**UNIVERSITY OF KWAZULU-NATAL**

# CONSUMER RESPONSE TO POWER CONSERVATION PROGRAM

By

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**The above student has satisfied the requirements of English Language competency.**

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- eThekwini Municipality
- All the participants of the survey

## Abstract

In January 2008 the South African power grid operated by Eskom became severely constrained because electricity demand exceeded supply. Following the immediate measure of load shedding, Eskom implemented a medium term strategy of Power Conservation to encourage consumers to reduce their power usage so that overall demand could be managed. Despite the extensive campaigns the 10% electricity savings target was not met in 2008.

The aim of this study was to review the experiences of other countries that had successfully implemented Power Conservation Programmes and to research the different approaches that were taken in other countries to encourage behaviour change. A survey and quantitative analysis was undertaken on a sample of electricity consumers within the eThekwini Municipality Central Region to gauge the response of consumers to the power conservation campaigns conducted within the municipality. The analysis was done to determine how the response had varied among the various groups by taking into account demographic factors like age, gender and income level. The population of the sample frame was estimated at 15 000 customers. Two hundred and eighty responses were received and analysed.

A salient finding of the study was that the majority of respondents were aware of the reasons for power conservation and the campaigns undertaken, but that there was a preference for Government to lead the initiative and subsidise the required savings measures. A second important finding was that different demographic groups implemented different savings measures, for different reasons and preferred different strategies to encourage savings.

The main recommendations made were that Government should lead the savings drive, with customised campaigns for different demographic groups. The campaigns should place greater emphasis on the financial benefits to be gained. It was necessary for new and different savings measures to be communicated. Further, the was a need for Government to introduce legislation to enforce electricity savings.

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## Acronyms and Abbreviations

| | |
|---|---|
| AMEU | Association of Municipal Electricity Undertakings |
| BUSA | Business Unity South Africa |
| CFL | Compact Fluorescent Lights |
| DME | Department of Minerals and Energy |
| DPE | Department of Public Enterprises |
| DSM | Demand Side Management |
| ESKOM | State owned electricity utility in South Africa |
| ESLC | Electricity Supply Liaison Committee |
| ESMAP | Energy Sector Management Assistance Program |
| GDP | Gross Domestic Product |
| IARC | Industry Association Resource Centre |
| IPP | Independent Power Producer |
| kWh | Kilo Watt Hour |
| LPU | Large Power Users |
| MW | Mega Watts |
| NEEA | National Energy Efficiency Agency |
| NERSA | National Energy Regulator of South Africa |
| PCP | Power Conservation Programme |
| SANEA | South Africa's National Energy Association |
| SAPP | Southern African Power Pool |
| TEPCO | Tokyo Electric Power Company |
| TOU | Time of Use |

# CHAPTER 1: INTRODUCTION

## 1.1 Introduction

In January 2008 the stability of the South African power grid operated by Eskom became severely unstable, due to electricity demand exceeding generating capacity. When demand on the power system exceeds supply the voltage drops beyond acceptable levels which subsequently results in power stations tripping out in sympathy. Partial loss of generating capacity would result in a system brown-out, and total collapse of the power system would result in a catastrophic blackout. According to Ruffini (2008) the planning and forecasting tools used in Eskom had indicated many years earlier that demand would outstrip supply in 2007/8. However, the failure of Eskom and Government to spend capital early enough to strengthen the power generation capacity resulted in demand exceeding supply in 2008 (Ruffini 2008, 10). The demand for electricity over the past few years had increased substantially due to investment in South Africa and GDP growth.

In January 2008 Eskom had resorted to rotational load shedding as a necessary measure to ensure that the South African power system did not black-out. A black–out of the power system had never before been experienced by Eskom. According to Maurer et al (2005) the experience in California in 2000 had taught many electricity supply utilities of the dire consequences of a black-out (Maurer et al 2005, 28). Load-shedding was the only immediate option and had to be implemented to great dissatisfaction of all South Africans and great financial losses to South African businesses.

Despite the immediate need for load shedding it had come with its own disadvantages. One of the biggest technical disadvantages of load shedding was the strain placed on power plant equipment as a result of planned switch-off and switch-on. The impact of increased operations and in-rush currents had resulted in an increase in equipment failures. Municipalities complained of the negative impact that load shedding had on equipment. In response to the concerns expressed by the various affected parties, the Electricity Supply Liaison Committee (ESLC)

commissioned a report on the impact of load shedding on power plant equipment. In February 2009 Eskom released a report from Industry Association Research Centre (IARC) confirming the negative impact on certain types of equipment. The report by Eskom's IARC (2003) confirmed that load shedding has a direct impact on the lifespan of transforming devices, cables and direct current supplies when power is switched off and on continuously (Silva & Smith 2009, 3).

To avoid the negative implications of load-shedding, Eskom had to go on a phase of power conservation as a medium term measure. According to Smit, Naidoo & Naidoo (2008), Power Conservation is an industry term referring to the method of encouraging consumers to reduce their power usage so that the electricity utility can manage demand (Smit, Naidoo & Naidoo, 2008). Eskom had set a target of 10% reduction in electricity consumption. The target was applicable to all Eskom's direct customers e.g. mines and all bulk customers like municipalities. Achieving the 10% reduction meant that there had to be a drastic shift in the behaviour of consumers who had historically become accustomed to surplus capacity. Despite the massive and expensive campaigns run by Eskom and the various municipalities, only 4% reduction was achieved in 2008. According to figures quoted in eThekwini Municipality 2008 annual report, the municipality had achieved a 6% savings in consumption from the previous year.

## 1.2 Motivation for the Study

The concept of power conservation is not new internationally. Other countries like India, China and Brazil have implemented this strategy many years ago to cope with supply/demand constraints. The findings and recommendations from the study will enable eThekwini Municipality to implement a strategy based on the experiences and best practices from other countries to the benefit of South Africa. The literature review was done on some of the countries that had implemented Power Conservation.

Table 1.1 shows the comprehensive list of countries that had experienced supply/demand constraints and that had implemented specific strategies to force consumer behaviour change.

| COUNTRY | YEAR |
|---|---|
| Argentina | 1988 |
| Indonesia | 1991 |
| Malaysia, Colombia | 1992 |
| Ivory Coast, Ghana, Togo, Benin | 1998 |
| Chile | 1998 |
| Philippines | 1999 |
| Tanzania, Kenya, Yugoslavia, California | 2000 |
| Russia, New Zealand, Brazil, Norway | 2001 |
| Venezuela, India, Dominican Republic | 2002 |
| China | 2003 |
| South Africa | 2007 |

**Table 1.1: Countries that have experienced Supply/Demand constraints**

Adapted from The International Bank for Reconstruction and Development 2005, **Implementing Power Rationing in a Sensible Way: Lessons Learned and International Best Practices** report prepared by L Maurer, M Pereira & J Rosenblatt, The World Bank, Washington. P14.

In South Africa, the power conservation campaigns that had been communicated prior to the study to encourage consumers to reduce electricity consumption had not yielded the desired results. According to the Eskom website an average reduction of only 4% had been achieved nationally, despite the shock that consumers had experienced in early 2008 with load shedding (Eskom 2008). The campaigns that had been run had targeted all consumers to reduce consumption in broad terms, i.e. a 'one-size-fits-all' approach. There had not been any focussed campaigns that took into account the needs of different demographic groups and the types of conservation methods that best suited and attracted each group.

The study resulted in certain recommendations for future campaigns that could result in increased electricity savings. A 10% reduction in consumption would mean that

Eskom would be able to better manage the supply/demand constraint. Further, if eThekwini Municipality was successful in the power conservation efforts, then Eskom and National Government could use the success of this municipality to encourage other municipalities that the target of 10% was realistic and achievable. Eskom would also benefit if load shedding did not have to be used, since load shedding resulted in increased plant and equipment operations, which in turn resulted in higher maintenance and breakdown costs.

Residential consumers throughout South Africa would benefit if Eskom achieved the 10% reduction in consumption. Consumers would not have to experience the negative impact of load shedding that was experienced in the first quarter of 2008.

Consumers would benefit from not having to pay excessively more for electricity. In 2008 Eskom was granted a 32.5% tariff increase to fund part of the capital cost of the new power stations that were needed to be built. In 2009 Eskom had applied to the National Energy Regulator of South Africa for a further 34% increase in electricity tariff and was granted a 31.3% increase.

Businesses in South Africa and the country as a whole will benefit if Eskom achieved the 10% reduction in consumption. Businesses in South Africa had lost billions of rand in revenue during the period that Eskom had implemented rotational load shedding.

Business in South Africa would benefit if their behaviour and process change had resulted in less electricity being used per unit of product produced. These businesses would benefit from increased profits.

There would be benefits for the environment if the reduction in consumption resulted in the delay in building another coal fired power station.

## 1.3 Focus of the study

The study was undertaken for the benefit of eThekwini Municipality, Eskom, South Africa, South Africans, businesses and the environment. The findings of the survey were presented to eThekwini Municipality Energy Office that was set up to facilitated the power conservation efforts.

## 1.4 Collection of data

The survey was undertaken with a cross section of electricity consumers within a selected cluster of eThekwini Municipality Central region. The geographic cluster used for the survey was Pinetown, Umlazi, Cato Manor, Queensburgh, Chatsworth and Westville. This geographic cluster was chosen because it was representative of various age groups, income levels and both genders and permitted generalisations to be made about the entire population of eThekwini Municipality.

Table 1.2 depicts the statistics pertaining to eThekwini Municipality.

| | |
|---|---|
| Maximum demand | 1 857MVA |
| Energy sales | 11 163GWh |
| Total number of customers | +/- 580 000 |
| Number of conventional residential customers | 324 233 |
| Number of conventional residential customers in Central Region | 69 229 |
| Average revenue of conventional residential customer | R296/month |
| Number of prepaid customers | 263 063 |
| Average revenue of prepaid customer | R87/month |

**Table 1.2: eThekwini Municipality statistics**

Adapted from eThekwini Municipality 2008. **2007/8 annual report**. Durban.

The respondents that were surveyed displayed the following common characteristics:

1. Varied income levels
2. Respondents were literate
3. Respondents had access to media i.e. television, radio and print media
4. Covered both gender groups
5. Varied in age
6. Respondents had a formal house

7. Respondents had access to electricity
8. Varied electricity usage patterns and amounts

The analysis of the survey was done to find correlations between the following variables:

- Income level and response to power conservation
- Gender and response to power conservation
- Age and response to power conservation

Analysis was also done on the following:

- Respondents understanding of the need to save electricity
- Most common power conservation techniques used by the respondents
- Respondents understanding of what led to the electricity situation
- Respondents opinion on the role of various stakeholders
- Success of various communication strategies
- Respondents opinion on a strategy that would change behaviour

The study entailed quantitative analysis. Software applications for statistical analysis were used for the quantitative analysis. SPSS for Windows was the quantitative data analysis package that was utilised.

## 1.5 Problem statement

Prior to the study, eThekwini Municipality had not reached the target of 10% savings that was called for by Eskom and national Government. The failure of consumers to reduce consumption nationally by 10% meant that the probability of load shedding would increase, at huge inconvenience to consumers and cost to businesses.

eThekwini Municipality and Eskom had spent huge amounts of money on campaigns to encourage consumers to save electricity. Prior to this study there had been limited analysis on the response of individual categories of consumers to the campaign. This study provided eThekwini Municipality with an analysis of the existing behaviour of electricity consumers within the eThekwini Municipality Central region. The study provided the Energy Office with recommendations on how to implement focussed campaigns per demographic consumer group based on what conservation methods best suited each group. Other Municipalities that did not have the funding to undertake a similar study would benefit from the recommendations made in this study.

## 1.6 Objectives

The questions chosen for the survey permitted the use of quantitative analysis to answer the research questions identified in the previous section. Since the survey undertaken was a cross sectional survey with varied ages, gender, income group and education levels; the survey questions were kept simple. The questions were chosen so as not to encroach on the respondents' privacy.

The study answered certain questions for the management at eThekwini Municipality that would assist them when they make decisions on the Power Conservation Programmes in support of Government and Eskom. In order to determine the strategy that the municipality should follow with power conservation, this study was intended to achieve the following:

1. To determine what energy conservation techniques had been used by other countries (from literature review)
2. To determine the strategies followed by other countries to force behaviour change towards electricity saving (from literature review)
3. To establish the success of the various energy conservation techniques used in other countries (from literature review)

4. To test the understanding of consumers on the background to the electricity crisis in South Africa
5. To establish an appropriate medium for advertising and communicating messages to encourage electricity saving
6. To establish the reasons why consumers had responded to the savings call
7. To determine the electricity saving measures implemented per demographic group based on age, income level and gender
8. To establish consumers opinion on a strategy to be followed to achieve the desired behaviour change
9. To establish if high income households consumed more electricity than low income households
10. To determine if consumer behaviour had changed

## 1.7 Research questions

The results from the survey were analysed to determine the following:

- Is there a relationship between demographic factors like age, gender and household income, and the electricity savings measures implemented?
- Is there a relationship between demographic factors like age, gender and household income, and behaviour change towards power conservation?
- Is there a preferred strategy that would result in electricity savings?
- Do consumers understand the situation that led to the electricity shortage?
- What is the best communication medium to be used to encourage electricity savings?
- Has consumer behaviour towards electricity usage changed?

## 1.8 Limitations of the study

The following where identified as limitations of the study:

- The study was limited to a cluster of customers supplied by eThekwini Municipality Central Region and did not give a national picture
- The study is limited to residential loads and did not survey the response of businesses and industry
- The sample size was limited to 400 respondents due to time constraints from a population of 15 000 households
- Time taken to collect the feedback from respondents was limited

## 1.9 Structure of the chapters

Chapter 1 is the introduction and gives the reader a broad overview of the topic. The motivation for the study was explained together with the focus of the study. The problem statement, objectives and research questions were listed. The limitations of the study were explained in this introductory chapter.

Chapter 2 is a review of literature on the subject. The funnel method was used by first exploring international subject matter of the topic, before exploring literature on South Africa and finally eThekwini Municipality.

Chapter 3 is a review of literature on the research method. The chapter gives the reader an explanation of the process followed for data collection and the quantitative research method. The sampling technique was explained in this chapter and the contents of the survey and the characteristics of the sample were explained.

In Chapter 4 the results of the quantitative analysis were presented in the form of frequency tables and graphs. The outputs of the statistical analysis tool were explained in words and correlations between certain demographic factors were stated.

Chapter 5 is a discussion of the finding of the analysis. In this chapter the findings of the analysis were interpreted and explained in conjunction with the literature review of Chapter 2. Any new findings were stated in this chapter and an attempt was made to understand and explain any findings contradictory to previous literature. The aims and objectives stated in Chapter 1 are explored in Chapter 5.

In Chapter 6 the findings and recommendations from the study were listed. Suggestions for future study are also stated in this chapter.

## 1.10 Summary

This chapter is an introductory chapter that briefly explained the reasons that led to the need for power conservation and the circumstances that led to the electricity situation in South Africa. The South African power situation was explained in relation to the global experiences of other countries. The area of study was motivated and the benefits of the study were explained. In this chapter the realistic objectives of the study were stated. The focus of the study was stated as being eThekwini Municipality Central Region and the statistics pertaining to the area of study were listed. The questions answered following the quantitative analysis were listed.

The researcher discussed the characteristics of the sample and the relationships between various variables that were analyzed. Finally, the limitations of the study were identified and listed.

The next chapter is a review of literature on the topic. The literature review was first done on the experiences of other countries and then went into a review of literature pertaining to South Africa before finally focussing on eThekwini Municipality.

# CHAPTER 2: THE GLOBAL ELECTRICITY SITUATION

## 2.1 Introduction

This chapter is a review of literature on the global electricity situation. The funnel method was used to describe the global experiences of other countries before honing into the situation in South Africa and finally eThekwini Municipality. The literature review is an exploration on the experiences of various other countries which have in the past experienced situations where demand for electricity had exceeded supply. The situation in these countries arose either because of generation constraints/problems, or as a result of generation not expanding proportionally to demand. This chapter documents the manner in which the Governments and the supply authorities of the various countries had responded to their individual situations. For each of these countries the responses of the electricity consumers to the measures taken by their respective Governments is stated. The countries that were reviewed in detail are; China, Brazil and Japan.

The final part of this chapter covers that South African electricity situation. The history that led to the diminishing reserve margin in South Africa prior to 2008 is discussed. The immediate short-term, the medium term and the long term strategy of the South African Government and ESKOM were explained. Since the area of study for the quantitative analysis is eThekwini municipality, an overview of the municipality was given, as well as the response of the municipality to the South African Government's strategy was stated.

## 2.2 World-wide electricity situation

In 2005 the World Bank commissioned a report on the global electricity situation. The work was undertaken by Maurer, Mario and Rosenblatt under the umbrella of the World Bank Energy Sector Management Assistance Program. The report by Maurer et al (2005) stated that many countries around the world have experienced

electricity shortfall for reasons that vary from country to country. Some have forecasted this shortage but failed to react fast enough in curbing this shortfall by either investing in new generating plant or by reducing demand. Some countries failed to forecast this shortage due to poor planning or no planning. In some countries the situation arose as a result of a shortage of primary resources needed for generating electricity, like water and coal. Shortages also arose as a negative consequence of the exponential growth in the economy, where the planning and building of power stations simply did not occur as fast as the demand of electricity did. Power shortages are a phenomenon that is not only limited to the developing nations, but have also occurred in the first-world. Countries like the United States; in particular the state of California had experienced power shortages in 2000 and 2001. The power crisis in California had significant political and economic ramifications due to the massive media coverage it received (Maurer et al 2005). According to Finamore et al (2003) when the United States was experiencing electricity shortages the country's recovery strategy had resulted in more than 50 utilities implementing Demand Side Management (DSM) programs between 1985 – 1995, at a cost below the cost of generating additional electricity (Finamore et al 2003, 6).

Maurer (2005) stated that the experiences of the countries that had already experienced power shortages revealed that some customers were cognisant of the problems and how to save electricity, whereas others were less tolerant and unwilling to engage in power conservation efforts. The response of the consumers largely depended on how the situation in the country was approached, who drove the power conservation initiative, what policy framework was used and the involvement of Government. Countries took different approaches to power conservation. In the less democratic countries like China it was easy for Government to resort to regulation to force conservation. As an immediate quick response strategy Brazil had implemented rolling blackouts to encourage and oblige consumers to reduce consumption. Brazil later took the 'sensible' approach of consumer involvement in the solutions, but under the leadership of Government. Brazil chose the approach of a quota system with financial penalties and incentives to force behaviour change. Japan implemented massive power saving campaigns to encourage consumer behaviour change and had successfully achieved the reduction in electricity demand (Maurer et al 2005).

The remedial action taken by the Governments and state authorities in the different countries also varied which in turn had varying results. From the various literature reviewed, the global situation and responses in the countries is summarised in Table 2.1.

| Country | Year/s | Cause | Response |
|---|---|---|---|
| Chile | 1988-1999 | Drought effecting generation<br>Demand exceeding supply | Forced load-shedding |
| China | 2003-2005 | Demand exceeding supply | Forced load-shedding<br>Quotas<br>Minimum Demand Side Management |
| California | 2001-2002 | Drought effecting generation<br>Demand exceeding supply<br>Policy issues | Interruptible supply contracts<br>Forced load-shedding<br>Minimum Demand Side Management |
| Dominican Republic | 2002-2005 | Financial problems effecting generation resources | Haphazard and discriminatory load shedding |
| Japan | 2003 | Forced nuclear generation outages | Effective Demand Side Management |
| Brazil | 2001-2002 | Drought effecting generation<br>Demand exceeding supply | Quotas<br>New tariff structures to force demand reduction |

**Table 2.1 Summary of global electricity situation and responses**

Adapted from The International Bank for Reconstruction and Development 2005, **Implementing Power Rationing in a Sensible Way: Lessons Learned and International Best Practices** report prepared by L Maurer, M Pereira & J Rosenblatt, The World Bank, Washington.

The comprehensive study undertaken by the World Bank ESMAP in 2005 shows that South Africa was not alone in the electricity crisis. The surplus generating capacity in South Africa supported by the slow economic growth prior to 1994 meant that the crisis in South Africa only manifested itself later than in other countries. Figure 2.1 shows the graphical picture of the global shortfall and illustrates the spread across various continents and economies. The yellow and green shaded areas depict the countries that have a potential electricity shortage.

