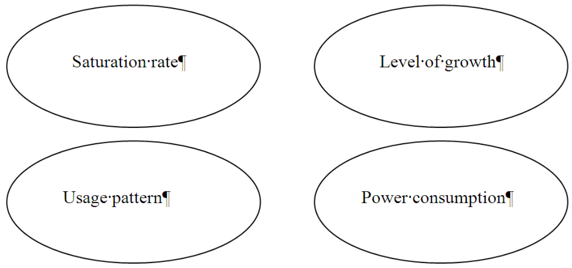

Figure 5. The four data elements that must be determined to formulate a targeted DSM strategy

5.2 Usage patterns, history and future

According to Figure 4 another device that enjoys considerable growth in the South African market are cellphones. The main culprit with cellphones is the charger. Chargers use a variety of different plugs and voltages. Internally they vary from "cheap and nasty" transformer type chargers to sophisticated switched power supply based chargers with microprocessor control. Energy Star does provide efficiency guidelines for cellphone chargers, but in reality very few chargers are in fact Energy Star compliant due to the plethora of different chargers available.

Most consumers leave a cellphone charger plugged in at the mains socket even when no device is connected to it. Consumers just are not aware of the fact that the charger is still using energy even when the cellphone is disconnected and this is the main source of the problem. Although the individual power draw is small, the sheer number of chargers makes for a significant national power draw. In November 2008 a group of cellphone manufacturers banded together to raise awareness of the wastefull nature of cellphone chargers.[21]. LG, Motorola, Nokia, Samsung Electronics and Sony Ericsson have developed a ratings system to show consumers how much energy chargers use in standby mode. Five stars designate the most efficient chargers, using 0.03 watt or less while chargers that consume more than 0.5 watt get no stars.

To put the problem into perspective, consider Table 1 which shows that there are over 60 million cellphone users in South Africa. If every cellphone charger drew 0.5 watt during standby, that would present a national load of 30 million Watt or 30MW. On the other hand if every charger drew only 0.03 Watt, that figure can be reduced to only 1.8MW. It is evident that more efficient cellphone chargers make sense.

Network	Number of subscribers in millions
Vodacom	39.6
CellC	6.4
MTN	17.2
TOTAL	63.2

Table 1 Number of cellular subscribers in sa in millions [22],[23] and [24]

To standardize cellphone chargers and encourage manufacturers to produce a single efficient type of charger, the United Nations telecoms (ITU) agency approved technology on 23 October 2009 that will enable the production of a universal cellphone charger. [20] It is expected that the introduction of a universal charger will reduce the standby power consumption of a typical cellphone charger by 50%. Consumers will also no longer need to buy a new charger every time they change their phones resulting in less electronic waste being generated.

5.3 Television

Since the introduction of television into South Africa in 1976, television has entered every aspect of our lives. It has become the primary form of entertainment and news for many South Africans. The first colour television sets in South Africa were quite expensive making for a slow initial uptake. Later as many more households started to purchase television sets this new load on the power grid started to become more important. When MNET started their first broadcasts in 1986, South Africans were fist introduced to the set-top box. A set-top box is a device used to convert from one type of signal to another. In the case of the MNET set top box (more commonly called a decoder) the conversion was made from a scrambled to a descrambled signal. For many South Africans at the time MNET was considered a luxury. As such uptake was slow and the effect of the new power demand from set-top boxes was spread over many years.

Digital satellite television was first introduced to South Africa by Multichoice in 1992. Once again this new technology was considered a luxury. Satellite receivers were expensive and as such uptake was also slow. Once again the new demand from yet another set-top box was spread over many years. Multichoice reached 1.5 million subscribers in November 2007 [14]. From 1992 to 2007 the extra load on the national grid from DSTV decoders went from 0W to approximately 27MW. (Assuming 18W per decoder, based on 2004 measurements). This additional load appeared gradually over 15 years.

There are approximately 5.2 million television sets in South Africa. [17] Assuming that current DSTV subscribers would have no interest in purchasing a new set-top box for terrestrial digital television, this still leaves 3.7 million television viewers who have to make the switch to digital by November 2011 or face having no analogue signal to receive [15].

If one set-top box uses 10W (based on typical consumption of similar boxes) a new load of 37MW can appear on the national grid in the span of only 3 years.