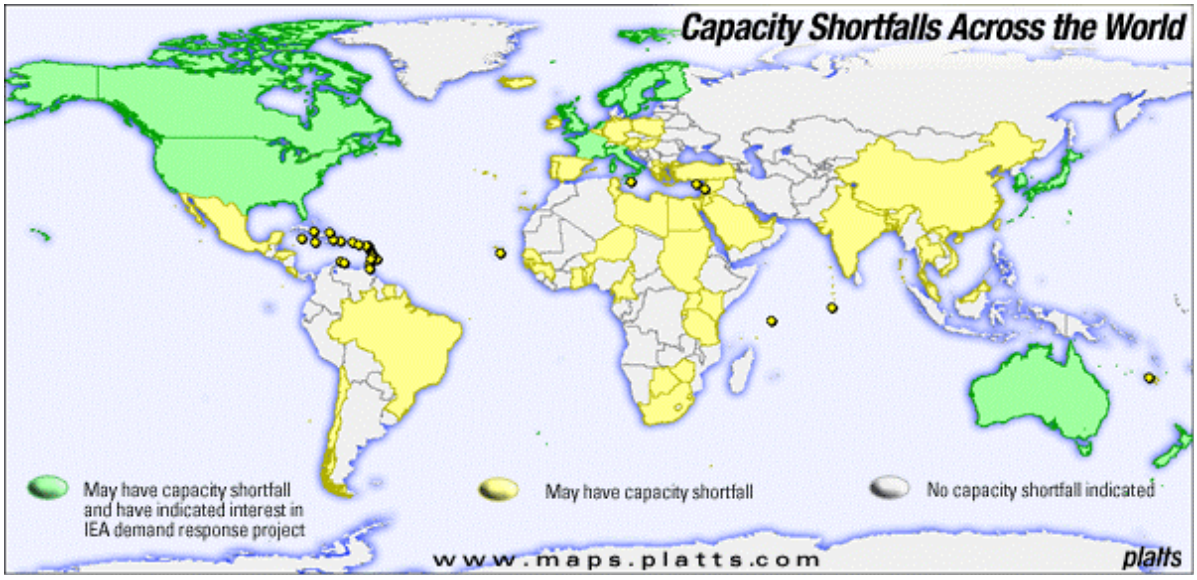


**Figure 2.1 Global Supply/Demand electricity shortages Levels of Strategy**

Adapted from The International Bank for Reconstruction and Development 2005, **Implementing Power Rationing in a Sensible Way: Lessons Learned and International Best Practices** report prepared by L Maurer, M Pereira & J Rosenblatt, The World Bank, Washington. P14.

## 2.3 Demand side management in China

Finamore et al (2003) define Demand Side Management (DSM) as 'a mechanism in which a utility or some other state designated entity uses funds derived from the electrical system to promote energy efficiency through targeted educational and incentive programs' (Finamore et al 2003, iv). According to Iyengar (n.d.) the economic growth in China which was being driven by manufacturing and infrastructure industries put a sever strain on energy resources (Iyengar n.d., 1). The study undertaken by Maurer et al (2005) stated that China experienced chronic power shortages in 2003 and 2004. The financial crisis in the Asian market between

1998 and 2000 had resulted China having experience very slow economic growth in the period preceding the crisis. Due to the low demand for electricity, the expansion planners in the electricity sector had deliberately delayed investments in power plants. These planners had not forecast the sudden economic growth that started in 2003 which had resulted in an exponential increase in electricity demand. This is the unfortunate side effect of positive growth of the economy. It was estimated that the shortfall in generating capacity was between 20 000 to 30000 MW. The shortfall in electricity was as a result of the electricity sector not having built the required number of generating plants to cope with the sudden demand increase. The situation in China was further compounded by the drought experienced in parts of China during this period. This meant that many of the crucial hydro-electric generation plants could not operate at full capacity. There was a coal supply problem that affected the coal-fired generation plants. There were also safety matters the slowed down generation capacity (Maurer et al 2005).

According to Finamore et al (2003) 'As growing power shortages in China threaten its continued economic growth, it becomes more important than ever to find ways to use energy more efficiently' Finamore et al 2003, iv). In 2005, Cheng had undertaken studies in China on policy framework and technology that could be used to reduce electricity consumption patterns. Cheng (2005) developed a simulation model that looked at usage patterns per user-type, taking into account 'time-of-use patterns, lifestyle and behavioural factors, distributed consumption behaviour of electricity users, appliances and equipment utilization patterns' (Cheng 2005, 2). The study revealed that in China the following measures had been introduced to reduce electricity consumption:

- Improvement in building technology
- Active management of new supplies
- Management of high-energy temperature sensitive loads
- Implementation of behavioural and load management strategies
- Management of industrial loads
- Policy framework to improve appliance efficiency

According to Maurer et al (2005), rather than leave Demand Side Management (DSM) to the utilities, the Chinese Government had taken the lead role in driving DSM. This was done by establishing a coordinated policy framework for energy consumption reduction (Maurer et al 2005, 27). According to Finamore et al (2003), the policy department of the State Council developed the DSM policies and roles of various stakeholders, Government agencies and power grid companies (Finamore et al 2003, 24). It must be noted that policy changes are easier in countries like China than in more democratic countries. In general though, Government does play an important role in the legislative arrangements that apply to the country. The advantage of Government taking the lead is that it can create policy that supports a growing economy with a constraint power system by changing residential consumer behaviour. The second advantage is that the policy that Government implements to reduce consumption would result in the delay in capital investment on new generation plants.

Cheng (2005) identified that the largest contributor to peak demand in China was the residential load. In particular, she identified that residential the load highly depended on the life style of the people, the appliance stocks and the types of appliances that are used (Cheng 2005, 29). Maurer et al (2005) identified that two of the larger contributors to the electricity demand increase in China was the population growth and demographic distribution. An increase in urbanization and reduction in rural population resulted in the increase in electricity demand in Shandong. This increase in overall electricity demand occurred because urban residents consumed more electricity than rural residents due to their increased wealth and improved life styles. Urban consumption grew by 1% per annum and rural by 5% per annum (Maurer et al 2005, 26).

The research undertaken in China to simulate behaviour patterns was based on ten carefully selected household appliances. Cheng (2005) chose ten household items and simulated the usage patterns of each taking into account daily and seasonal trends. The research undertaken showed the following findings relevant to China:

- Air conditioning was one of the fastest growing household appliances, but only among urban residential customers. It grew from 0.23% in 1990 to 24.83% in 2003. Usage in rural areas remained very low.

- Usage of heat-pumps was low.
- Most urban and rural homes used fans for cooling
- Use of heaters were based more in geographic location and showed no relevance to urban/rural split. However, the use of heaters was low, and most rural households relied on conventional heating methods.
- Incandescent lamps had the largest share of lighting use, accounting for up to 60% share of lighting. Incandescent lamps were still largely used in rural areas.
- Use of television was saturated in Shandong. The only difference between the rural and urban customer was the size of the television set.
- Water heating was high but saturated in urban areas. Water heating was low in rural areas due to the availability of public bath houses. Solar water heating was gradually growing in urban areas.
- Use of water pumps was high in urban areas and low in the rural areas.
- Refrigeration was high and saturated in urban houses but low in rural households.
- Use of kitchen appliance was low in urban areas and very low in rural areas.

(Cheng 2005)

Cheng (2005) developed and used a simulation model to come up with the following life-style behaviour and electricity saving measures:

- Energy efficient building by use of proper orientation, shading and insulation of openings
- Energy efficient compressor appliances e.g. air conditioners, pumps and refrigerators
- Energy efficient lighting
- Energy efficient water heaters

(Cheng 2005).

The emphasis on lighting was justified because according to Finamore et al (2003) more than 10% of China's total energy consumption was used for lighting, and 90% of residential lighting was from inefficient incandescent lamps. Changing from these inefficient lamps to fluorescent lamps would save 75% of residential electricity used (Finamore et al 2003, 51).

The model developed and used by Cheng (2005), revealed that there were distinct differences between urban and rural household electricity consumption. For each of the energy efficiency proposals above and for the different categories of customer i.e. urban and rural, the model was used to simulate the impact on the power grid base load demand. Different human behaviour patterns were used as the input to the simulation. The simulation resulted in the following significant findings:

- Urban household used 78% of the energy and rural only 22%. This in itself points to the fact that if one wants to encourage electricity savings; it has to be done in the urban areas.
- Appliance efficiency alone would result in 10% energy saving.
- Building efficiency combined with appliance efficiency could result in 25% energy saving in the residential sector.

(Cheng 2005)

According to Finamore et al (2003) 'China had achieved remarkable progress in reducing the energy needed to fuel its rapid economic growth, and is continuing to develop an impressive array of programs and policies deigned to accelerate energy efficiency in every sector' (Finamore et al 2003, 38).

## 2.4 Encouraging active demand participation in Brazil

Von Der Fehr and Wolak (2003) stated that Brazil as a developing economy faced the challenge of attracting entrants in expensive combined-cycle gas turbine power generation while at the same attempting to maintain least cost of electricity (Von Der Fehr & Wolak 2003, 3). Maurer et al (2005) stated that Brazil had experienced

electricity shortages in 2001 and 2002. The power utility had resorted to power curtailments in response to the shortage. The generators in Brazil at that time comprised of mostly hydro-electric plants that were dependent on the water levels in dams. The crisis in Brazil was not as a result of insufficient maintenance or generating plants or unpredicted increase in demand, but rather as a result of an unexpected shortage of water. The power system should have been designed to maintain some sort of equilibrium in supply and demand even under low water conditions, but this buffer did not exist. Over the years and as a developing economy, Brazil had kept electricity prices low so as to allow the majority of people access to electricity. However, attracting new investment in power generation, paying a reasonable wholesale price to generators and at the same time keeping electricity affordable, was a challenge in itself. Independent Power Producers (IPPs) wanted to get the highest return for their investment in generating plants since they had no social obligation and were merely in the market to make a profit. To address the shortcoming, Brazil had resorted to a regulatory framework to encourage IPP participation. The framework allowed for the IPPs to bid their capacity to the national grid at a spot price. However the downside of this was that the IPPs held back the supply of the capacity until the spot price was very high. This in turn meant that electricity consumers had to pay more for electricity (Maurer et al 2005).

According to Finamore et al (2003) the Government of Brazil established a separate agency to administer DSM programs and spend a considerable amount of money on these programs (Finamore et al 2002, 72). Maurer et al (2005) stated that having learnt from the previous cases, Brazil had resorted to encouraging active demand management. The strategy of Brazil was and is still deemed by many industry experts as being the international best practice. Similar to China, the Government of Brazil led the power conservation initiatives. The successful experience of Brazil displayed the need for a centralized high-level authority driving and co-coordinating the power conservation initiatives during the time of crises. Even though this high level authority drove the initiatives in Brazil, the people ultimately made their own decisions on how to save electricity. This was as a result of the Government encouraging consumer participation rather than being punitive. From the Brazil case one can conclude that there are a few ways that the electricity sector can encourage

consumers to participate in active demand side management. Some of these ways are:

- Continuous and active campaigning to get consumers to reduce their electricity consumption by changing their behaviour
- Forcing behaviour change by indirectly creating consumer inconvenience by means of rolling blackouts
- Encouraging responsible citizenship by encouraging residential consumers to reduce their individual electricity consumption so that the industrial loads which are the lifeblood of the economy can continue to operate uninterrupted
- Forcing behaviour change by implementing new tariff structures
- Active campaigning by environmental groups to encourage consumers to reduce electricity usage so that further coal fired power stations do not have to be built
- Encouraging residential consumers to save electricity so that they benefit from reduced bills

(Mauer 2005)

The utility in Brazil discovered that considerable demand participation existed during the power rationing phase. When referring to generation capacity constraints Von Der Fehr and Wolak (2003) stated that 'there are in principle two ways of eliminating a shortage: either price must be increased to choke off demand, or demand must be rationed' (Von Der Fehr and Wolak 2003, 19). Finamore (2003) stated that one of the barriers to successful demand reduction is the traditional tariff structure used by utilities (Finamore et al 2003, iv). One of the methods of encouraging demand reduction was by implementing a tariff structure that depended on system conditions. This meant implementing 'smart' metering technology that charged consumers more per unit of electricity when the system was constrained e.g. during peak periods. The difficulty of this system is firstly in the metering technology, and secondly in communicating the system constrains to consumers in real-time when they needed to reduce load instantaneously to avoid higher tariffs. The simpler and alternate tariff

structure implemented in Brazil was to have a fixed per unit component not based on system conditions and then a higher cost for units above this base component.

According to Noreen (2008), price elasticity is defined as 'the degree to which a change in price affects the unit sales of a product (Noreen et al 2008, 606). Studies by Von Der Fehr and Wolak (2003) showed that in the short-term the price elasticity for demand is very small. However, the authors also found that in the long-term demand will respond more elastically to price changes. Higher prices of electricity can put a severe burden on the household budget, and it is unlikely that consumers would be willing to continue to pay the high price for electricity. This meant that in the long term consumers would reduce consumption so as to maintain a sound household budget. The experience from Brazil had shown that in the long term consumers would change their electricity consumption behaviour to suit their budgets, and would eventually even forget about the inconvenience of the behaviour change. The regulated pricing changes in Brazil that forced consumer behaviour change had resulted in a 20% load reduction from June 2001 to December 2001, when compared to the same period of the previous year. Research by Von Der Fehr and Wolak (2003) had shown that in the short term 'it is not uncommon to find estimate of the demand elasticity of 0.2 or lower' (Von Der Fehr and Wolak 2003, 26). From the demand elasticity one can work out that a 10% price increase would result in a low 2% demand reduction. This means that Government had to implement a regulated pricing structure that imposed severe penalties for high consumption in order to achieve the desired demand reduction.

Maurer et al (2005) stated that a tariff system of quota allocations, penalties, cut-offs and incentives were used in Brazil to force behaviour change. The quota allocation differentiated per consumer category e.g. agricultural sector had to reduce by 5% whereas residential had to reduce by 10%. There was a bonus system for consumers that overachieved on electricity savings and penalties for those that exceeded the quota. While that rationing phase was successful in avoiding a disaster, the financial costs were severe in the commercial market. Rationing was done in the following manner:

- Residential consumers that historically used less than 100KWh/month had no tariff surcharge. They were given financial rewards if more than 20% was

saved, and threats with cut-offs if the quota was exceeded, but no surcharge for exceeding quota. The reason for not having a surcharge was to protect these low income earners. This was justified by the assumption that the probability of the low income earners exceeding the quota excessively was very low. Further, the quota should not be a hindrance to the progress of low income earners in terms of lifestyle.

- Residential consumers that historically used between 100KWh/month and 200KWh/month paid a surcharge for exceeding the quota and this had a step increase in surcharge for higher excesses. These residents were also threatened with service cut-offs for a few days when the quota was exceeded.

(Maurer et al 2005)

According to Maurer et al (2003) 'some commentators assert that the success of the rationing scheme rested more on the threat of disconnection than in the price signal mechanism themselves (surcharges and bonuses)'. A remarkable achievement of this quota system was that the low-income earners brought the biggest saving in electricity consumption. This was contrary to the common belief that low income earners who use less electricity, have fewer appliances and do not have the resources to change to energy saving devices like CFLs, would contribute least to power conservation. Subsequent analysis concluded that the financial incentive was a greater motivator to the low-income earners (Maurer et al 2005, 64).

Contrary to the Brazilian model of discriminatory tariffs, the national response from the South African Government (2008) on the electricity crisis confirmed it's reluctance to implement a tariff structure that would adversely affect poor house households since South Africa was a growing economy with huge economic and social imbalances. Electrification of households that have historically had no access to basic services like electricity was a Government priority. Department of Public Enterprises (DPE) had stated in the national response that 'the tariff will have to be pro-poor and discourage wasteful consumption' (DPE 2008, 3).

According to the report by Maurer et al (2005), in January 2002 when the Brazilian drought was over and the power system was stable, the Brazilian Government removed the quotas and saving targets. This lifting of the quota did not result in a

significant increase in consumption. This is an indication that peoples behaviour changed and that they learnt how to save electricity. After the quota was lifted, 65% of the people surveyed stated that they still maintained the savings habits achieved during rationing (Maurer et al 2005, 98).

## 2.5 Encouraging consumer participation in Japan

According to Maurer et al (2003), when Japan had to shut down a number of its nuclear generation plants in 2003 for safety inspections, Tokyo Electric Power Company (TEPCO) launched an ambitious savings plan across all consumer categories. TEPCO advertised the energy conservation methods on websites, television, radio, newspapers, magazines, brochures and other channels. This was an approach taken to educate consumers on the extent of the crisis and the role that they needed to play. TEPCO used targeted campaigns in some of the following ways:

- Residential customers were asked to reduce the use of air-conditioners, reduce lightening and make more rational use of appliances
- Industrial customers were asked to move to self-generation and to move operations to areas where networks were less constrained
- Commercial and office buildings had to reduce lighting, air conditioners and usage of elevators
- Railroads had to reduce air conditioning and move to self-generation

Maurer et al 2003, 43).

The survey by Maurer et al (2005) revealed that consumers responded very favourably to the power conservation campaign in the following manner

- 94% reduced lighting
- 58% changed the settings of thermostats
- 56% turned off televisions when not watching

- 89% conserve electricity on a regular basis
- 10% were likely to conserve electricity on a regular basis
- Only 1.5% were not involved in active conservation efforts
- 80% believed that power conservation was necessary to prevent blackouts
- Majority of respondents were conscious of the situation and what needed to be done

(Maurer et al 2005, 60)

The strategy in Japan was to create strong knowledge and consciousness about the electricity problem. This focus on education and social conscience is what made it possible for TEPCO to get almost instant response to power conservation, which in turn prevented blackouts.

## 2.6 The electricity situation in South Africa

Prior to the electricity crisis in 2008, Eskom had built the last power station in 1996. According to Adams (2009), the South African Government of the day had then taken a policy decision that electricity would no longer be a monopoly. The White Paper on the Energy Policy published in December 1998 gave the warning that supply would exceed demand. While Government was considering the energy policy the electrification of households in the previously disadvantaged areas steamed ahead. The need to provide electricity to millions of households that had previous not had access to electricity resulted in the diminishing of the electricity reserve margin (Adams 2009). This is the same situation which resulted in the crisis in China, which according to Finamore et al (2003) had 'enabled China to lift more that 200 million out of poverty and raise their average standard of living dramatically' (Finamore et al 2003, 1). According to Adams (2003) the South African Government policy of the day was to rid Eskom of the monopoly by encouraging private sector participation in the electricity market. However, just as it had occurred in Brazil, the economics of the situation did not make it viable for the private sector to enter the generation market (Adams 2009).

When commenting on this earlier decision and the free market principle, the Chairman of Eskom, Bobby Godsell (2009) stated that 'Tariffs were deliberately regulated to below their economic floor price levels, and no generation capacity was built by anyone' (Adams 2009, 7).

### 2.6.1 Diminishing energy reserve margin

The situation that lead to the electricity reserve margin diminishing to crisis levels was stated in a NERSA Consultation Paper on the Power Conservation Programme Rules that had been developed by the regulator. According to a NERSA (2008), 'South Africa's current energy situation is underpinned by higher than anticipated growth in electricity demand, and limited investment in new generation infrastructure over the last 15 years which resulted in limited additional supply coming online. This has consequently led to the generation net reserve margin falling below the 10%' (NERSA 2008, 3). A reserve margin of less than 5% means that any unplanned loss of generation capacity would invariably lead to outages. This diminishing reserve margin placed severe constraints on the power system when maintenance outages were required at the power stations and when there were unplanned breakdowns.

South Africa had shown a year-on-year power demand increase of 4.31% between 2006 and 2007 (Figure 2.2). The Department of Minerals and Energy (DME) (2008) stated that 'the growth in peak demand from 2006 to 2007 was 4.9% which is 1760MW' (DME 2008, 2). Figure 2.2 also shows that this substantial increase in consumption with no increase in generation supply had resulted in the Eskom reserve margin diminishing throughout the year.

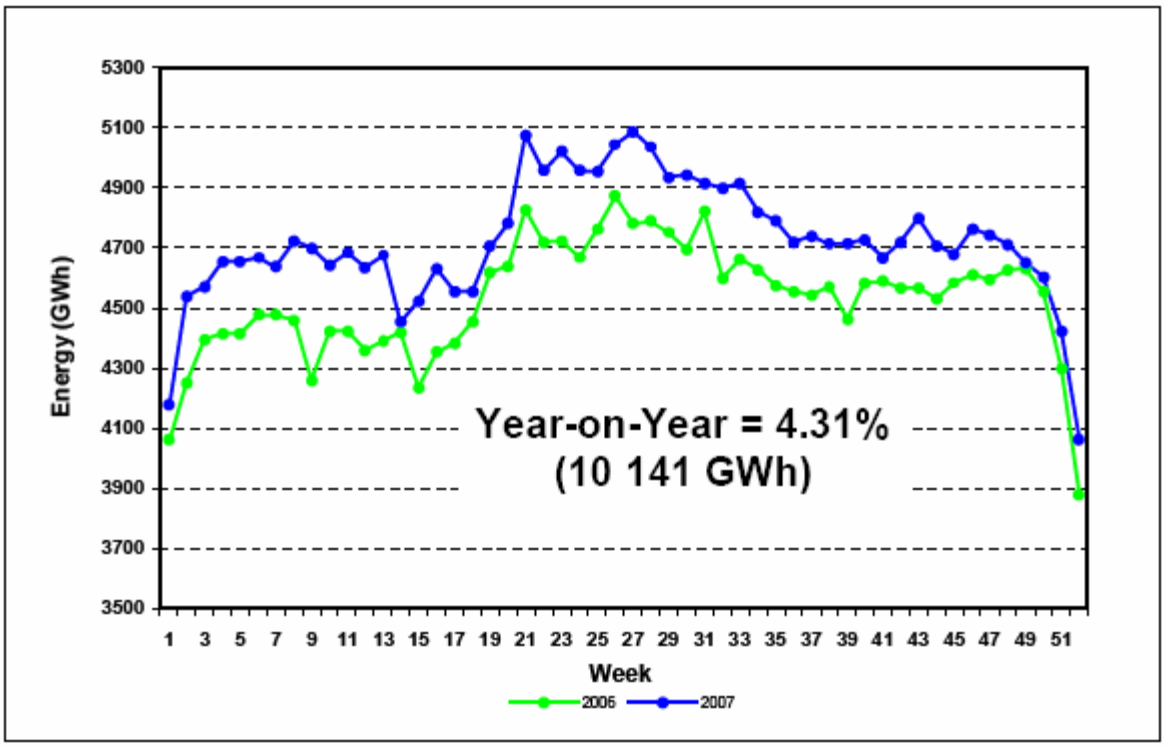


**Figure 2.2 The electricity usage trend in South Africa**

Adapted from Department of Minerals and Energy. 2008. **National Response to South Africa's energy shortage**. South Africa. P1.

According to Creamer (2008), the cause of the diminishing reserve margin 'was not just poor planning by Eskom, but also a massive policy failure' (Creamer 2008, 9). After 2000, Eskom was no longer at liberty to build new power stations and depended totally on Government approval. The policy of the day was aligned to private investors, but the low cost of electricity dissuaded any private sector investment. It was only in 2004 that the policy changed which stated that Eskom must supply 70% of all new capacity.

This diminished reserve margin first became evident in 2006 when the infamous 'foreign bolt' incident resulted in the shutdown of Reactor 2 at the Koeberg nuclear power plant. According to a media release by Eskom (2006), the situation at Koeberg was compounded by problems on the Transmission line to Western Cape which resulted in the supply to Western Cape being severely constrained. This was the first time that the South African public was exposed to load shedding. The

continued diminishing reserve margin together with breakdowns and planned maintenance meant that Eskom had to resort to load shedding to avoid the power system from collapsing. A collapse of the power system occurs when demand exceeds supply which in turn results in a decrease in power frequency to the extent that the power system starts to trip (Eskom 2006, 1).

### 2.6.2 Load shedding in South Africa

Yelland (2008) stated that the South African power system became excessively unstable on 24th January 2008 as a result of an excessively diminished energy reserve margin (Yelland 2008, 11). DME (2008) stated that the 'immediate need for the country is to ensure that our electrical system is brought back to normal' (DME 2008, 9). Eskom resorted to rotational load shedding of its direct customers and indirect customers (via the various municipalities) to achieve a 10% reduction of energy consumption. Demand Side Management was the only immediate solution to the problem of the reduced reserve margin. The DME (2008) stated that 'The risk of load shedding will remain high until at least 2013 if we do not take immediate actions to ameliorate the situation' (Department of Minerals and Energy 2008, 1). Eskom which also supplies various Large Power Users (LPU's), like the mines and multi-national companies, also had to load-shed several of these larger direct customers. The load shedding of these large customers, the core of the South African economy had severe consequences for the South African economy as well as the global commodity prices. During this period, Eskom had taken immense pressure from the South African consumers and the media.

### 2.6.3 Response by the National Government and Eskom

DME (2008) stated that the stability of the national power grid had far reaching consequences beyond consumer inconvenience, and is Government's accountability. Many issues of national security and the economic prosperity of the country depended on a stable power grid. On the African continent, the Southern African Power Pool (SAPP) was crucial for the economic and political stability of the countries that are supplied from this interconnected grid (DME 2008, 4).

Von Der Fehr and Wolak (2003) stated that the power shortages that occurred in California and Brazil confirmed that no matter what the reasons for supply shortages, Government will be held accountable for continuity of supply; and that the failure to accept accountability for this could result in the downfall of the Government (Von Der Fehr and Wolak 2003, 24). DME (2008) issue a document on the short, medium and long terms plans that Government would take to address the power shortage situation (DME 2008, 11). The release of the document showed that Government had taken the lead in driving power conservation and Government showed this commitment by active campaigning for demand reduction and responsible social behaviour.

A national response by the DME (2008) was an attempt by Government to field some of the pressure and take some responsibility for the situation. This response by the DME (2008) elaborated on the short to medium term measures that were needed to be implemented while new power stations were being built. Some of the measures outlined were:

- Reducing unplanned / breakdown outages of the generating plant
- Bring on Open Cycle Gas turbine at a huge cost
- Encourage larger customers to go on interruptible contracts so as to permit Eskom to switch them off when needed
- Use of load shedding as the last resort
- Place an embargo on new loads
- Resort to power rationing
- Intensify Demand Side Management
- Implement Power Conservation Programme

(DME 2008)

In response to the electricity situation in South African, the South African Government commissioned a study that explored the measures implemented in other utilities globally, with special emphasis on consumer behaviour in support of the Power Conservation Programme. According to the South African Government (2008), power conservation is known to be a quick win and ‘recommends the energy

rationing applied in Brazil in 2001 as the best practice in the event of an energy crisis' (DME 2008, 11).

Figure 2.3 shows that comparative electricity prices for various countries.

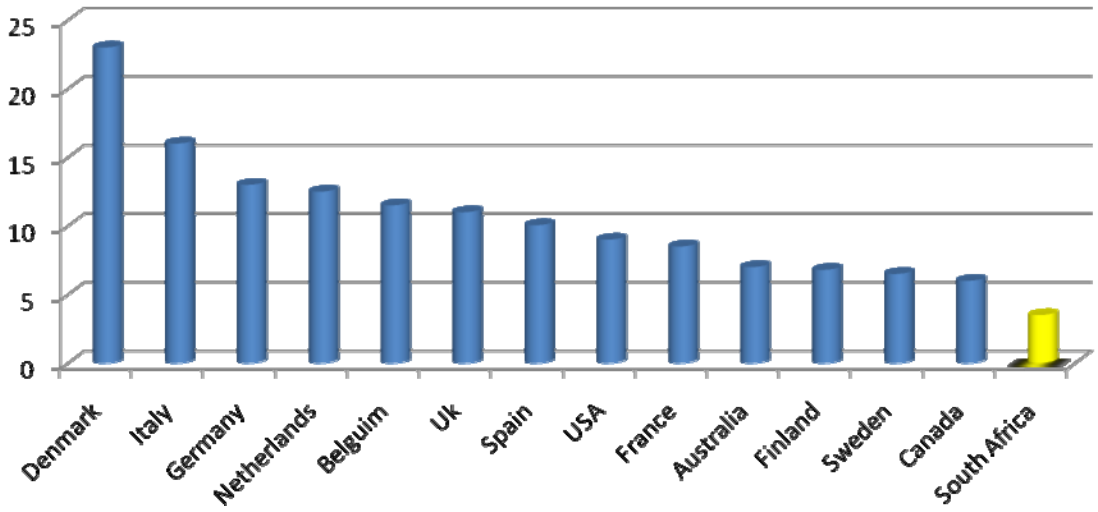


**Figure 2.3 Comparative of international electricity**

Adapted from Department of Minerals and Energy. 2008. **National Response to South Africa's energy shortage**. South Africa. P3.

The comparative electricity prices produced by the DME (2008) illustrated the fact that the benefit gained by consumers over the years of having low prices had also resulted in a failure to spend capital on the much needed power system expansion projects that would have avoided the current situation (DME 2008, 11). Figure 2.3 shows that other countries that had invested in new power plants had resulted in the price gap between South Africa and the next cheapest county increasing by 74% in 2007 from 30% in 2006.

For many years South Africa had been the lowest cost producer of electricity with the vision 'To be the lowest cost producer of electricity by any measure' (Eskom Financial Statement, 1997). The low cost of electricity was advantageous in attracting commercial and industrial foreign investment into South Africa. The downside of this low cost of electricity is that it became economically unfeasible for Independent Power Producers to build generating plants in South Africa and to

compete with Eskom. The low cost of electricity supplied by Eskom is illustrated in Figure 2.3 which shows the comparison of the price of electricity in various countries. In an Interview with Yelland (2008), Eskom CEO Jacob Maroga commented on the history behind electricity pricing. Maroga (2008) stated that Eskom previously had 'some 30% excess generation capacity, and in those days we did not even think of demand management. In fact, quiet the opposite- we encouraged and marketed the use of electricity' (Yelland 2008, 11).

### 2.6.4 Power Conservation in South Africa

According to Creamer (2008), as with many other countries that were forced to resort to rolling blackouts, the uproar from the business community was undesirable to the developing economy. Many emerging businesses and retailers could not tolerate the power interruptions as it severely affected their revenue. The mining sector was severely impacted by the reduced production and this had a global impact on the commodity price of gold and coal (Creamer 2008). Von Der Fehr and Wolak (2003) wrote an article on the Power Sector reform in Brazil and they stated that 'Brazil's experience with rationing and California's experience with rolling blackouts have demonstrated that the total economic cost of electricity supply interruptions are significantly in excess of the direct willingness of consumers to be curtailed' (Von Der Fehr and Wolak 2003, 12). This highlights the fact that forcing residential consumers to change their electricity usage behaviour by imposing blackouts is not successful. Residential consumers are willing to experience these blackouts at the cost of the entire economy. Finamore et al (2003) stated that energy efficiency programs can be implemented in the following ways:

- Providing financial incentives to consumers to change behaviour
- Educating end-users
- Engaging suppliers to provide energy efficient products

(Finamore et al 2003, 5)

Figure 2.4 illustrates the positive impact of various electricity reduction programmes (Eskom 2008). Of significance to this study is the demand reduction with 5% and

10% reduction due to PCP. The figure graphically demonstrates that PCP can add a significant positive impact to the crisis, even with no additional generation.

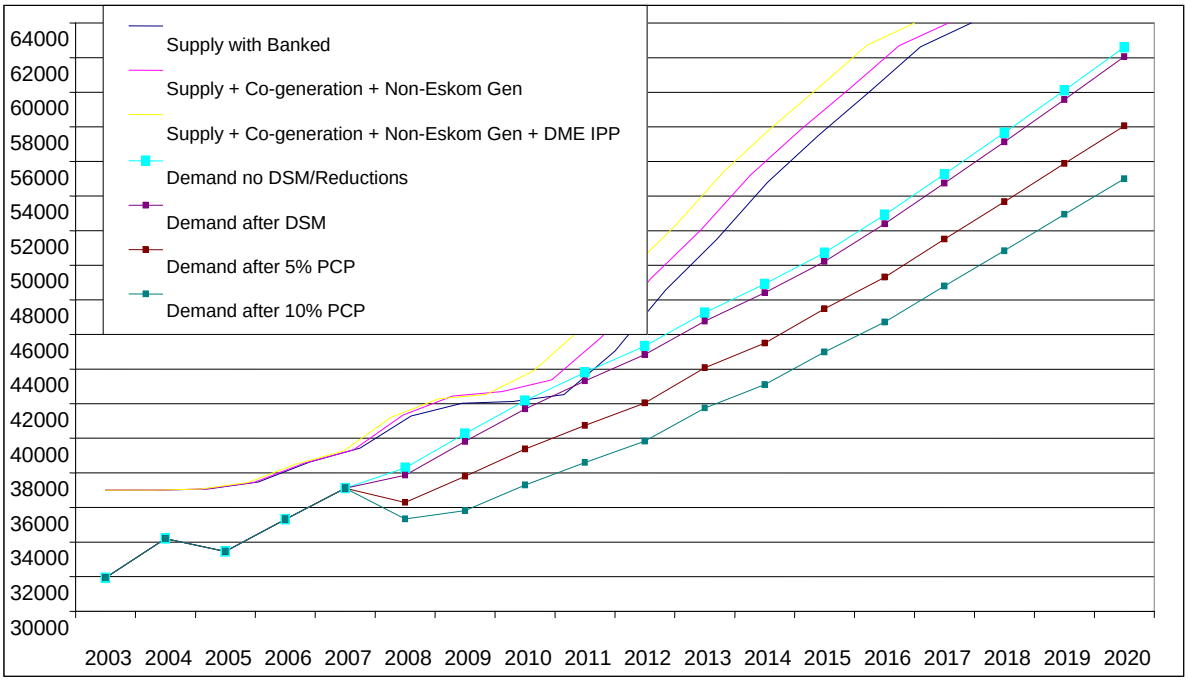


**Figure 2.4 Potential impact of Power Conservation**

Adapted from Eskom Discussion with BUSA and EIUG. 2008. **Proposed Interim Energy Conservation Strategy**. South Africa. P4.

Finamore et al (2003) stated that investing in energy efficiency is often cheaper, cleaner, safer, faster and more reliable that building more power plants (Finamore 2003, 5). Eskom (2008) introduced a programme call Power Conservation Programme (PCP) with the aim of driving a sustained reduction of 3000MW that would enable growth and at the same time ensure adequate operational reserve for security of the power system, while new power stations were being built. The PCP started in July 2008 and planned to run until 2012 when the first new generating plants come on-line.

Maroga (2008) stated that the low price was actually a disincentive for consumers to conserve power and that there was inadequate price signals (Yelland 2008, 11). Von Der Fehr and Wolak (2003) stated that for residential consumers there was the opportunity for Eskom to introduce Time-of-Use (TOU) tariffs. With this tariff

structure, electricity would cost more during peak periods when the power system is constrained and less during off-peak periods. This financial implication would force consumers to change their life style behaviour patterns by performing their own load shifting (Von Der Fehr and Wolak 2003, 20). However, as with any good argument there could be an equally good opposing view on the matter. Robertson (2009) commented that a punitive electricity tariff alone is not the solution (Robertson 2009, 10). According to Finamore (2003), when the State of California experienced the electricity crisis, it was the promotion of energy efficiency that ultimately returned the situation to normality and reduced electricity consumption in 2001 by 6.7% (Finamore et al 2003, 7). Robertson (2009) proposed a more holistic approach to implementing power conservation that looked at the people and soft issues. He stated the following:

- Implementing lasting change takes longer than people want it to take
- There has to be a consistent appealing message that motivates constructive change
- The above message needs to be broadcast to all people that need to change
- Resorting to force e.g. use of legislation and punitive measures may result in reluctant, resentful change that is not sustainable
- Government needs to own the error in judgment when making the appeal for PCP

(Robertson 2009)

Unlike other countries, prior to January 2008 the South African electricity user had never been exposed to the threats of load shedding or excessive supply interruptions. According to a document prepared by a Working Group commissioned by the Electricity Supply Liaison Committee (ESLC) (2008) when load shedding was implemented as an immediate measure, the South African society had been largely unprepared for the associated disruptions which had resulted in a significant impact to society and the local economy (NRS 048-9 2009, 1). Eskom's Power Conservation Program (2008) that was first introduced in 2008 was aimed at

providing lower cost alternatives in addressing the diminishing reserve margin by focusing on the use of electricity (Eskom 2008).

The South African Government stated that 'A Power Conservation Program will have an immediate "quick wins" solution that will reduce and, depending on its success negate the need for load shedding or significantly reduce these in future' (DME 2008, 10). Consumers were encouraged to use electricity more efficiently and outside Eskom's peak load periods.

The power conservation program was a joint initiative between the Department of Minerals and Energy, National Energy Regulator of South Africa (NERSA) and Eskom. The aim of the power conservation program was to save 4 255MW of generation capacity over a 25-year period. The advantages of the Power Conservation Program were:

- Increase in the energy reserve margin
- Reduction or elimination of the need for load shedding
- Allow for maintenance of power plant assets
- Improvement of energy efficiency viability
- Positive impact on the environment due to less emissions from generators
- Economic productivity gains in economy through elimination of wasteful electricity usage
- A permanent consumer behaviour change forced by PCP

Eskom's senior manager responsible for DSM, Etzinger (2008) stated that Eskom had achieved savings of almost 430MW through DSM activities in the 2007/8 financial year. Etzinger stated that consumer behaviour change had resulted in a further 897MW of power savings from load shifting (Hartdegan 2008, 10).

Eskom encouraged households to reduce electricity consumption by advising consumers of the facts regarding the common uses of electricity, as illustrated in Table 2.2.

| | |
|---|---|
| Water heating | The single biggest factor in household electricity consumption is water heating and amounts to an average of 24% of the total electricity consumed. |
| Lighting | Lighting, in the average household, accounts for 11% of electricity consumption. Consumers can halve or even quarter their lighting costs by switching to CFLs - energy efficient, compact fluorescent light bulbs. |
| Standby mode | 15% of electricity is wasted on appliances that are put on standby mode. |
| Space heating and Air-conditioning | A big contributor is heating and air-conditioning |
| Cooking | Cooking uses an average of 8% of the electricity consumed in a typical home. Consumers can change this by cooking less, using the microwave more and by switching to gas. |
| Refrigeration | Refrigeration accounts for 15% of the household electricity usage. |

**Table 2.2 Electricity usage facts produced by Eskom**

Adapted from www.Eskom.co.za. 2008. **Preparing the home front: Making your home energy efficient**. South Africa.

Eskom used a dial on the national television channel to graphically show to the viewers the status of the power grid. Based on the position of the gauge consumers were encouraged to switch off non essential appliances when the power system became constrained. The probability of load shedding increased as the dial moved from Green towards Brown. Once in the Brown position, load shedding was in

progress. Table 2.3 illustrates the comprehensive list of dials that were used and the expected response from the consumers.

| Dial | Colour / Meaning | Recommended action |
|---|---|---|
|  | Green<br>Limited strain on supply | Use electricity wisely and switch off lights in unused rooms |
|  | Orange<br>Electricity supply is under constrain | Switch off non-essential appliances for duration of peak or until status return to green |
|  | Red<br>Have to reduce demand | Switch off additional appliances for duration of peak or until status return to orange |
|  | Brown<br>Load shedding on progress | Switch off all appliances and lights except minimal lighting and TV set |

**Table 2.3: Dials used by Eskom to display status of power**

Adapted from www.eskom.co.za. 2008. **Understanding the current electricity supply challenges facing Eskom**. South Africa.

To encourage the change to efficient lighting Eskom went on a self-funded program replacing incandescent light bulbs with energy efficient Compact Fluorescent Lights (CFL). According to Kock (2008), in South Africa 65 million incandescent bulbs are sold every year. CFLs use 70% less energy, last 10 times longer than traditional incandescent bulb and produce the same amount of light (Kock 2008, 19). According to the Eskom DSM website, within the eThekwini region Eskom used contractors to go house-to-house and swap out the light bulbs. A total of 4000 000 bulbs were replaced in the eThekwini region. To avoid consumers going back to the cheaper incandescent bulbs Eskom used major chain stores like Game to supply the CFLs at a subsidized price in exchange for failed CFLs. According to Koch (2008), Australia banned the traditional bulb, in UK the authorities reached an agreement

with retailers that they would stop selling the traditional bulb within four years, and the US Government was in the process of legislating the phasing out of incandescent bulbs entirely (Kock 2008, 19). The US Government had taken this position because in the US lighting consumes 22% of the total energy usage.