According to the South African Advertising Research Foundation, South Africans watch 3 to 4 hours of television per day. This in turn means that the typical South African television set is in standby mode for 20 out of 24 hours. [16]. According to Shuma-Iwisi et al. the bulk of television sets in use are less than 10 years old. This means that an accurate national standby power consumption figure for television sets can be calculated using consumption data for different models from 1999 – 2009.

The bulk of sets measured used less than 2 Watt of power during standby, with a few sets using up to 11 Watt. If 5.2 million television sets draw 2 Watt during standby, that is a load of 10.4 MW that could potentially be reduced or eliminated. Care should be taken to monitor the standby power consumption figures of televisions imported into

South Africa to ensure that the current national standby power consumption for televisions does not increase and is ideally reduced. Government can mandate that all sets sold in South Africa must be Energy Star compliant and that locally produced sets are tested and certified by the South African Buro of Standards.

It is however not sufficient to simply manage the standby power consumption of television sets. Traditional cathode ray tube (CRT) based television sets use 80 – 100 Watt of power during normal operation. Newer plasma screen sets can use up to twice as much. With CRTs quickly becoming obsolete, consumers will be replacing their CRT based television sets with newer plasma screen or Liquid Crystal Display (LCD) based sets. If newer sets use more electricity than the sets they replace, the peak demand from television sets will only increase. The ideal situation would be for the replacement set to use less electricity than the sets they replace.

LCD televisions have almost completely displaced CRT televisions due to their compact design and superior picture quality. Almost all the television sets currently on display in a typical electronics store are LCD based. All LCD and plasma sets offer a vertical resolution of at least 768 lines. All CRT televisions have a native vertical resolution of 480 lines.

Viewable Diagonal Screen Size (Inches)	Aspect Ratio	Viewable Screen Size in Inches	Screen Area in Inches^2 (cm^2)	Maximum On Mode Power in Watts	
				480 Lines of Native Vertical Resolution	768 or 1080 Lines of Native Vertical Resolution
20	16:9	17.4 x 9.8	170.5 (1,100)	45	66
32	16:9	27.9 x 15.7	438.0 (2,826)	78	120
42	16:9	36.6 x 20.6	754.0 (4,865)	115	208
50	16:9	43.6 x 24.5	1068.2 (6,892)	153	318
60	16:9	52.3 x 29.4	1537.6 (9,920)	210	391

Table 2 Maximum on mode power consumption for television sets according to energy star

From Table 2, it is interesting to note that Energy Star allow for a 35% increase in power consumption for a 32" television when going from 480 to 768/1080 lines of native vertical resolution. At larger screen sizes the allowed increase is even more pronounced at 47%. This means that even if all new sets purchased in South Africa are Energy Star compliant a substantial increase in total power consumption will still occur.

Manufacturers can choose to improve on the minimum requirements set by Energy Star so that LCD and plasma sets do exist that use the same amount of power as the CRT sets they replace. In some cases, however, plasma based sets still use so much more power than the sets they replace that due to the very high power consumption of plasma television sets, Australia is poised to ban all plasma televisions by 2011 [18].

6. CASE STUDIES

As it is evident from the preceding discussion that television sets and cellphones can benefit the most from a targeted DSM strategy the power consumption of these devices were measured. The power consumption of television sets on display at a local electronics store was measured using a Fluke 43 power quality analyzer and 80i-110s low current probe. During testing of television sets the following methodology was employed:

- All power saving features were bypassed
- All televisions were set to display a snow pattern. A snow pattern on a television set has a random distribution of peak white and black pixels.
- Controls for brightness, contrast and colour saturation was not adjusted from the settings as set up by sales staff in the store. It was assumed that all sets were adjusted for a comfortable brightness and contrast level. It was believed that this would be more representative of actual viewing levels.
- The sound on all televisions were muted during testing

7. RESULTS

Screen Size	Model	On (Watt)	Standby (Watt)
42"	LG Plasma 42PQ60R	322	0.3
42"	LG LCD 42LH70	216	1.3
32"	LG LCD 32LH70	81.3	0.7
50"	SAMSUNG PLASMA PS50B430	250	0.9
46"	SAMSUNG LCD LA46B530	166	0.9
42"	SAMSUNG PLASMA PS42B430	242	1.0
42"	SAMSUNG PLASMA PS42B450	263	0.9
40"	SAMSUNG LED UA40B6000	139	0.1
40"	SAMSUNG LA40B550 LCD	159	0.9
32"	SAMSUNG LCD LA32B450	93.1	0.9

Table 3 Power consumption of new television sets (2009)