As was done in Japan, South Africa used PCP as an attempt to make the consumer part of the solution. Unlike Brazil and China where a punitive system of penalties and higher tariffs were used to encourage savings, South Africa saw this as a risk to the poorer population. Stratham (2008) stated that affluent households would complain about the doubling of the unit cost of electricity to 40c but would have no material change in consumption habits. Instead such a hike would cripple the large poor population (Stratham 2008, 12).

Figure 2.5 is a typical illustration that was used by Eskom to show residential households what to concentrate on when trying to save their 10%. To encourage consumer behaviour change Eskom used various forms of media e.g. print, radio and television to encourage consumers to save 10%.

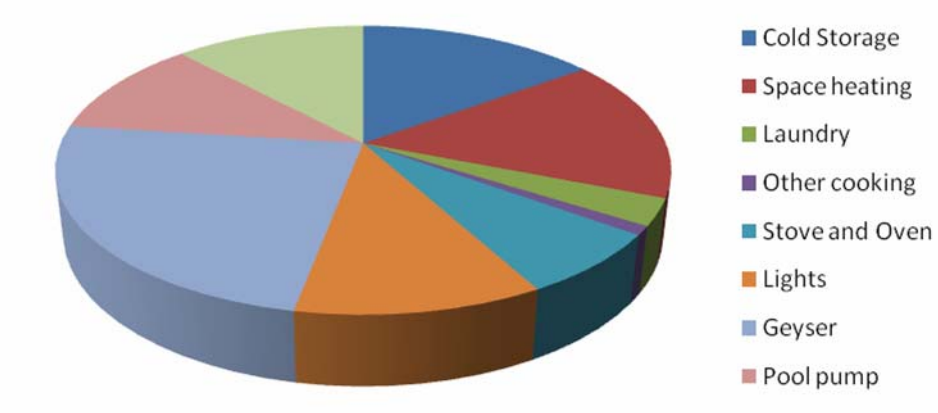


**Figure 2.5 Average household energy usage**

Adapted from www.eskom.co.za. 2008.

Space heating and air-conditioning was another larger contributor to power usage. When commenting on DSM and commercial use of electricity, Rycroft (2008) stated that 'it is estimated that in excess of 50% of a total buildings load is used for air-conditioning in many cases' (Rycroft 2008, 3). In the same article Rycroft (2008)

gave an example of the DSM program implemented in the Carlton Towers office block. He stated that an Eskom subsided programme of replacing 15000 bulbs with energy efficient lighting and a reduction of air-conditioning within the building had reduced the building load by 1730KW. If this change can be achieved in a single commercial building, then the Eskom target of 4 255MW of generation capacity reduction over a 25 year period is achievable if all consumers change their consumption patterns and behaviour (Rycroft 2008, 4).

### 2.6.5 Brief overview of eThekwini Municipality

The eThekwini Municipality website (2009) stated that Durban is the third most populous city in South Africa with a population of approximately 3.8 million people which equates to 7% of the South African population. The African community made up the largest sector (68%) of the population followed by the Indian community (20%), White community (9%) and Coloured community (3%). The age profile reveals that that the working age group accounted for 68% of the population, and the youth accounted for 28% of the population. The unemployment rate was 36.8% in 2006. eThekwini contained a vast spectrum of cultures, beliefs and physical and economic landscapes. Muslims, African Christians, Catholics, Jews and Hindus built monuments to their gods and prophets that became defining elements of the physical and cultural skylines of eThekwini Municipality (www.eThekwini.co.za).

The eThekwini economy comprised of manufacturing, finance, trade and transport sectors. These sectors together with community services and construction attributed to 783 863 jobs. Prior to the global economic crisis the local economy grew by an average of 4.2% per annum between 1996 and 2007. The city posted a GDP of R133 billion in 2007 which is 5.6% increase over 2006 (www.eThekwini.co.za).

In response to Governments call to reduce electricity consumption, eThekwini Municipality established an Energy Office in February 2009 to create awareness around saving electricity and promoting energy efficiency. This office was intended to establish the municipality as the leading authority in promoting and implementing power conservation (www.eThekwini.co.za).

Figure 2.6 illustrates a geographical map of eThekwini Municipality. The location of eThekwini is on the east coast of South Africa, with Durban metropolitan being the economic hub of KwaZulu Natal province and the port being the busiest on the continent. The municipality has a 35% urban population, 36% rural and 29% peri-urban with 60 000 traditional rural households (www.eThekwini.co.za).

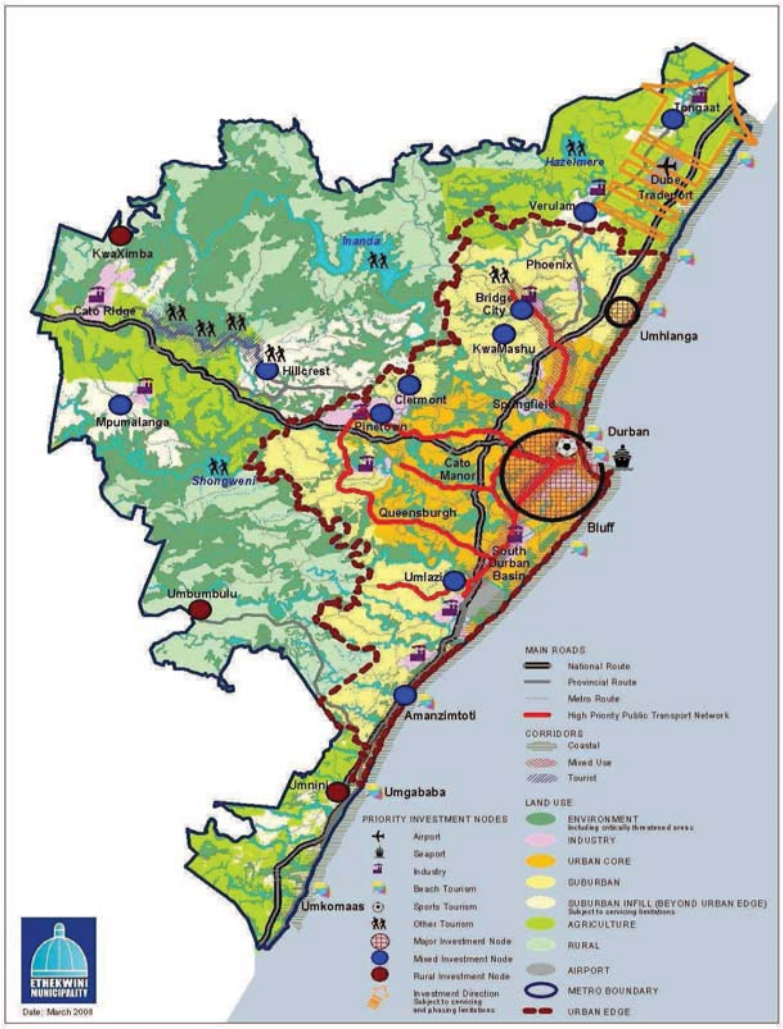


**Figure 2.6: Map of eThekwini Area**

Adapted from www.eThekwini.co.za

### 2.6.6 Encouraging PCP within eThekwini Municipality

An article by Carnie (2009) stated that 25 of the biggest power users in Durban would face 'crippling electricity tariff hikes unless they cut consumption by 10%' (Carnie 2009). This article was a commentary on a NERSA publication about the

punitive tariff structure that was being proposed. Carnie (2009) stated that this punitive system would see tariffs jump from 25c/kWh to R9/kWh. This penalty system was a replica of the Brazilian model. The proposal targeted savings per industrial customer based on the past 3 year's usage pattern. The penalty would kick-in if this target was exceeded. However NERSA had also proposed a reward system that is understood to be similar to the Brazilian model. In this instance, users who use less than their target would be able to auction their surplus savings to other companies (Carnie 2009). Finamore et al (2003) stated that it is possible for utilities to implement pricing mechanisms like TOU tariffs and tiered rates, because they can discriminate between customers based on the knowledge of the customers historical usage patterns (Finamore et al 2003, 14).

In January 2008, DME released a document entitled 'Electricity Regulations for the Prohibition of Certain Practices in Electricity Supply and Compulsory Norms and Standards for Reticulation Services'. A summary of some of the energy efficiency practices to be encouraged are

- Energy efficient lighting to replace incandescent lights
- Unoccupied building not to be lit after hours
- All streetlights to be off during the day
- Solar geyser to be used in residential houses that cost >R750 000
- All geyser to have blankets
- Commercial buildings must have solar heating
- Remotes switching to be incorporated to geysers, aircons, swimming pools
- Streetlights to use energy efficient bulbs
- By 2010 all residential customers using >500kWh to have TOU tariffs

- Non compliance will be dealt with in terms of penalties

(WATTnow 2008, 15):

eThekwini Municipality had used various forms of print media to advertise the need to save electricity and to educate consumers on what they could do to save 10%. According to the eThekwini website all lights in all municipal buildings in eThekwini region are switched off after hours. The municipality also surveyed all its buildings so that the information gathered could be used to implement suitable energy efficiency and load reduction measures. Streetlights have photocells installed so that they switch off during daylight. Streetlights and robots were being changed to energy efficient products (www.eThekwini.co.za). eThekwini Municipality went further and established an Energy Office that was launched on 3rd February 2009 to drive the power conservation campaigns. The role of the Energy Office was to establish strategic partnerships with voluntary organizations, Government, tertiary institutions, business and public. Finamore et al (2003) stated that the success of energy efficiency programs depended on that the ability to provide incentives and motivation to the consumers (Finamore et al 2003, 34). The eThekwini Municipality Energy Office used the print media campaigns to motivate consumers by showing then the savings that they could achieve in financial terms.

## 2.7 Summary

The subject matter covered aspects of the global electricity crisis and explained the world wide shortfalls that had previously occurred. The literature review looked into the electricity crisis experienced in China during 2003 and 2004, and the subsequent Demand Side Management Programme that was implemented by the Chinese Government. The review looked at the role played by Government in implementing policy change to force savings. A review of the Brazilian electricity crisis of 2001 and 2002 was done as part of the study. The literature review explained the very different approach taken by Brazil in encouraging electricity consumers to save electricity. The review also explained the approach taken in Brazil of encouraging demand reduction by the implementation of quotas, penalties and rewards to

encourage behaviour change. The final international case was Japan. The review was on the consumer participation in Japan during 2003 which lead to load reduction.

An explanation of the history behind the specific electricity crisis that was experienced in South Africa in 2008 was given. An explanation was given on the electricity supply / demand situation and the response from the South African National Government on the matter. The comments and papers of various industry experts on the load shedding situation were used as part of the literature review. A review was done on the Power Conservation Programme as a national strategy to reduce electricity demand and recommend action plans to be implemented.

The final part of the review was on PCP within the eThekwini Municipality. This section explained the steps taken with eThekwini Municipality in support of the National Power Conservation Programme. Though still in the early stages of PCP, literature on some of the steps already taken by the municipality to encourage PCP was explained.

Since the municipality lacked information on the response of consumers to the campaigns that had already been implemented towards PCP, the empirical research in the next chapter was intended to bridge this gap and provided the municipality with information that had enabled it to customise its PCP campaigns so that the campaigns are more demographic specific and targeted.

# CHAPTER 3: {tc "CHAPTER THREE"}RESEARCH METHODOLOGY

## 3.1 Introduction

The literature review explained the experiences of other countries with power conservation and then looked at the situation in South Africa and in particular the electricity savings campaigns implemented by eThekwini Municipality. The focus of the study was on the response of electricity consumers within eThekwini municipality to the call made by Eskom, the South African Government and eThekwini Municipality for electricity consumers to use electricity sparingly. eThekwini Municipality had widely advertised various methods for households to save electricity. Despite the massive communication campaigns, eThekwini Municipality had not reached the 10% savings target. The research was designed to confidentially determine the response of electricity consumers within eThekwini Municipality towards power conservation.

This chapter is a literature review of research methodology and the approaches to be taken in this study. The method used to conduct the quantitative analysis, the approach followed to administer the survey and the method used to analyse the data were stated.

The research problem, objective of study, focus of study, research design, data collection strategy and data analysis method are discussed in this chapter.

## 3.2 Objectives of the Study

White (2002) stated that prior to formulating the objectives the researcher should do a brief literature review on at least 10 articles on the subject, to firstly identify availability of literature and to secondly evaluate what has already been done (White 2002, 74). For this purpose a review of journals on the subject of power conservation was done. Since the subject is relatively new in South Africa, the

author had found adequate recent local articles on the topic that assisted in formulating the objectives of the study.

Struwig and Stead (2001) stated that 'the objective or aim delineates (describes) the scope of the research effort and specifies what information needs to be addressed by the research process (Struwig & Stead 2001, 35). In formulating the objectives of research, White (2000) stated that the one should attempt to give the work some originality by isolating how the research questions are different from what is already known to the researcher (White 2000, 73). Based on these statements, the objectives of this study were:

1. To test the understanding of consumers on the background of the electricity crisis in South Africa
2. To establish the appropriate medium for advertising and communicating messages to encourage electricity saving
3. To determine the response of consumers to electricity savings per demographic group based on age, income level and gender
4. To establish the reasons why consumers have responded to the savings call
5. To determine the electricity saving measures implemented per demographic group based on age, income level and gender
6. To establish consumers opinion on the strategy to be followed to achieve the desired savings
7. To establish if high income households consume more electricity than low income households
8. To determine if consumer behaviour had changed

## 3.3 Data collection Strategies

### 3.3.1 Sampling

Hart (2006) stated that 'sampling is a procedure for generalising about a population without researching every unit in the population' (Hart 2006, 338). White (2000) defined the total population as the sampling frame and the individuals within the

population as sampling units (White 2000, 59). The survey was undertaken with a cross section of electricity consumers within a selected cluster of eThekwini Municipality Central region. The geographic cluster covered for the survey was Pinetown, Umlazi, Cato Manor, Queensburgh, Chatsworth and Westville. This geographic area was chosen because it was representative of various age groups, income levels and both genders and permitted generalisations to be made about the population of eThekwini Municipality.

White (2000) stated that due to the limitation of resources it is impossible for the researcher to investigate every sampling unit (White 2000, 60). The estimate of the total number of formal households with electricity in this geographic area was 15 000 which formed the sampling frame. Even though a selected geographic area of eThekwini Municipality was used as the cluster due to the limitation of time, access and money, the study was generalised for eThekwini Municipality in totality.

White (2000) gives the following definitions of types of sampling techniques:

- Random (probability sampling in which every sampling unit has an equal chance of being selected, the sampling frame is accurately known and statistical analysis is to be undertaken
    - Simple random sampling - each sampling unit is given a number and numbers are selected at random to form the sample
    - Systematic random sampling – population is arrangement in some order e.g. alphabetically by name and every nth unit is selected to form part of sample
    - Stratified random sampling – population is split into layers e.g. age groups and a random sample is taken proportionally from each layer
- Non-random (non-probability) sampling us used when sampling frame is not accurately know and detailed statistical analysis in not required
    - Cluster sampling – sampling takes place within a random sample of clusters
    - Quota sampling – a number of interviews randomly interview a given quota

- Purposive sampling – researcher picks the sample that they think will deliver the best information to satisfy the objectives

(White 2000, 60)

Non-random (non-probability) sampling was used for the study since the sampling frame was not accurately known and detailed statistical analysis was not required. Due to time and financial constraints cluster sampling was used to reduce the sampling frame to a carefully selected subset. Hart (2006) stated that this subset must be carefully chosen so that it shares the properties or variables of the population (Hart 2006, 339). Choosing a representative sample was a necessary requirement in order to permit inferences being made on the entire population with confidence. A representative sample is 'a sample that reflects the population accurately so that it is a microcosm of the population (Bryman and Bell 2003, 182).

### 3.3.2 Sample size

White (2000) explained that sample size is a compromise between practical issues and theoretical considerations (White 2000, 64). Struwig and Stead (2001) recommend that a sample size between 150 and 200 can represent an acceptable reflection of the population, and that increasing sample size beyond 200 gives the researcher only modest gains (Struwig and Stead 2001, 119). Bryman and Bell (2003) recommended consulting the school guidelines on minimum expected sample size (Bryman and Bell 2003, 196). A sample size of less than 200 respondents is not recommended by the UKZN Graduate School of Business. Hart (2006) illustrated a table recommending sample size per population (Hart 2006, 344). From the table it was determined that for a population size of greater than 1000, a sample of 382 was required was required. A suitable sample size of 400 participants was chosen.

## 3.4 Research Design and Methods

Bryman and Bell (2003) defines research design as the framework created for the collection and analysis of the data (Bryman and Bell 2003, 40). White (2000) defined research design as 'the blueprint or detailed outline for the whole of your research and dissertation' (White 2000, 25).

Struwig and Stead (2001) stated that the most common research methods used for quantitative research are exploratory, descriptive, experimental and quasi-experimental (Struwig and Stead 2001, 7). The research method used for this study is descriptive research, in particular, statistical method. The technique used for collecting data was a self-completion questionnaire. Inferential statistics were used to formulate a generalisation of electricity consumer behaviour across eThekwini municipality from the sample used in the study.

### 3.4.1 Construction of the instrument (Questionnaire)

White (2000) stated that the researcher needs to first decide on the kind of analysis required before designing the questionnaire (White 2000, 50).

This study required quantitative research to satisfy the main objectives. The questionnaire (*Annexure 2*) used for the survey examined all the required variables simultaneously. According to Struwig and Stead (2001) there are two types of questionnaires, namely interviewer-administered questionnaire and self-administered questionnaires (Struwig and Stead 2001, 89). For this study a self-administered questionnaire was used as the quantitative test instrument. The questionnaire avoided questions that encroached on the individual's privacy. The questions were kept simple as the sample covered various LSM's and different literacy levels. This was a necessary requirement since the study had to cover electricity consumers across various demographic groupings.

### 3.4.2 Recruitment of study participants

For the study non-probability cluster sampling was used. The cluster was chosen so that that sample was representative of the following characteristics:

- Varied in income levels
- Had to be literate
- Have access to media i.e. television, radio and print media
- Covered both gender groups
- Varied in age

- Have a formal house within eThekwini Municipality Central Region
- Have access to electricity

The respondents with the above characteristics were recruited at various gatherings e.g. public meetings, lobby groups, business meetings, customer centres, schools and tertiary institutions.

### 3.4.3 Pretesting and validation

White (2000) stated that it is important that a pilot is conducted with a smaller number of volunteers so that any ambiguity can be tested and any problems with the analysis can be identified (White 2000, 51). Prior to the distribution of the questionnaire, it was tested with family and friends to test the time that it would take to answer the questions as well as to test any ambiguity. This pretesting was important to test the ease with which the questions were understood by non-technical persons. Bryman and Bell (2003) identified the following advantages of pre-testing:

- Gives the researcher a greater sense of confidence
- Verifies that questions provide a variety of responses for analysis
- Questions that are not understood become apparent
- Allows the researcher to determine the adequacy of the instructions
- Gives an indication on the order of the questions

(Bryman and Bell 2003, 274).

Since Struwig and Stead (2001) stated that in designing the questionnaire the researcher should avoid the use of ‘subject-related or technical jargon’ it was important for the purpose of this study to conduct the pilot to ensure that a suitable compromise between the technical topic and the varied education levels of the target population was achieved (Struwig and Stead 2001, 91). The pilot confirmed that the required analysis could be done and that the research questions could be satisfied.

White (2000) stated that validity is concerned with the design fully meeting the research questions and objectives (White 2000, 25). As part of the validity process the author verified that the results from the pilot survey could be quantitatively analysed, enabled generalisations to be made on the population, answered the research questions and addressed the objectives. Hart (2006) stated that validity is about building sufficient robustness into the research to enable generalisations to be made (Hart 2006, 334).

### 3.4.4 Administration of questionnaire

According to White (2000) questionnaires can be either self completion questionnaires or self-administered questionnaires in which the researchers fill in the responses after asking the questions (White 2000, 52). For this study the questionnaire that was designed was a self-completion questionnaire. Respondents were asked to complete the questionnaire themselves and deposit into a collection box. The questionnaire had to be completed in writing since it had to accommodate those who did not have access to electronic communication or the internet. This was a necessary requirement in order for the sample to be representative of people across various LSM and demographic groups.

A total of 400 questionnaires were distributed and 280 completed responses were collected. This gave a response rate of 74%. It had taken respondents an average of 3 minutes and 40 seconds to answer the questionnaire.

## 3.5 Data analysis methods

### 3.5.1 Data capturing methods

The questionnaires collected were checked for completeness and numbered uniquely. SPSS for Windows was chosen for data analysis. A set of coding instructions was formulated to covert the responses into numeric entries. SPSS was set-up with 19 variables, and information from the questionnaire was manually captured into SPSS for Windows.

### 3.5.2 Independent variables

The independent variables for the research relating to consumer response to electricity savings were:

- Age of respondents
- Gender of respondents
- Household income of respondents

The independent variables formed the categories of the data analysis.

### 3.5.3 Dependent variables

The dependent variables upon which the analysis was undertaken were:

- Understanding the reasons for PCP
- Opinion on responsibility for demand exceeding supply
- The impact of various communication channels used
- Awareness of eThekwini savings drive
- Amount of electricity saved by respondents
- Measures used by respondents to promote electricity savings
- Recommendations on savings ambassadors
- Opinion on Government / Eskom actions to encourage savings
- Personal electricity savings implemented
- Reason for implementing electricity savings
- Recommendation on measures to force behaviour change

The independent variables were analysed in relation to each of the dependent variables.

### 3.5.4 Analysis and presentation of data

The sample characteristics of the chosen sample frame favourably compared with the population of eThekwini as a whole. Pie-charts and Bar-graphs were used to graphically depict the quantitative data, and the relationship between the variables and the demographic factors. The analysed data from the sample was used to draw generalisations of electricity consumers across eThekwini municipality.

## 3.6 Summary

This chapter covered a literature review on research methodology. The statement of problem and objectives of study were discussed. The literature review was used to explain sampling, sample size, research design and the analysis of data. The literature was used to motivate and justify the use and application of these concepts for this study.

The strategy used for data collection was stated and the choice of respondents and number of respondents was justified. The method of data collection and administration of the questionnaire was stated in this chapter.

The chapter that follows covers the quantitative analysis of the survey. The analysis is categorised into certain demographic factors and an explanation on the analysis based on the demographic factors of gender, age and income level is given.

# CHAPTER 4: RESULTS

## 4.1 Introduction

This chapter covers the quantitative analysis of the survey responses. SPSS for windows was used to analyse the data collected from the survey. The outputs of SPSS for Windows are explained in this chapter. The analysis in this chapter is subdivided into three different categories. The first category covers the demographic profile of the respondents in terms of age, gender and income levels. The second category was an analysis of the non-demographic related responses. The third part is an explanation on the analysis based on the demographic factors of gender, age and income level.

## 4.2 Descriptive statistics of the Independent Variables

The geographic area covered as part of the survey was Pinetown, Umlazi, Cato Manor, Queensburgh, Chatsworth and Westville. This geographic area was chosen because it is the main urban centre of the eThekwini Municipality and was representative of various age groups, income levels and both genders. The estimated number of formal households with electricity in this geographic area was 15 000 households.

Since the objectives of the study were to analyse the understanding of consumers and the response of consumers to electricity savings in relations to certain demographic factors, the questionnaire was designed to elicit the following demographic details of the respondents: age, gender and income level. The author was of the opinion that different demographic groupings responded different to the call by Government, Eskom and eThekwini Municipality to save electricity. The author was also of the opinion that different demographic groupings preferred different strategies to encourage savings.

A total of 400 questionnaires were distributed and 280 responses were received. This gave a response rate of 74%. The average time taken to complete the survey was 3 minutes and 40 seconds.

### 4.2.1 Age of respondents

Figure 4.1 illustrates the age profile of the respondents of the survey. The data illustrates a fair spread of respondents across all selected age categories with the lowest being 10.4%, and which corresponds to the respondents younger than 25 years of age.

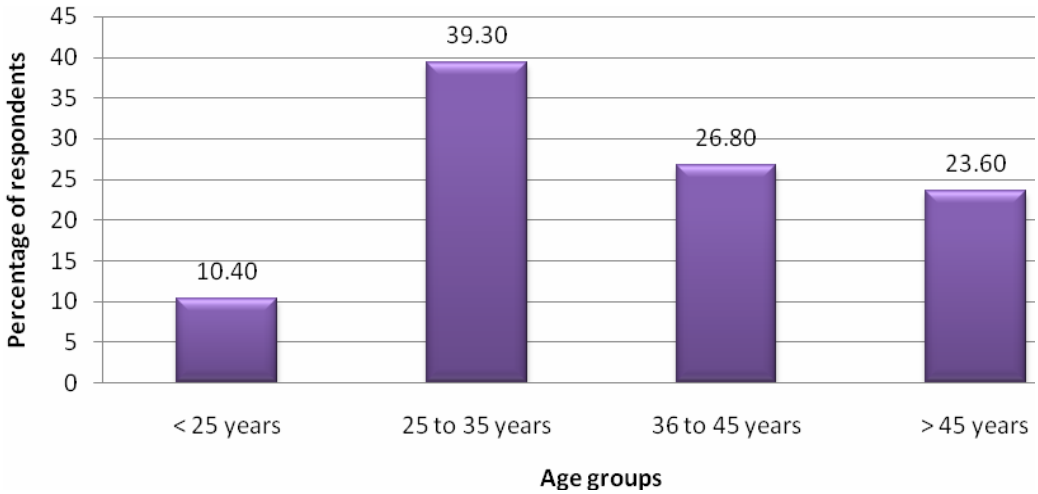


**Figure 4.1 Percentage of respondents per age group**

### 4.2.2 Gender of respondents

Figure 4.2 illustrates the gender profile of the respondents of the survey. The information gathered shows that the sample represented both genders with 61.8% males and 38.2% females.

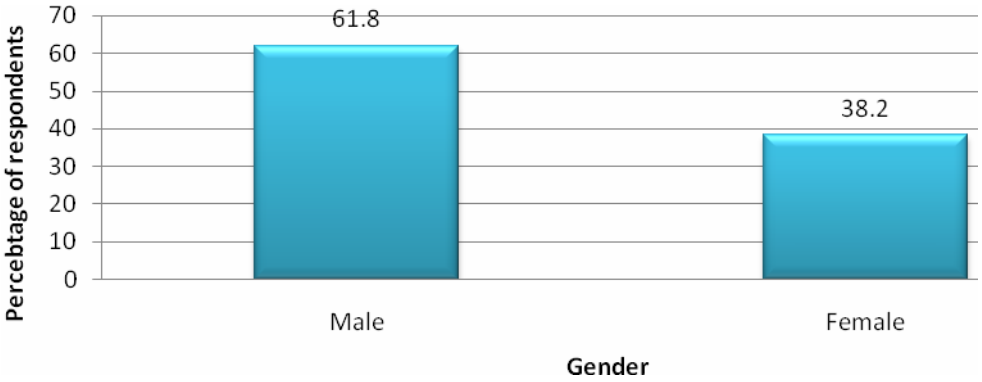


**Figure 4.2 Percentage of respondents per gender**

### 4.2.3 Income level of respondents

Figure 4.3 illustrates the household income profile of the respondents of the survey. The data shows a fair representation of respondents across all income levels with the lowest being 3.2% which corresponded to the respondents in the R40 000 – R49 999 income bracket.

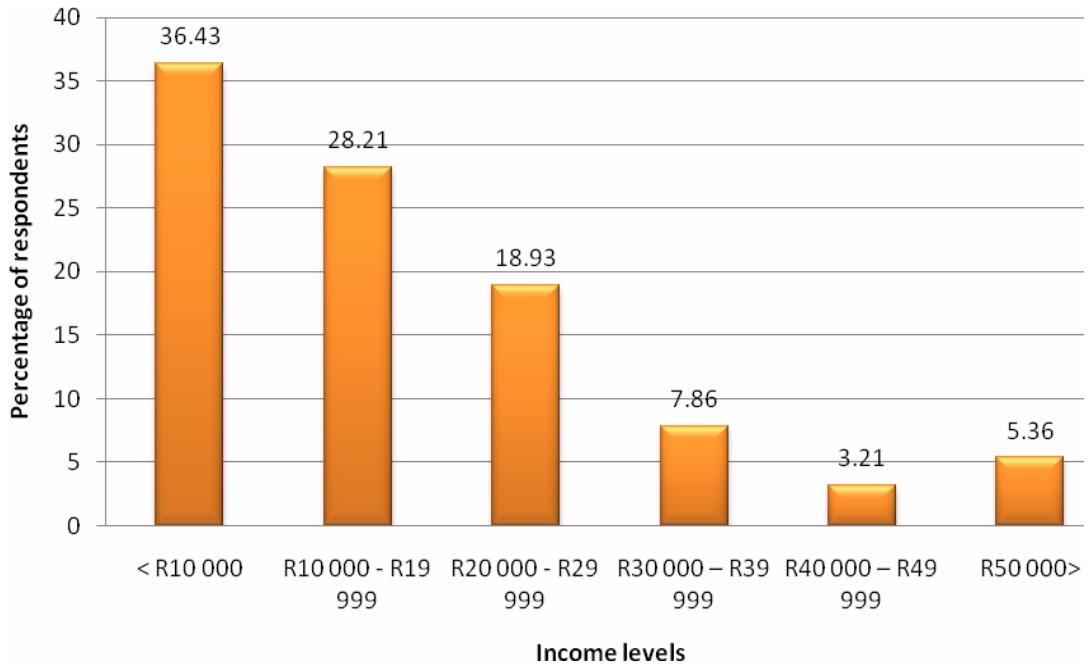


**Figure 4.3 Percentage of respondents per income group**

## 4.3 Overall combined descriptive statistics

The analysis in this section was done on the total number of respondents and was not analysed in terms of any demographic factors.

### 4.3.1 Understanding the reasons for PCP

Figure 4.4 represents the response to the question 'Why is eThekwini Energy Office requesting you to save electricity?'.

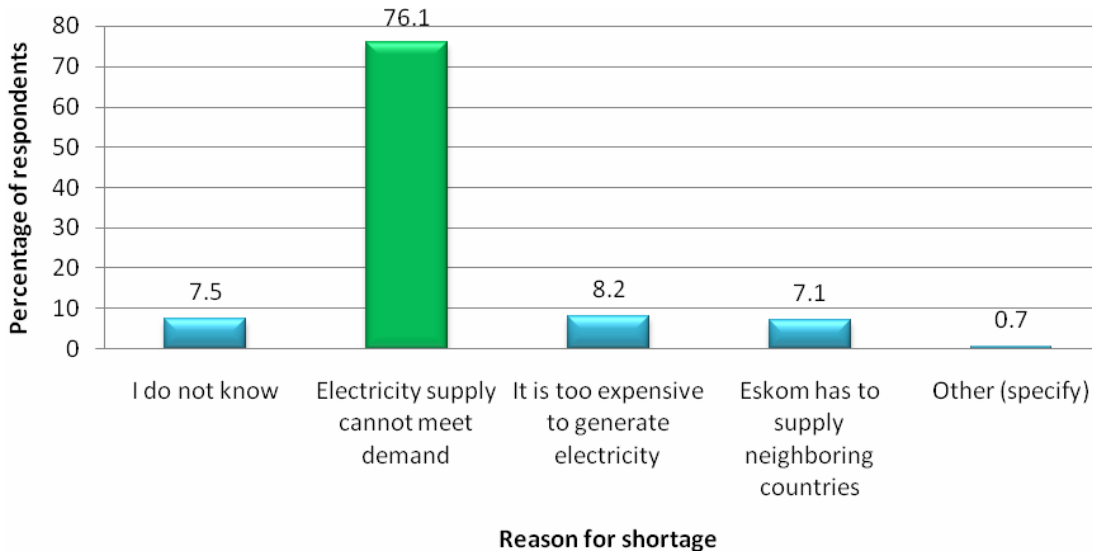


**Figure 4.4 Understanding of reasons for PCP**

When commenting on the reason why South Africa was experiencing an electricity shortage, 76.1% of the respondents chose the option that 'Electricity supply cannot meet demand' but 7.5% of the respondents were not aware of the reason for the shortage.

### 4.3.2 Responsibility for demand exceeding supply

Figure 4.5 represents the response to the question 'Rank in order from most (1) to least (4), who you think is responsible for the electricity shortfall'.

The analysis showed that the majority of the respondents were of the opinion that Eskom and Government were either most responsible or more responsible than the other entities.

The graph illustrates that the majority of the respondents were of the opinion that households were least responsible for the electricity shortage.

The graph illustrates that the majority of the respondents were of the opinion that industry were less responsible than the other entities.

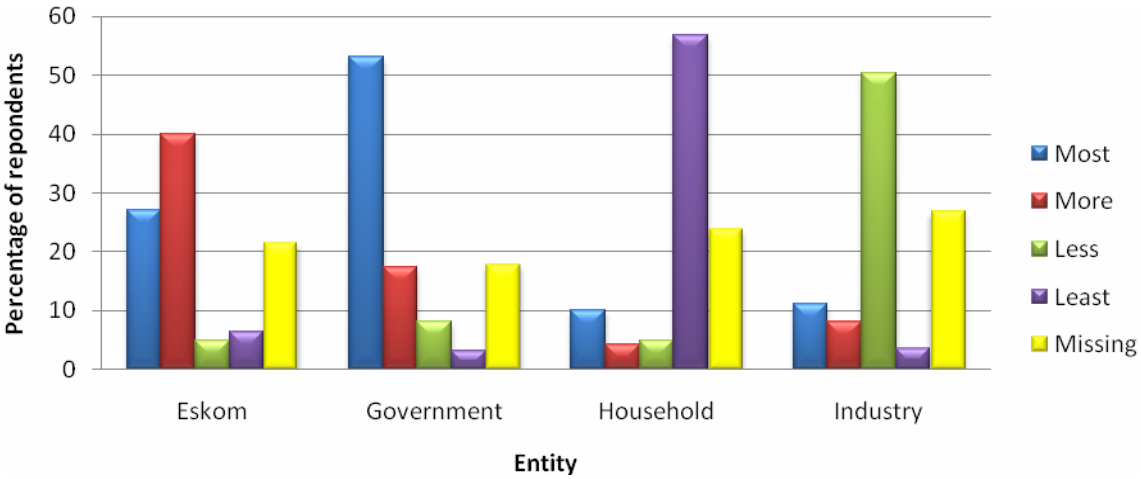


**Figure 4.5 Opinion on level of responsibility per entity**

### 4.3.3 Impact of various communication channels used

Figure 4.6 is the graphical representation of the response to the question 'How did you become aware of the need to save electricity?'.

The analysis showed that 68.9% of respondents learnt about the need to save electricity via television. Print media was the next source of information (16.8%). The results revealed that only 0.4% of respondents had received no communication about the need to save electricity.

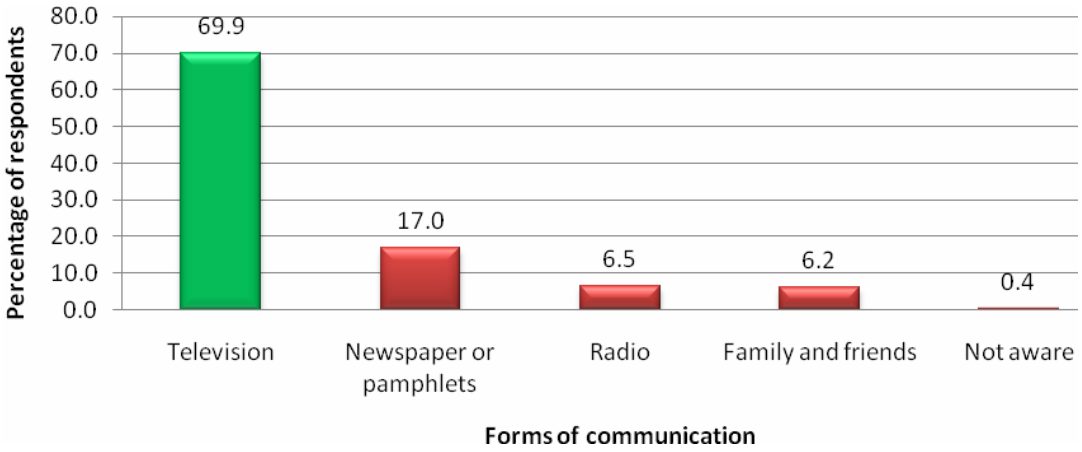


**Figure 4.6 Respondents source of information**

### 4.3.4 Awareness of eThekwini savings drive

Figure 4.7 is the graphical representation of the response to the question 'What is eThekwini Municipality doing to encourage electricity savings?'.

A high percentage (60.4%) of respondents indicated that they were aware of the electricity saving campaigns that were promoted by eThekwini Municipality. Responses on the types of electricity savings implemented by the municipality, indicated that 18.2% of the respondents were aware of the lighting efficiency drive within the municipality buildings, but 12.9% of the respondents indicated that eThekwini Municipality was doing nothing to promote electricity savings.

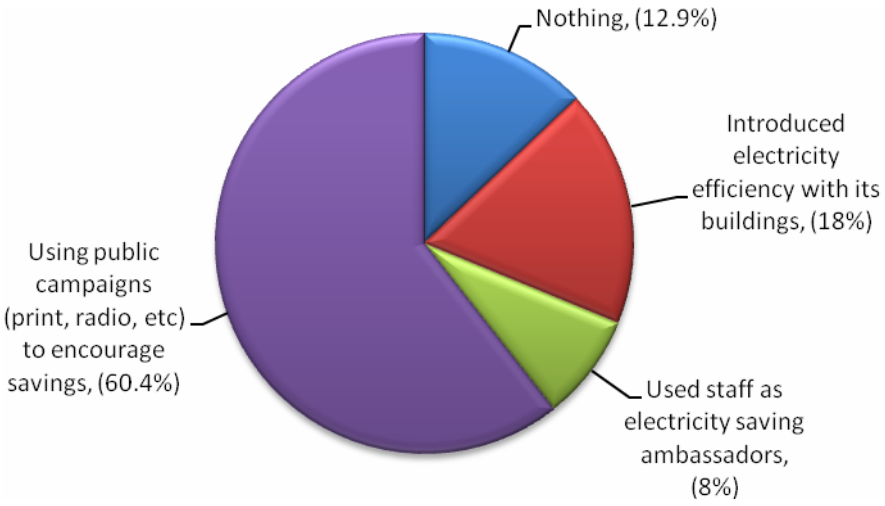

**Figure 4.7 Savings measures implemented by eThekwini**

### 4.3.5 Amount of electricity saved by respondents

Table 4.1 is the frequency table and graphical representation of the response to the question 'How much electricity do you think you saved since load shedding started?'.

In response to the above question, 36.1% of respondents indicated that they had saved the maximum they could save and 34.3% of respondents indicated that they have saved and were still trying to save more. However, 5.7% of respondents achieved no savings in electricity.

| Electricity saved | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Nothing | 16 | 5.7 | 5.7 | 5.7 |
| Very little | 67 | 23.9 | 23.9 | 29.6 |
| Maximum that I can save | 101 | 36.1 | 36.1 | 65.7 |
| Maximum that I can save and still trying to save more | 96 | 34.3 | 34.3 | 100.0 |
| Total | 280 | 100.0 | 100.0 | |

**Table 4.1 Personal savings achieved**

### 4.3.6 Measures used by respondents to promote electricity savings

Figure 4.8 is the graphical representation of the response to the question 'What have you done to encourage others to save electricity?'.

On the question of the promotion of electricity savings, 60.7% of respondents spoke to others about saving electricity but 18.9% have not communicated to others about the need to save electricity.