8. ANALYSIS OF RESULTS

8.1 Television

From table 3 it is evident that the standby power consumption of modern LCD and plasma sets is consistently below or very near 1 Watt. From table 4, the average standby power consumption of a television in 2004 was 3.6 Watt compared with 0.8 Watt in 2009. A reduction in standby power consumption of 78% in 5 years. A potential problem surfaces though when one compare the on mode power consumption of older CRT sets and newer LCD/Plasma sets. From tables 3 and 4 it can be seen that while the average on mode power consumption of a CRT TV is about 90 Watt, that of an LCD/Plasma set is about 190 Watt. An increase of over

Screen Size	Model	On (Watt)	Standby (Watt)
106cm	LG MT42PM12 Plasma Flat Panel	265	3.8
84cm	Sony KV-XA34	125	1.1
	Samsung 3426	131	2.5
74cm	Sony KV-SR29	120	1.4
	Panasonic 29FJ20	82	1.2
	Samsung CS29Z6 100Hz CRT	185	1.8
	Philips 29PT7322	114	1.3
64cm	Sony KVSW25	75	1.2
	Philips 25PT4323	53	1.2
	Tedelex EC2559	75	3.2
54cm	Sony KVHW212	53	1.0
	LG CT20F95M	58	7.1
	LG 20J 50/55	58	11.6
	LG 21CB55	60	8.0

Table 4 Power consumption of new television sets (2004)

211%. From table 2 it can be seen that Energy Star does allow for an increase in the on mode power consumption between older CRT based (480 line) sets and newer LCD/Plasma (768 or 1080) line sets. While the average maximum allowed on mode power consumption of 480 line sets is 120 Watt, it is 220 Watt for 768/1080 line sets. An increase of 183%. This means that most of the increase in on mode energy consumption is due to the change in display technology.

Before any further analysis of the measured power consumption of television sets can be undertaken, it has to be determined what size plasma/lcd television consumers will choose to replace their existing CRT based sets with. The motivation behind why a consumer would choose one type of set over another is varied and complex. Certain assumptions would therefore need to be made. These are:

- The replacement set has to fit in the same space as the old set
- The replacement set must have the same apparent image size as the set it replaces.
- Consumers would prefer a new set with the same image area as the older set
- Consumers equate screen size with status

Normally it would be simple to say that a consumer would replace an existing 64cm set with a new 64cm set. A problem arises since new television sets have a 16:9 image aspect ratio whereas older CRT sets have a 4:3 aspect ratio. To specify the image size of a particular television, the distance between the corners of the image is measured.

For the analysis, sets with similar image area will be compared. A CRT television set with an aspect ration of 4:3 and a diagonal image size of 74cm has an image area of 2628.48cm^2. The closest in equivalent area would be a 16:9 aspect ration TV with a diagonal screen measurement of 32 inches.

Model	**Current μA_{RMS} (no-load)**	**Power Consumption Watt**	**Efficiency Markings**	**Type of phone**
Nokia AC-3E	232	0.05336	V	High-End
Motorola SSW-1189EU	290	0.0667	IV	Budget
Motorola PSM5189A	3700	0.851	None	High-End
Samsung TAD437EBE	260	0.0598	IV	High-End

Table 5 Power consumption of cellphone chargers (no load)

8.2 Cellphone Chargers

Due to the very small power consumption levels that had to be measured, the regular Fluke 43 and 80i-110s probe combination was no longer sensitive or accurate enough. It was therefore decided that a direct measurement of the RMS current would be in order. A Fluke 17B Digital Multimeter was placed in series with the load and the current through the charger measured in the No-Load condition. In the No-Load condition no phone is connected to the charger. The RMS voltage of the mains was also measured and found to be 232V. The power consumption was then calculated according to $P = IV$.

From Table 5 it can be seen that the Nokia charger had the lowest power draw in the no-load condition. It also had a V rating for efficiency. The measured power consumption is within an acceptable range for a device with a V rating. The Motorola SSW-1189EU and Samsung TAD437EBE measured next highest with 0.0667 and 0.0598 Watt respectively. Both devices had a IV efficiency rating. Measured results are within the range specified by Energy Star. The Motorola PSM5189A had the highest power consumption in the no-load condition of all the chargers tested. It also had no V efficiency rating. This charger belongs to a phone that is approximately 5 years old. All the other chargers were from phones less than two years old. The Motorola SSW-1189EU belongs to a cheap budget phone. The charger for such a cheap phone was still surprisingly efficient. Given the results from table 5, the ages of the phones and the market they are targeted to (high-end, budget) it would be reasonable to assume that the bulk of the phones currently in circulation in South Africa would have chargers with at least an IV rating [27].