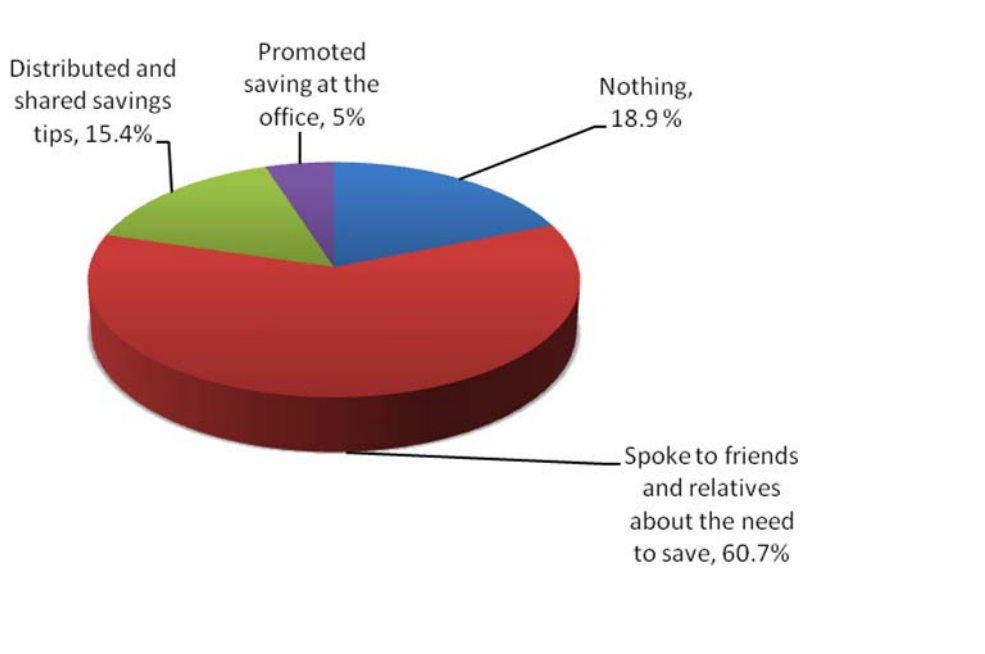


**Figure 4.8 Respondents personal actions to encourage savings**

### 4.3.7 Recommendations on savings ambassadors

Table 4.2 is the frequency on the response to the question 'Who do you think should be driving and promoting electricity usage savings?'.

The vast majority at 61.8% were of the opinion that Government should be the one to promote electricity savings. This was followed by 17.9% who were of the opinion that eThekwini Municipality should promote savings.

| Who should promote | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| | Government | 173 | 61.8 | 62.0 | 62.0 |
| | eThekwini Municipality | 50 | 17.9 | 17.9 | 79.9 |
| | Religious/Community leaders | 10 | 3.6 | 3.6 | 83.5 |
| | Councilors | 5 | 1.8 | 1.8 | 85.3 |
| | Eskom | 38 | 13.6 | 13.6 | 98.9 |
| | Lobby groups | 3 | 1.1 | 1.1 | 100.0 |
| | Total | 279 | 99.6 | 100.0 | |
| | System | 1 | .4 | | |
| Total | | 280 | 100.0 | | |

**Table 4.2 Opinion on who should promote savings**

## 4.4 Descriptive statics in relation to Age

### 4.4.1 Government / Eskom actions to encourage savings

Figure 4.9 is the graphical representation on the response to the question 'What do you think Government and Eskom should be doing to encourage electricity savings?'.

A high percentage in all age categories were of the opinion that Government should firstly accept responsibility for the problem. However, it was the respondents over 45 years that felt most strongly about this, with 53% choosing this option.

All age categories were of the opinion that all electricity savings initiatives should be subsidized. A high percentage (39%) of the respondents younger than 25 years chose this as an option.

The imposing of penalties was the least favorable response across all ages.

The respondents over 45 years of age were of the opinion that the introduction of legislation was not the solution.

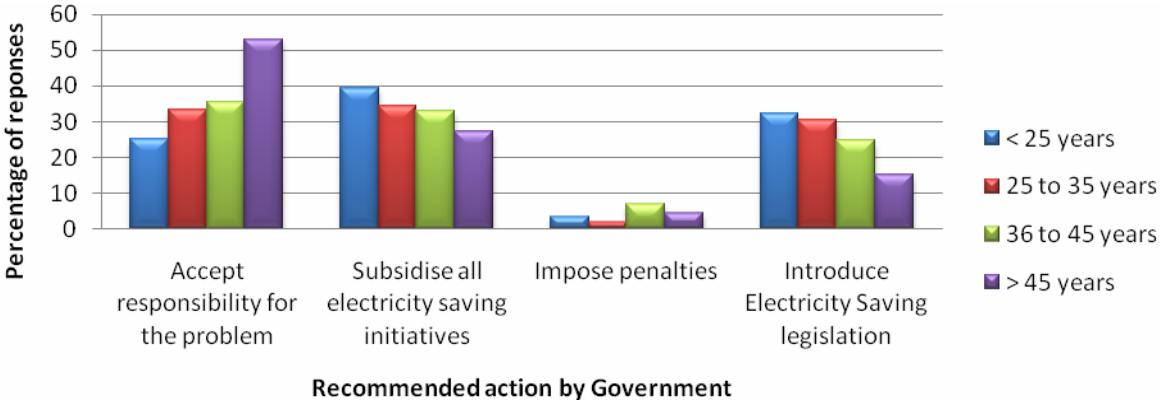


**Figure 4.9 Recommended action by Government/Eskom per age group**

### 4.4.2 Personal electricity savings implemented

Figure 4.10 is the graphical representation in response to the question 'What have you done to save electricity?'.

10% of respondents younger than 25 years have done nothing to save electricity.

The switching off of unused lights and the use of CFLs was the most common electricity saving measure implemented.

The reduction of space heating/cooling and showering instead of bathing had been the least implemented measure with all age groups.

Switching-off of unused appliances among respondents <25 years and those >45 years age groups was low relative to the other groups.

In general all age groups have implemented one or more electricity savings measures. The overall trend showed that there is an increasing trend in electricity savings with the higher age groups.

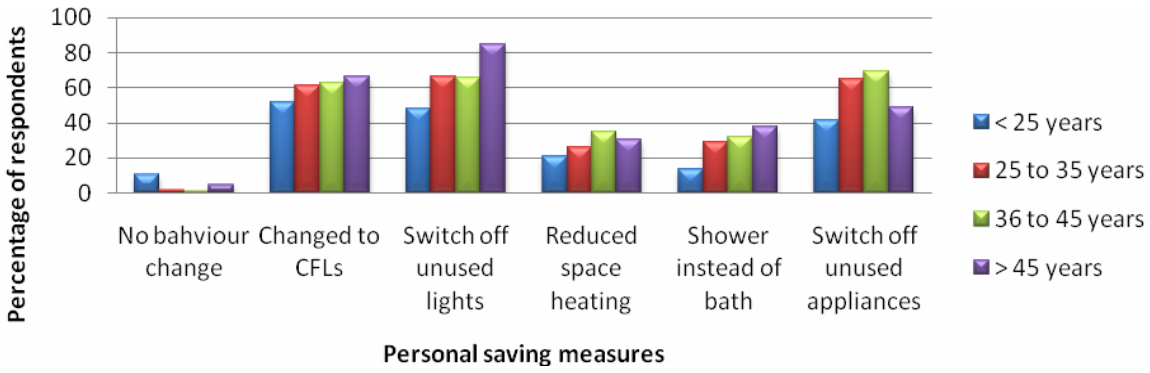


**Figure 4.10 Personal savings implemented per age group**

### 4.4.3 Benefits of implementing electricity savings

Table 4.3 is the frequency table of the response to the question 'Why have you started to save electricity?'.

| | Percentage of respondents | | | |
|---|---|---|---|---|
| | **< 25 years** | **25 to 35 years** | **36 to 45 years** | **> 45 years** |
| To save on the electricity bill | 31 | 39 | 47 | 42 |
| To reduce negative effect on environment | 15 | 6 | 12 | 18 |
| To avoid load shedding | 50 | 45 | 25 | 32 |
| To support Government and the municipality | 4 | 9 | 16 | 8 |

**Table 4.3 Personal reasons for saving electricity per age group**

The need to avoid load shedding was higher (50% of those younger than 25 years of age) with younger respondents than older respondents (32% of those older than 45 years).

Responsibility towards the environment and Government was a low priority reason for electricity savings.

The need to save on the electricity bill was higher (47% of respondents between 36 and 45 years) with older respondents than younger respondents (31% of respondents younger than 25 years).

### 4.4.4 Measures to force behaviour change

Table 4.4 is the frequency table of the response to the question 'What do you think will reduce electricity demand?'.

The introduction of rewards and savings was the favoured response from all age groups, with the older respondents feeling more strongly about this.

The introduction of penalties and fines was the next most frequent response, with the respondents younger than 25 years of age choosing this option as frequently as the introduction of rewards and savings.

The introduction of new tariffs and quotas was the least favoured response.

| | Percentage of respondents | | | |
|---|---|---|---|---|
| | **< 25 years** | **25 to 35 years** | **36 to 45 years** | **> 45 years** |
| Nothing | 14 | 10 | 9 | 2 |
| Penalties and fines for wastage | 41 | 19 | 20 | 14 |
| Rewards for savings | 41 | 61 | 62 | 79 |
| Introducing quotas | 0 | 7 | 3 | 5 |
| New tariffs and with increased costs | 3 | 3 | 5 | 2 |

**Table 4.4 Recommended actions to force savings per age group**

## 4.5 Gender of sample

### 4.5.1 Government / Eskom actions to encourage savings

Table 4.5 is the frequency table of the response to the question 'What do you think Government and Eskom should be doing to encourage electricity savings?'.

More (42%) male respondents recommended that Government should accept responsibility followed by Government subsidizing all electricity saving Initiatives.

In relation to males more females recommended that there should be an introduction of penalties and Electricity Saving Legislation.

On the whole the majority of respondents were of the opinion that the introduction of penalties would not encourage electricity savings.

| | Percentage of Respondents | |
|---|---|---|
| **Action from Government and Eskom** | **Male** | **Female** |
| Accept responsibility for the problem | 42 | 32 |
| Subsidize all electricity saving initiatives | 37 | 25 |
| Impose penalties | 2 | 7 |
| Introduce Electricity Saving legislation | 19 | 37 |

**Table 4.5 Recommended actions by Government/Eskom per gender**

### 4.5.2 Personal electricity savings implemented

Table 4.6 is the frequency table of the response to the question 'What have you done to save electricity?'.

The analysis revealed that there was a marginal difference between the male and female respondents when it came to personal electricity saving measures implemented.

A very small percentage had done nothing towards saving electricity.

Lighting and appliance efficiency had been the most favoured means of saving electricity. Majority of respondents indicated that they had changed to CFLs and switch off unused lights and appliances.

Only 28% or respondents had reduced the electricity usage for space heating/cooling.

Only 30% of respondents had reduced electricity usage by showering instead of bathing.

| | Percentage of Respondents | | | | | |
|---|---|---|---|---|---|---|
| | **No behavior change** | **Changed to CFLs** | **Switch off unused lights** | **Reduced space heating** | **Shower instead of bath** | **Switch off unused appliances** |
| Male | 4 | 62 | 68 | 29 | 30 | 58 |
| Female | 2 | 62 | 70 | 28 | 31 | 63 |

**Table 4.6 Personal electricity savings implemented per gender**

### 4.5.3 Benefits of implementing electricity savings

Figure 4.11 is the graphical representation of the response to the question 'Why have you started to save electricity?'.

Figure 4.11 shows that the reason why respondents had responded to the national call to save electricity did not vary significantly between males and females.

The majority (42% male and 40% female) of respondents of both genders had implemented electricity savings measures to save on the electricity bill and to avoid load shedding.

The reduction of the negative impact that the building of new power stations would have had on the environment and the support for Government were not the reasons chosen by many of the respondents for saving electricity.

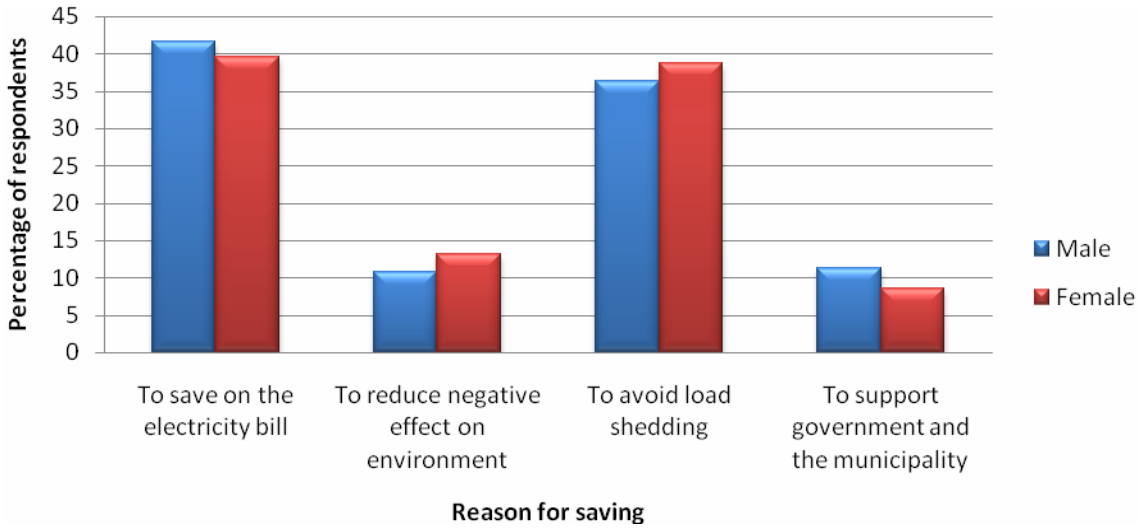


**Figure 4.11 Reasons for saving electricity per gender**

### 4.5.4 Measures to force behaviour change

Figure 4.12 is graphical representation of the response to the question 'What do you think will reduce electricity demand?'.

Figure 4.12 shows that the response to the question was only marginally different between males and females.

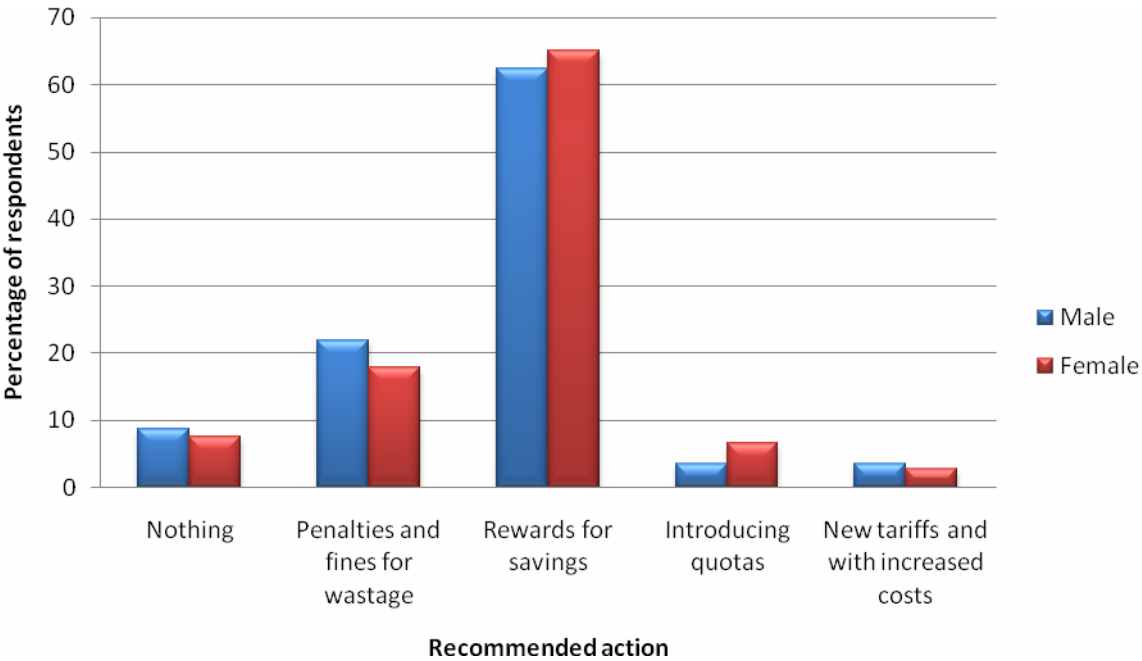

**Figure 4.12 Opinion on measures that will change behaviour per age group**

The preferred measure that would change consumer behaviour in support of electricity saving was the introduction of rewards for savings.

The introduction of punitive measure like penalties, quotas, fines and higher tariffs was not a preferred option among both genders.

## 4.6 Descriptive statistics in relation to Household Income

### 4.6.1 Government / Eskom actions to encourage savings

Figure 4.13 is the graphical representation of the response to the question ‘What do you think Government and Eskom should be doing to encourage electricity savings?’.

The most favoured responses were for Government to accept responsibility, subsidize all electricity saving measures and introduce legislation to support savings.

The high and very low income group supported the options that Government subsidize all electricity saving measures and introduce legislation to support savings.

The middle income group favoured the acceptance by Government for the problem.

The introduction of penalties was not favoured by all groups.

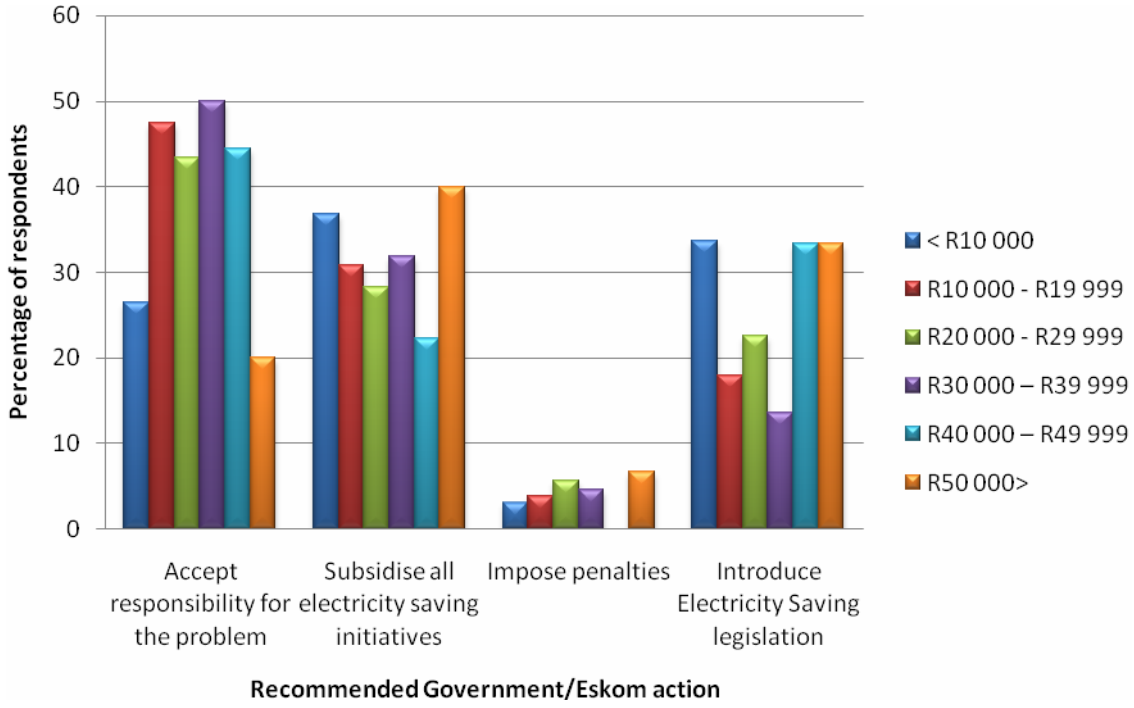


**Figure 4.13 Recommended actions from Government/Eskom per income group**

### 4.6.2 Personal electricity savings implemented

Table 4.7 is the frequency table of the response to the question 'What have you done to save electricity?'.

The favoured responses for all income groups were the changing to CFL, switching off of unused appliances and switching off of unused lights.

A very small percentage showed no behaviour change.

Reduction of electricity used for space heating/cooling and saving electricity by showering instead of bathing was low in all income groups.

In general as the income level increased so did the frequency of electricity savings.

| | Percentage of respondents | | | | | |
|---|---|---|---|---|---|---|
| | **No behavior change** | **Changed to CFLs** | **Switch off unused lights** | **Reduced space heating** | **Shower instead of bath** | **Switch off unused appliances** |
| < R10 000 | 2 | 51 | 53 | 23 | 16 | 54 |
| R10 000 - R19 999 | 6 | 62 | 76 | 33 | 34 | 52 |

| | | | | | | |
|---|---|---|---|---|---|---|
| R20 000 - R29 999 | 2 | 68 | 79 | 30 | 28 | 72 |
| R30 000 – R39 999 | 0 | 82 | 73 | 36 | 55 | 68 |
| R40 000 – R49 999 | 0 | 89 | 89 | 33 | 44 | 78 |
| R50 000> | 7 | 67 | 80 | 33 | 73 | 73 |

**Table 4.7 Personal electricity savings implemented per income group**

### 4.6.3 Benefits of implementing electricity savings

Table 4.8 is the frequency table of the response to the question 'Why have you started to save electricity?'.

Saving of the electricity bill was the most favoured response for all income groups.

Avoiding load shedding was also favoured by all income groups but the frequency of response decreased as income level increased.

The response for the option pertaining to reduction of the negative impact on the environment as a result of the building new power stations increased in frequency as income level increased.

Saving electricity in support of Government was not a common response for all income groups.

| | Percentage of respondents per income groups | | | | | |
|---|---|---|---|---|---|---|
| | < R10 000 | R10 000 - R19 999 | R20 000 - R29 999 | R30 000 – R39 999 | R40 000 – R49 999 | R50 000> |
| To save on the electricity bill | 42 | 39 | 43 | 45 | 22 | 33 |
| To reduce negative effect on environment | 9 | 7 | 13 | 18 | 33 | 27 |
| To avoid load shedding | 36 | 45 | 34 | 32 | 33 | 27 |
| To support Government and the municipality | 12 | 9 | 9 | 5 | 11 | 13 |

**Table 4.8 Personal reasons for saving electricity per income group**

### 4.6.4 Measures to force behaviour change

Table 4.9 is the frequency table of the response to the question 'What do you think will reduce electricity demand?'.

Incentive in the form of rewards for savings was the most favoured response with all income groups, but decreased in frequency with the increase in income level.

Penalties and fines for wastage were only favoured by the higher income groups.

All other measures were very low in terms of frequency and with little variance between income groups.

| | Percentage of respondents per Household Income level | | | | | |
|---|---|---|---|---|---|---|
| | **< R10 000** | **R10 000 - R19 999** | **R20 000 - R29 999** | **R30 000 – R39 999** | **R40 000 – R49 999** | **R50 000>** |
| Nothing | 5 | 9 | 11 | 14 | 0 | 13 |
| Penalties and fines for wastage | 21 | 19 | 17 | 14 | 56 | 27 |
| Rewards for savings | 64 | 68 | 66 | 64 | 44 | 40 |
| Introducing quotas | 8 | 1 | 2 | 9 | 0 | 7 |
| New tariffs and with increased costs | 3 | 3 | 4 | 0 | 0 | 13 |

**Table 4.9 Recommended actions to force savings per income group**

### 4.6.5 Amount of electricity consumption

Table 4.10 is the frequency of the response to the question 'What is your total household income per month?'.

The graph displays a spread of all income groups for each of the electricity bill categories. It also showed that the very low income earners are most dominant in the low electricity bill categories. However there have been some low to medium income earners that have had very high electricity bills.

| | Percentage of respondents per Household Income level | | | | | |
|---|---|---|---|---|---|---|
| | **< R10 000** | **R10 000 - R19 999** | **R20 000 - R29 999** | **R30 000 – R39 999** | **R40 000 – R49 999** | **R50 000>** |
| <R100 | 18 | 1 | 0 | 0 | 0 | 0 |
| R100 - R199 | 30 | 9 | 6 | 0 | 11 | 0 |
| R200 - R299 | 20 | 20 | 19 | 14 | 11 | 20 |

| | | | | | | |
|---|---|---|---|---|---|---|
| R300 - R399 | 12 | 24 | 38 | 23 | 11 | 20 |
| R400 - R499 | 8 | 13 | 10 | 14 | 0 | 20 |
| R500> | 13 | 33 | 27 | 50 | 67 | 40 |

**Table 4.10 Monthly electricity bill per income group**

## 4.7 Summary

The characteristics of the participants of the survey were explained in relation to the demographic factors like age, gender and income level. Frequency tables and graphs generated as outputs from SPSS for Windows were used to illustrate the characteristics of the sample. Non-demographic related analysis was done on the responses to some of the questions from the survey. The outputs from SPSS were explained and illustrated in the form of tables and graphs.

The explanations and outputs from this chapter are discussed in detail in the chapter that follows. The discussion in the next chapter was used to test the hypothesis upon which this study was based. The relationships between the demographic factors and the response to PCP were ascertained in the following chapter.

# CHAPTER 5: DISCUSSION

## 5.1 Introduction

This chapter discusses the findings obtained from the results. The salient findings are firstly stated before they are discussed in detail in relation to the established objectives. The literature review in Chapter 2 was used to draw any relevant correlations between previous international and local literature and the findings of this study.

## 5.2 Summary of findings

Certain salient findings have been determined from the results explained in Chapter 4. The following have been discussed under the relevant objectives in Section 5.3:

- The correct reason for the Power Conservation Program was stated by 76.1% of respondents and the shortage but 7.5% were not aware of the reason for the shortage.
- Knowledge on electricity savings was attained by 68.9% of the respondents from television, 17% from print media and only 6.5% from radio.
- Regarding the awareness of the eThekwini Municipality electricity saving campaigns, 60.4% of respondents were aware of the campaigns but 13% indicated that the municipality was doing nothing.
- A high (60.7%) percentage of respondents had spoken to others about saving electricity.
- The majority (67%) of respondents indicated that Eskom and Government were most responsible for the shortage, and that households and industry were least responsible

- On the question about who should drive the savings campaign, 61.8% of the respondents were of the opinion that Government should drive the campaign and 17.9% felt that the municipality should drive the campaign

- All age groups felt strongly that Government should acknowledge responsibility the electricity crisis. Older respondents felt most strongly about this. Males indicated a preference for Government acknowledgement of the responsibility.

- Regarding the quantity of electricity saved, 36.1% indicated that they were saving the maximum amount of electricity they could save and 34.3% were still trying to save more. However 5.7% of respondents had achieved no savings and 10% of respondents younger than 25 years made no electricity savings.

- All age groups were of the opinion that electricity saving should be subsidised, but a higher percentage (39%) of younger respondents chose this option. The very high and very low income earners also were of the opinion that measures should be subsidised.

- Older respondents were against the enforcement of legislation to force behaviour change. Females preferred the introduction of legislation. The very high and very low income earners also felt strongly that legislation should be introduced.

- Lighting and appliance efficiency was the most common saving measure by all age groups, both genders and all income groups. Greater amount of savings were achieved with increasing age and income level. Switching-off of unused appliances among respondents <25 years and those >45 years age groups was low relative to the other groups. Very little electricity was being saved from space heating/cooling and showering by all ages, both genders and all income groups.

- The need to avoid load shedding was higher with younger respondents and with respondents in the lower income levels.

- The need to save on the electricity bill was high among all income groups, but higher with older respondents. However there was no significant difference between males and females.

- Concern about the environment was not a preferred reason for saving electricity, though concern for the environment was relatively higher with higher income levels.
- Support for Government was not a reason for savings across all age groups, both genders and all income levels.
- All age groups and both genders favoured the introduction of rewards for savings to change behaviour, but the frequency decreased with higher income groups.
- The introduction of punitive measures like quotas, penalties and fines was least favoured in terms of encouraging savings by most age groups and both genders. Higher income groups indicated a preference for fines and penalties. Respondents younger than 25 years of age indicated a preference for fines and penalties.
- A fair percentage of low income earners have high electricity bills.

## 5.3 Discussions of objectives

### 5.3.1 Objective 1: To establish consumers understanding of the electricity crisis in South Africa

The first objective of the study was to determine if the population of eThekwini Municipality understood the reason for the Power Conservation Program and why people were being asked to save electricity. When load shedding started in January 2008 there was a great deal of media coverage on load shedding and blame apportionment, but the question arose whether sufficient resources were allocated to conveying the reasons for the shortage rather than who was to blame. This objective was explored on the overall sample and not in relation to any demographics.

The majority of respondents stated the correct reason why South African consumers were requested to save electricity which is that demand for electricity had exceeded generation supply capacity. These respondents understood the reason why there was an electricity shortage in South Africa. The reason for the electricity crisis was

stated by NERSA as 'South Africa's current energy situation is underpinned by higher than anticipated growth in electricity demand' (NERSA 2008, 3). However, there was a small percentage of 7.5% that did not know the reason there was a shortage of electricity. This indicated an opportunity to further increase awareness on the problem and to consequently improve electricity savings further.

The majority of respondents indicated that Eskom and Government were most responsible for the electricity shortage, and that households and the industrial sector were least responsible for the shortage. This common understanding of the responsibility corresponds with the statement by Adams (2003) that the South African Government policy of the day was to rid Eskom of the monopoly by encouraging private sector participation in the electricity market (Adams 2009). The responsibility of Government for the situation is further highlighted by Creamer (2008) who stated that the diminishing reserve margin 'was not just poor planning by Eskom, but also a massive policy failure' (Creamer 2008, 9). However this objective did not test the reason why the respondents were of this opinion and did not test their understanding of the economics relating to the earlier policy of Government.

### 5.3.2 Objective 2: Determining the appropriate medium for communicating messages about electricity saving

This objective was investigated because it had a direct bearing on the strategy that needed to be implemented to encourage savings. The best strategy communicated via the wrong medium would not reach the target population. From the literature review it was shown that Eskom used national television to encourage savings and that eThekwini Municipality used extensive print media to drive the savings campaigns. When commenting on the promotion of energy efficiency, Finamore et al (2003) referred to the use of funds derived from the sale of electricity for the promotion of 'energy efficiency through targeted educational and incentive programs' (Finamore et al 2003, iv). This meant that if campaigns were demographic-specific then the correct strategy and medium must be used.

Majority of respondents learnt about the electricity shortage and the need to save electricity from television. There was a small percentage that learnt about the situation from the print media and a very small percentage learnt about the situation

from the radio. This is an indication that the television was the best medium for communication and had better coverage. The use of the dials indicated in Table 2.3 by Eskom to make consumers aware of the real time electricity shortage had been an effective means of communicating with electricity consumers.

A high percentage of respondents were aware of the electricity campaigns that were driven by eThekwini Municipality. eThekwini Municipality had used extensive print media communication to inform electricity users about the electricity shortage and the types of savings that consumers could implement. The response from the sample indicated the effectiveness of eThekwini Municipality's electricity savings campaigns. Only 18% were aware of the lighting efficiency drive within the municipality and 13% indicated that they were not aware of any savings campaigns by eThekwini Municipality.

A high percentage of respondents had spread the savings message by word of mouth. The need for effective and appropriate communication is a critical consideration in the formulation of a PCP strategy because according to DME (2008) 'The risk of load shedding will remain high until at least 2013 if we do not take immediate actions to ameliorate the situation' (Department of Minerals and Energy 2008, 1).

### 5.3.3 Objective 3: To determine the response of consumers towards electricity savings

This purpose of this objective was to determine if consumers had responded to the savings campaigns that had been communicated prior to the study. According to the South African Government (2008), power conservation was known to be a quick win and 'recommends the energy rationing applied in Brazil in 2001 as the best practice in the event of an energy crisis' (DME 2008, 11). The Brazilian savings campaign was a multi-pronged approach to get consumers to respond. This objective was analysed in terms of the various demographic factors so that targeted campaigns could be implemented following the study.

A high percentage of respondents indicated that they had implemented one or more electricity saving measures. Some of the respondents indicated that they had

exhausted all the saving measures they could implement and others were still pursuing further savings measures, but a small percentage (5.7%) made no attempt at saving electricity. Maurer (2005) stated that in Japan only a small percentage of 1.5% were not involved in active conservation (Maurer et al 2005, 60).

In terms of the age demographics, 10% of respondents younger than 25 years had saved no electricity. There had been a trend that older respondents saved more electricity than younger respondents. There was a common trend with more electricity being saved by higher income groups. The understanding of the consumer response to electricity saving in relation to demographics was important because if one looked at the situation that occurred in China, it showed that the response to electricity savings varied in relation to demographics (Maurer et al 2005, 26).

### 5.3.4 Objective 4: To establish the reasons why consumers responded to the savings call

In order for any future savings campaigns to yield the desired results, it is necessary to determine the reasons why the consumers responded to the savings drive in the manner that they did. This objective would enable any future campaign to be implemented in a manner that continued to encourage those that were already saving, and at the same time encourage those that had not started to save electricity.

The need to avoid load shedding was higher with younger respondents and with lower income levels. In Japan the study by Maurer et al (2005) revealed that 80% of electricity users implemented savings to prevent blackouts (Maurer et al 2005, 60). The experience of Brazil indicated that despite the inconvenience that load shedding caused to consumers ‘the total economic cost of electricity supply interruptions are significantly in excess of the direct willingness of consumers to be curtailed’ (Von Der Fehr and Wolak 2003, 12). From the results it was be concluded that the reason why the higher income groups did not express a significant need to avoid load shedding, was that they saw load shedding as an acceptable alternative to the negative economic impact on the country.

The need to save on the electricity bill was high among all income groups, but higher with older respondents. However there was no significant difference between males and females. In general the survey response did indicate that the electricity bill was an important consideration for the users. Maroga (2008) stated that the low price was actually a disincentive for consumers to conserve power and that there were inadequate price signals (Yelland 2008, 11). Von Der Fehr and Wolak (2003) stated that one way of reducing demand was that 'price must be increased to choke off demand' (Von Der Fehr and Wolak 2003, 19). According to Maurer et al (2003) the low-income earners in Brazil brought the biggest saving in electricity consumption and the subsequent analysis in Brazil concluded that the financial incentive was a greater motivator to the low-income earners (Maurer et al 2005, 64). Further Stratham (2008) commented on the impact that a price hike would have on low income earners due to the ratio of their electricity bill relative to their income. He stated that a price hike would have no effect on high income earners but would cripple the large poor population (Stratham 2008, 12).

Concern about the environment was not a reason for savings, though concern for the environment was relatively higher with higher income levels. Part of the multi-pronged strategy in Brazil was the active campaigning by environmental groups to encourage consumers to reduce electricity usage so that further coal fired power stations did not have to be built (Maurer 2005).

Support for Government was not a reason for savings across all age groups, both genders and all income levels. However Government does have a crucial role to play in development of policy as stated by Finamore et al (2003), that the policy department of the State Council in China developed the Demand Side Management policies and roles of various stakeholders, Government agencies and power grid companies (Finamore et al 2003, 24).

### 5.3.5 Objective 5: To determine the preferred electricity savings measures

eThekwini Municipality had promoted electricity savings by advising consumers on the different ways that savings could be achieved and the benefits of the different ways. The focus of this objective was to establish if certain savings measure were more desirable to certain demographic groups. This information would enable

eThekwini Municipality to customise the campaigns per demographic group so that greater success would be possible. Maurer (2005) stated that the experiences of the countries that had already experienced power shortages revealed that some customers were cognisant of the problems and how to save electricity, whereas others were less tolerant and unwilling to engage in power conservation efforts (Maurer et al 2005).

Lighting and appliance efficiency was the most common savings measure implemented by all ages, both gender and all income groups. Lighting efficiency is an area of electricity savings that can yield a significant portion of the desired savings. China had placed emphasis on lighting because according to Finamore et al (2003) more than 10% of China's total energy consumption was used for lighting, and 90% of residential lighting was from inefficient incandescent lamps (Finamore et al 2003, 51). The survey by Maurer et al (2005) revealed that in Japan the consumers responded very favourably to the power conservation with 94% having reduced lighting (Maurer et al 2005).

The saving of electricity by switching off of unused appliances is seldom practiced by the respondents younger than 25 years and the respondents older than 45 years.

Very few respondents were saving electricity by reducing the use of space heating and cooling. When commenting on this savings measure Rycroft (2008) stated that 'it is estimated that in excess of 50% of a total buildings load is used for air-conditioning in many cases' (Rycroft 2008, 3).

The reduction of electricity usage by showering instead of bathing was low for all income groups. Information supplied by eThekwini Municipality showed that each person that showers instead of bathing could save +/-R162 per year is that shower once a day. The reason why electricity is saved by showering instead of bathing is that a person uses 40% less water to shower than to bath and this means that less water has to be reheated in the geyser. A person could save a further +/-R110 per annum by fitting a low-flow/aerated shower head that uses 40% less water than a conventional shower head.

### 5.3.6 Objective 6: To establish consumers' opinion on the strategy to be followed to achieve electricity savings

Deciding on the strategy to follow had to be based on factors that consumers could relate to. The purpose of this objective was to determine from the respondents the factors that were most relevant to them so that a suitable strategy could be formulated and implemented. According to Maurer (2005), the response of the consumers largely depended on how the situation in the country was approached, who drove the power conservation initiative, what policy framework was used and the involvement of Government (Maurer et al 2005). The focus of this objective was to determine if there was a correlation between consumer expectation and the statement issued by DME (2008) on the short, medium and long term plans that Government would take to address the power shortage situation (DME 2008, 11).

A high percentage (62%) of respondents were of the opinion that Government should take the lead in driving the savings campaigns, with a smaller percentage being off the opinion that the municipality should be the driver of electricity savings. The high percentage of respondents that indicated that Government must be the main driver of electricity savings correlates with the high percentage (67%) of respondents that indicated that Eskom and Government were most responsible for the electricity shortage. Even though all age groups stated that Government must acknowledge responsibility, more than half of the respondents over 45 years indicated that there must be this acknowledgement from Government. This acknowledgement of responsibility for the situation was also a frequent response from male respondents. Finamore et al (2003) confirmed the need for Government to take the lead by stating that the Government of Brazil established a separate agency to administer DSM programs and spend a considerable amount of money on these programs (Finamore et al 2002, 72). Robertson (2009) proposed that Government needed to own the error in judgment when making the appeal for PCP (Robertson 2009).

One method of promoting consumer behaviour change was by the introduction of legislation and the enforcement thereof. A high percentage of females as well as the very high and very low income earners were of the opinion that electricity saving legislation should be introduced. However the older respondents were against the introduction of legislation to force electricity savings. The very high and very low

income earners also felt strongly that legislation should be introduced. Robertson (2009) stated that resorting to force e.g. use of legislation and punitive measures may result in reluctant, resentful change that is not sustainable (Robertson 2009).

A high percentage of respondent indicated that Government should subsidise all electricity savings measures. This probably stems from the respondents opinion that Government was responsible for the electricity shortage and that Government must acknowledge their responsibility and lead the savings campaigns. The younger respondents, as well as the very low and very high income earners felt strongly about the subsidisation of the savings measures. Von Der Fehr and Wolak (2003) stated that the power shortages that occurred in California and Brazil confirmed that no matter what the reasons for supply shortages, Government will be held accountable for continuity of supply; and that the failure to accept accountability for this could result in the downfall of the Government (Von Der Fehr and Wolak 2003, 24). Finamore et al (2003) explained that the benefit of Government subsidisation by investing in energy efficiency is often cheaper, cleaner, safer, faster and more reliable that building more power plants (Finamore 2003, 5).

All age groups and both genders favoured the introduction of rewards for savings to change behaviour, but the frequency decreased with higher income groups. Finamore et al (2003) stated that energy efficiency programs can be implemented by providing financial incentives to consumers to change behaviour (Finamore et al 2003, 5).

The introduction of punitive measures like quotas, penalties and fines to encourage savings was the least chosen response by most age groups and both genders. Higher income groups indicated a preference for fines and penalties which indicated that they were confident that they would make the required savings. This corresponds with the results that higher income groups had implemented a greater percentage of electricity savings measures than lower income groups. Respondents younger than 25 years of age indicated a preference for fines and penalties. According to Maurer (2005), in Brazil, even though this high level authority drove the initiatives, the people ultimately made their own decisions on how to save electricity. This was as a result of the Government encouraging consumer participation rather

than being punitive (Maurer 2005). Robertson (2009) stated that a punitive electricity tariff alone is not the solution (Robertson 2009, 10).

### 5.3.7 Objective 7: To establish if high income households consume more electricity than low income households

In order to implement targeted campaigns to promote savings one had to first understand 'lifestyle and behavioural factors, distributed consumption behaviour of electricity users, appliances and equipment utilization patterns' as was done by Cheng in China (Cheng 2005, 2). This objective was an attempt to explore in part the comment by Cheng (2005).