9. TYPICAL HOUSEHOLD MODEL

It has been stated before that according to the South African Advertising Research Foundation, South Africans watch 3 to 4 hours of television per day[16]. Figure 6 shows the on mode power consumption for LCD, Plasma and CRT television sets. It is evident that the on mode power consumption difference between LCD and CRT is not nearly as pronounced as that between Plasma and CRT. Figure 9 serves to once again demonstrate the relative inefficiency of Plasma display technology.

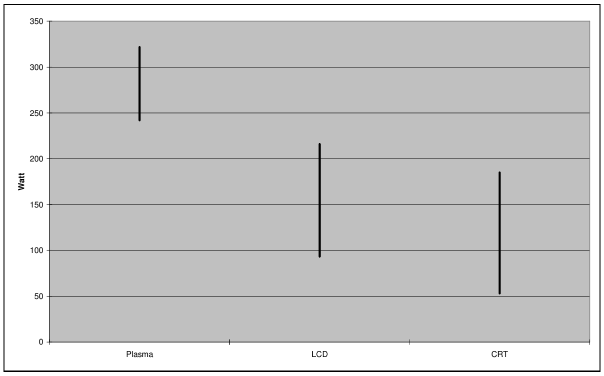

Figure 6. Range of measured on-mode power consumption for LCD, Plasma and CRT television sets, all sizes [author]

What type of sets do South Africans own? According to Harrison and Jones the average diagonal screen sizes as used worldwide by consumers are:

	Diagonal inches
CRT	21.4
LCD	30.1
Plasma	44.8

Table 6 Average diagonal screen size in 2009 [26]

Also according to Harrison and Jones the world wide TV market trend is as follows:

	Million	Percentage of total
CRT	102.9	51.1
LCD	82.9	41.2
Plasma	15.3	7.6

Table 7 Market trends for television sets in 2009 [26]

It has been stated earlier that there are approximately 5.2 million television sets in South Africa. From table 6 and 7 a model of a typical household can be constructed for South Africa if it is assumed that television viewers here follow world wide trends. Extrapolating from table 6 and 7 and taking into account the number of televisions in South Africa, table 8 can be constructed. From table 8 it is evident that although plasma based sets have the largest screens , they are also in the minority, while an almost equal numbers of CRT and LCD sets are present. Assuming that all CRT sets will eventually be replaced by LCD sets and considering the data of figure 6 an increase in the national power consumption due to television sets in the order of 100MW can be expected. This increase is unavoidable due to the switchover nationally from analogue to digital broadcasting. This increase can be minimised by encouraging the sale of Energy Star compliant sets.

Average LCD consumption = 154 W
Average CRT consumption = 119W
Difference = 35 W
Number of CRT sets to replace with LCD = 2.6572 million
Typical increase in consumption of LCD over CRT = 35 W

2.6572 million x 35W= 94.46 MW

If, however, half of CRT sets are replaced by plasma and half by LCD sets an increase in the national power consumption due to television sets in the order of 260MW can be expected. Clearly there exists a need to control the national uptake of plasma based television sets to a minimum.

Average LCD consumption = 154 W
Average CRT consumption = 119W
Difference = 35 W
Number of CRT sets to replace with LCD = 1.3286 million

1.3286 million x 35W= 46.5 MW

Average Plasma consumption = 282 W
Average CRT consumption = 119W
Difference = 163 W

Number of CRT sets to replace with Plasma = 1.3286 million

1.3286 million x 163W= 216.561MW

	Number of sets in millions	Typical Size in inches
CRT	2.6572	21.4
LCD	2.1424	30.1
Plasma	0.4004	44.8
TOTAL	5.2	

Table 8 Estimated number of sets in south africa by screen size

10.CONCLUSION

While great strides have been made with traditional DSM activities targeting geysers and lighting, it is the belief of this researcher that careful monitoring of appliance usage and purchase patterns could point towards even greater savings. This paper demonstrates how the transition from analogue to digital terrestrial television has the potential to add a significant additional load onto the national grid in a short time due to the increased use of so called set-top boxes and LCD/plasma television sets.

It is the recommendation of this researcher that government carefully monitor the standby as well as regular power consumption of imported television sets and that standards are set for maximum allowable energy consumption.

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