A fair percentage of low income earners had high electricity bills. Generally the very high income earners had reduced their electricity consumption by implementing electricity savings measures but not to the extent of the high income earners. However a higher percentage of very high income earners had implemented savings measures to reduce on their bill more than the high income earners.

On all the electricity savings measures there was a trend that indicated that as income level increased so did the frequency of the savings measures implemented. By implication that meant that higher income households have shown a greater reduction in electricity consumption than lower income households. A price comparison on the cost of incandescent light bulbs and CFLs showed that the average price of an incandescent bulb was R3 versus the price of a CFL at R14. A price comparison on the cost of solar geysers and conventional geysers showed that the average price of a solar geyser was R17 000 versus the price of a conventional geyser at R4 500. The price comparison indicated that even though energy saving devices like CFLs and solar geysers can result in a substantial reduction in electricity consumption and the electricity bill, lower income earners often did not have the financial resource to invest in these devices.

### 5.3.8 Objective 8: To determine if consumer behaviour had changed

The purpose of this objective was to determine the success of the electricity savings campaigns that had been implemented and to establish the sustainability of the campaigns that had taken place during the period of load shedding in South Africa. Maurer et al (2005) stated that a tariff system of quota allocations, penalties, cut-offs and incentives was used in Brazil to force behaviour change (Maurer et al 2005).

A high percentage of respondents indicated that they had implemented one or many electricity saving measures. Some of these respondents indicated that they had exhausted all the saving measures they could implement and others were still pursuing further savings measures, but a small percentage made no attempt at saving electricity. In terms of the age demographics, 10% of respondents younger than 25 years had saved no electricity. There was a trend that older respondents saved more electricity than younger respondents. There was a common trend with more electricity being saved by higher income groups.

The overall response indicated that the majority of electricity users had implemented the recommended savings that they were encouraged to implement, but there is an indication that new and innovative alternatives needed to be promoted. According to Finamore et al (2003) 'China is continuing to develop an impressive array of programs and policies deigned to accelerate energy efficiency in every sector' (Finamore et al 2003, 38). This illustrated that there needed to be persistent emphasis on savings.

## 5.4 Summary

In this chapter the significant findings from the results of the survey after it was analysed using SPSS for Windows was listed. The research findings of the study were discussed in relation to each of the objectives identified at the start of the study. The findings were explained in relation to the literature review done on previous international and local case studies. Where there have been correlations between this study and other literature these are stated. Any findings that could not be

correlated with other literature can be deemed to be the authors' own contribution to the field of research. All objectives that were identified as part of the study were fulfilled by the analysis of the data collected from the survey.

In the chapter that follows, recommendations for further study on the subject are listed. The contributions that this study has made to the field of power conservation are listed and that author's personal views on the subject are stated.

# CHAPTER 6: RECOMMENDATION AND CONCLUSIONS

## 6.1 Introduction

In this chapter the specific conclusions that arose from the results are stated. Recommendations were made based on the findings of the literature review and the quantitative analysis. These recommendations are intended to provide direction to eThekwini Municipality so that the municipality could in future implement focussed campaigns. These recommendations have taken into account the various electricity consumer groups based on certain demographic factors and the types of conservation methods that best suited each group.

Recommendations for future research are also stated in the chapter. These recommendations would be useful for future research on the subject, since the concept of power conservation is relatively new to South Africa but will be a permanent feature of power supply.

## 6.2 Implications of this Research

The start of the literature review covered aspects of the global electricity crisis and explained the world wide shortfalls that had previously occurred. The literature review looked into the electricity crisis that China experienced in 2003 and 2004, and the role played by the Chinese Government in implementing policy change to force savings. This was followed by a review on the Brazilian electricity crisis of 2001 and 2002 and explained the very different approach taken by Brazil in encouraging electricity consumers to save. A review was done on consumer participation towards the 2003 electricity savings in Japan which led to demand reduction.

The review of the situation in South Africa covered the history behind the electricity crisis that was experienced in South Africa in 2008. A review was done on the Power Conservation Programme used as a national strategy to reduce electricity demand, the proposed action plans, and the steps actually taken.

The final part of the literature review covered power conservation within the area of focus, which is eThekwini Municipality, and the steps implemented in support of the national Power Conservation Programme. The implication of the literature review was that it placed the South African situation into a global perspective.

A survey was undertaken on a sample of participants within the eThekwini Municipality Central Region. The sample was chosen to be representative of the target population based on certain demographic factors like age, gender and income level. Frequency tables and graphs obtained as outputs from SPSS for Windows were used to illustrate the characteristics of the sample. The response from the survey was analysed in terms of the chosen demographic factors and the significant findings were stated. The research findings of the study were discussed in relation to each of the objectives identified at the start of the study. The research empowers decision makers with information when formulating strategies to encourage electricity savings.

## 6.3 Recommendations for future research

The following were identified as opportunities for future research on the subject of power conservation:

- The current study looked at a demographically representative sample within eThekwini Municipality. A truly representative sample would be one that looked at the national picture and covered a number of other/all municipalities within South Africa.

- The study focussed on the response of consumers within eThekwini Municipality towards electricity saving. The focus of the research did not investigate whether the response was as a result of national Government communication on the subject or whether it was in response to the campaign by eThekwini Municipality. Future research could be undertaken on various municipalities that had used different approaches. The study could look at the municipalities that initiated no campaigns versus those that are very active in electricity savings campaigns.

- Due to the limitation of time the sample size was limited to 400 with 280 responses. Future research could be undertaken on a larger sample that is nationally representative.

- Due to the limitation of resources, the current research covered only a quantitative analysis. Future research could be undertaken with the use of qualitative tools. Qualitative analysis would give one a better understanding of why electricity users responded in certain ways.

- Research could be undertaken to understand the social and economic impact of power conservation in South Africa. Following a mandate from the Department of Minerals and Energy, the Human Science Research Council produced a document on this subject. The future research could be in the form of a case study.

- This research was undertaken within one year from South Africa first having experienced load shedding. It is unclear whether the response of electricity users is as a result of the 'shock' from the load shedding experience, or if it was in response to an effective electricity saving campaign. Future research could investigate the sustainability of the campaigns.

- Future research could be undertaken to better understand the reasons behind the different responses from different categories of consumers. This research would take the form of interviews. This research should investigate the cost of various electricity saving campaigns versus the effectiveness of the campaign.

## 6.4 Specific recommendations from this Study

The recommendations that follow are based on the results of this study:

- An opportunity exists to increase awareness of the electricity crisis and the reason for the electricity crisis, since some respondents had indicated that they were not aware of the reasons for the shortage. By increasing awareness on the reason for the electricity shortage a greater response towards electricity saving could be achieved.

- Television should be used as the medium for all electricity savings campaigns since print media and radio had a much lower coverage.

- Municipalities should be used as the channel of communication to the end customer since the respondents indicated that they were aware of the savings drive by the municipality. Municipalities should display active participation in electricity savings within their activities.

- The opportunity exists to encourage the small percentage (5.7%) of respondents that have implemented no savings measures. In particular, a specific savings campaign should be implemented to target the electricity users younger than 25 years of age. Role models like music personalities and sports stars that have an impact on this age group should be used to promote savings with this category of electricity consumers. This age group also indicated that they wanted to avoid load shedding. This appears to have been the deterrent to respondents in this age group that were actively involved in electricity savings. Hence the targets campaigns for this age group should focus on the issue of load shedding.

- Campaigns should place greater emphasis on the financial benefits to be gained in the form of a reduction in the electricity bill by the reduction in electricity usage. These campaigns should communicate the impact of the increasing electricity tariff on the electricity bill if savings measures are not implemented.

- Use should be made of environmental lobby groups to communicate the benefits to the environment if electricity is saved. This targeted campaign should appeal to the higher income groups that indicated sensitivity towards the environment.

- Further communication needs to take place on a variety of new and different savings measures since some consumers indicated that they have exhausted their savings measures.

- Consumers need to be encouraged to switch off unused appliances, since the results revealed that this means of savings had not been widely implemented.

- A great opportunity exists to substantially increase electricity savings by consumers showering instead of bathing. A focussed campaign should be implemented that covers all electricity users.

- Government needs to play a more active role in electricity savings campaigns. Respondents indicated that Government should firstly acknowledge their failure to ensure that there was sufficient generating capacity in the country. Government should take the lead in encouraging consumers to save electricity e.g. by using politicians to encourage consumers to save electricity.

- Government should introduce legislation to enforce electricity savings. Such legislation should be designed to discourage wasteful usage of electricity but should not be punitive in the form of fines. One example of doing this is the introduction of legislation to prohibit the distribution of inefficient appliances and equipment. The legislation should also reward responsible consumers who save and reduce electricity usage.

- Government should subsidise electricity savings measures. The results indicate that lower income earners are discouraged from implementing electricity savings due to the cost difference between energy efficient and conventional appliances.

## 6.5 Conclusion

In January 2008 the stability of the South African power grid operated by Eskom became severely unstable, due to electricity demand exceeding generating capacity. Eskom had set a target of 10% reduction in electricity consumption but achieving the 10% reduction meant that there had to be a drastic shift in the behaviour of consumers who had historically become accustomed to surplus capacity. Despite the massive and expensive campaigns run by Eskom and the various municipalities, only a 4% reduction was achieved in 2008. The campaigns that had been implemented had targeted all consumers to reduce consumption in broad terms. There have not been any focussed campaigns that took into account the various groups based on certain demographic factors and the types of conservation methods that best suited and attracted each group.

The literature review on international cases had shown the different energy conservation techniques used by other countries. The literature review explored the strategies used by other countries to force behaviour change towards electricity

saving. Based on each of the strategies of the other countries, the pros and cons of the various strategies were established.

The survey tested the understanding of consumers on the background to the electricity crisis in South Africa. The results established the appropriate medium for advertising and communicating messages to encourage electricity saving.

## 6.6 Summary

The implication of the study towards the successful implementation of a power conservation strategy was that it identified the preference of electricity consumers for Government to lead the initiative and subsidise the required savings measures. The study also found that different demographic groups implemented different savings measures, for different reasons and preferred different strategies to encourage savings.

The main recommendation for future research was that future study should be undertaken at a national level to explore the response of electricity consumers in municipalities that initiated no campaigns versus those that have been very active in electricity savings campaigns.

A very important aspect of this chapter was the specific recommendations made on the future strategy to be followed in South Africa to encourage consumers to save electricity. The main recommendations were that Government should lead the savings drive, with customised campaigns for different demographic groups. The campaigns should place greater emphasis on the financial benefits to be gained. It was necessary for new and different savings measures to be communicated, and finally that Government should introduce legislation to enforce electricity savings.

# REFERENCES


Adams, P 2009, 'Bobby Godsell spells it out…', *Energise*, Jan/Feb 2009, pp. 7.

Blumberg, B, Cooper, DR & Schindler, PS 2005, *Business Research Methods*, McGraw-Hill Education Berkshire, United Kingdom.

Bryman, A & Bell, E 2007, *Business Research Methods*, Oxford University Press, New York.

Carnie, T 2009, 'Penalties for power guzzlers', Mercury, 16 January, p. 5. South Africa.

Cheng, C-C 2005, 'Electricity Demand-Side Management for and Energy Efficient Future in China: Technology Options and Policy Priorities', PhD thesis, Massachusetts University of Technology, Cambridge.

Cooper, DR & Schindler, PS 2001, *Business Research Methods*, McGraw-Hill, New York.

Creamer, T 2008, 'Power crisis – Shedding Blame', *Engineering News*, January 2008, pp. 9.

Da Silva, SJ. & Smith, C 2007, *The impact of load shedding on Sub-Transmission plant*. ESKOM, South Africa.

Electricity Suppliers Liaison Committee 2009, *The impact of load shedding on sub transmission plant*, report prepared by SJ Da Silva & C Smith, South Africa

ESMAP, Brazil 2006, *Developing Financial Intermediation Mechanisms for Energy Efficiency Projects in Brazil, China and India,* Brazil.

*eThekwini Electricity Annual Report* 2008, South Africa.

Hartdegan, P 2008, 'Electricity- is South Africa still a part of the Dark Continent', *WATTnow,* June 2008, pp.10-13.

Hart, C 2006, *Doing your Masters Dissertation*, SAGE Publications Ltd, London.

Inter-American Development Bank 2003, *Power Sector Reform in Brazil – some issues*, report prepared by NM Von Der Fehr & FA Wolak , Oslo/Stanford.

Iyengar, J n.d., 'China power crisis dims production', viewed 7 May 2009, http://www.atimes.com/atimes/China/FI24Ad06.html.

Kock, G 1998, 'Incandescent light bulbs: Past and Future', *WATTnow,* January 2008, pp.18-19.

National Energy regulator of South Africa 2008, *NERSA Consultation Paper – Power Conservation Programme (PCP) Rules,* IDMS no: 40794v1, NERSA, South Africa.

*National Response to South Africa's energy shortage* 2008, Government written response, Department of Minerals and Energy, South Africa.

Natural Resources Defence Council 2003, *Demand-side Management in China – Benefits, Barriers, and Policy Recommendations,* report prepared by B Finamore, H Zhaoguang, L Weizheng, L Tijun, D Yande, Z Fuqiu & Y Zhirong, New York City.

Noreen, EW, Brewer, PC & Garrison, RH 2008, *Managerial Accounting for Managers,* McGraw-Hill Irwin, New York.

NRS 048-9 2009, *Electricity Supply – Quality of Supply,* report prepared by South African Electricity Supply Industry, South Africa.

Pallant, J 2005, *SPSS Survival Manual,* Open University Press, New York.

*Proposed interim energy conservation strategy* 2008, Presentation and Discussion with BUSA and EIUG, ESKOM, South Africa

The International Bank for Reconstruction and Development 2005, *Implementing Power Rationing in a Sensible Way: Lessons Learned and International Best Practices* report prepared by L Maurer, M Pereira & J Rosenblatt, The World Bank, Washington

Raycroft, M 2008, 'DSM back under the spotlight', *Energise*, Jan/Feb 2008, pp. 3.

Robertson, J 2009, 'Punitive electricity tariffs – absolutely the wrong way to go!', *Energise*, Jan/Feb 2009, pp. 10.

Ruffin1, A 2008, 'SA's Power Crisis and its own Special Solutions', *WATTnow*, July 2008, pp. 10.

Smit, P, Naidoo, R & Naidoo, V, 2008, *Reserve optimisation incorporating demand market participation*, South Africa.

Stratham, B 2008, 'SA's Power Crisis and its own Special Solutions', *WATTnow*, July 2008, pp. 10-14.

Struwig, FW & Stead, GB 2001, *Planning, designing and reporting research,* Hanli Venter, Cape Town.

*Unit 1 of Koeberg power Station remains out of service* 2006, media release, Eskom, South Africa.

*WATTnow* 2008, Crown Publications, Johannesburg

White, B 2000, *Dissertation Skills for Business and Management Students*, Continuum, New York.

White, B 2002, *Writing your MBA Dissertation*, Continuum, London.

Yelland, C 2008, 'Interview with Eskom CEO Jacob Maroga on the generation capacity crisis in South Africa', *EngineerIT,* February 2008, pp. 10-12.

www.eskom.co.za

www.eThekwini.co.za

# APPENDICES

## Annexure 1: Sample template requesting permission

**UNIVERSITY OF KWAZULU-NATAL**
**GRADUATE SCHOOL OF BUSINESS**

Dear Respondent,

**MBA Research Project**
**Researcher**: Veer N. Ramnarain (031-311 9008)
**Supervisor**: Prof Anesh Singh (031-2607061)
**Research Office**: Ms P Ximba (031-2603587)

I, **VEER NISHAAN RAMNARAIN** an MBA student, at the **Graduate School of Business**, of the University of Kwazulu Natal. You are invited to participate in a research project entitled **Consumer response to Power Conservation Programme**. The aim of this study is to provide eThekwini Municipality with an indication of the effectiveness of the present power conservation communication to users of electricity. The study would indicate what power conservation methods are used by various categories of electricity consumers, taking into account factors demographic factors like residential area, income, gender, education and age. Based on the study the Municipality will be in a position to utilize a more appropriate method of encouraging the electricity users to reduce consumption so that the 10% savings can be achieved for the benefit of the electricity grid and the country.

Through your participation I hope to understand the response of electricity users to the call made by Eskom and government. The results of the survey are intended to contribute to electricity demand reduction.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this survey. Confidentiality and anonymity of records identifying you as a participant will be maintained by the Graduate School of Business, UKZN.
If you have any questions or concerns about completing the questionnaire or about participating in this study, you may contact me or my supervisor at the numbers listed above.

The survey should take you about 15 minutes to complete. I hope you will take the time to complete this survey.

Sincerely

Investigator's

Signature _____ Date_____

# Annexure 2: Questionnaire

## Survey Questions – Power Conservation

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. What is you age group? | < 25 years | 25 to 35 years | 36 to 45 years | > 45 years | | |
| 2. What gender are you? | Male | Female | | | | |
| 3. Where is your residential suburb | Northern | Central | Southern | | | |
| 4. What is your total household income per month? | < R10 000 | R10 000 - R19 999 | R20 000 - R29 999 | R30 000 – R39 999 | R40 000 – R49 999 | R50 000> |
| 5. What is your household electricity bill? | <R100 | R100 - R199 | R200 - R299 | R300 - R399 | R400 - R499 | R500> |
| 6. Why is eThekwini Energy Office requesting you to save electricity? | I do not know | Electricity supply cannot meet demand | It is too expensive to generate electricity | Eskom has to supply neighboring countries | Other (*specify)* _____ | |
| 7. Rank in order from most (1) to least (4), who do you think is responsible for the electricity shortfall? | Eskom | Government | Residential users | Industries and big business users | | |
| 8. How did you become aware of the need to save electricity? | Not aware | Family and friends | Television | Radio | Newspaper or pamphlets | |
| 9. What do you think government and Eskom should be doing to encourage electricity savings? | Accept responsibility for the problem | Subsidise all electricity saving initiatives | Impose penalties | Introduce Electricity Saving legislation | | |
| 10. What is eThekwini Municipality doing to encourage electricity savings? | Nothing | Introduced electricity efficiency with its buildings | Used staff as electricity saving ambassadors | Using public campaigns (print, radio, etc) to encourage savings | | |
| 11. What have you done to save electricity? | Nothing | Changed to energy saving light bulbs | Switch off unnecessary lights | Reduced electricity use for heating e.g. geyser blankets, thermostats | Take a shower instead of bath | Switch off unused appliances |
| 12. Why have you started to save electricity? | To save on the electricity bill | To reduce negative effect on environment | To avoid load shedding | To support government and the municipality | To avoid load shedding | |
| 13. How much electricity do you think you saved since load shedding started? | nothing | very little | maximum that I can save | Maximum that I can save and still trying to save more | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 14. What do you think will reduce electricity demand? | Nothing | Penalties and fines for wastage | Rewards for savings | Introducing quotas | New tariffs and with increased costs | |
| 15. What have you done to encourage others to save electricity? | Nothing | Spoke to friends and relatives about the need to save | Distributed and shared savings tips | Promoted saving at the office | | |
| 16, Who do you think should be driving and promoting electricity usage savings | Governme nt | eThekwini Municipality | Religious/Co mmunitee leaders | Councilors | Eskom | Lobby groups |

**End of the Questionnaire**

Thank you for taking the time to complete the questionnaire

## Annexure 3: Ethical Clearance

UNIVERSITY OF
KWAZULU-NATAL

RESEARCH OFFICE (GOVAN MBEKI CENTRE)
WESTVILLE CAMPUS
TELEPHONE NO.: 031 – 2603587
EMAIL : ximbap@ukzn.ac.za

29 JUNE 2009

MR. VN RAMNARAIN (901489490)
GRADUATE SCHOOL OF BUSINESS

Dear Mr. Ramnarain

ETHICAL CLEARANCE APPROVAL NUMBER: HSS/0178/09M

I wish to confirm that ethical clearance has been approved for the following project:

*"Consumer response to Power Conservation Programme"*

PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years

Yours faithfully

Ximba

MS. PHUMELELE XIMBA
ADMINISTRATOR
HUMANITIES & SOCIAL SCIENCES ETHICS COMMITTEE

cc. Supervisor (Prof. A Singh)
cc. Mrs. C Haddon