

Management of electricity usage by household customers

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DECLARATION

I declare that the mini-dissertation hereby submitted to the University of Limpopo, for the degree of Masters in Business Administration (MBA) has not previously been submitted by me for a degree at this or any other university, that it is my work in design and in execution, and that all material contained herein has been duly acknowledged.

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31 December 2010
Date

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ABSTRACT

Management of electricity usage by household plays an important role in the growth of the country's economy, and the avoidance of load shedding from Eskom. Electricity usage is very important for the growth of the economy and creation of job opportunities.

The management of electricity usage by household's customers will play a very critical role in the growth of the country's economy and the creation of jobs. The contribution of households in applying the electricity saving techniques will reduce the risk of load shedding from Eskom during summer and winter. The save usage of electricity will give Eskom enough chance to build power stations to keep up with the demands and the growth of the South African economy.

For the household customers to contribute positively, Eskom and the municipalities should conduct road shows to educate customers about the save usage of electrical appliances and the saving techniques that can be applied by households. Customer awareness campaigns should be conducted in both rural, urban and semi-urban areas.

It will be very important for Eskom to communicate with the municipalities to run the awareness campaigns in the urban areas due to the high demand of electricity by households coming from the urban areas. The majority of households who are using the high consuming appliances of electricity reside in the urban areas and can play a vital role in minimizing the risk of load shedding that affected the country negatively in 2008.

The quantitative research method was followed for this research. A questionnaire was used to collect the data from the household's participants. Forty households from the five areas of Polokwane took part in the research totalling 200 participants.

It was discovered that the customer awareness campaigns were conducted by Eskom in the areas where they service customers, although there are some gaps in other areas where the customers are complaining about lack of road shows to teach households about the electricity saving tips. Municipalities in all the five areas of Polokwane where the research was conducted are still lagging behind with the customer's awareness campaigns. However Eskom customer services and the municipalities can work together and conduct road shows to reach more customers in order to reduce the risk of load shedding and power interruptions.

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1.1 Introduction

In 1998 the CEO of Eskom requested the government to allow the utility to increase the capacity at the generating stations. The request was based on the growing demand of electricity in the country, especially in rural areas where there was no electricity or running water before 1994. Eskom monitors its load every summer and winter so that it can make a good investment. The government refused to give Eskom a go-ahead because it was looking at the privatisation of the whole Eskom, which consists of Generation, Transmission and Distribution. Eskom requested permission in 1998 because the company was aware that the period of building a power station takes about five years because of the waiting period of the equipment like: turbines, generators etc. Had Eskom been given permission in 1998, by the year 2004 the generating capacity could have been increased and the load shedding could have been avoided. When Eskom made the electrification projects for the rural areas, it was estimated that the appliances that would have been used would have been less than the electric current of twenty Amperes (20A) which is the unit used to measure electric current at a voltage of two hundred and twenty volts (220V) which makes the total power of 4 400 Watts. Most power utilities nowadays are shaping future demand of their customers through a wide variety of demand side management (DSM) programs. In Eskom, customer services department are running road shows to provide increased value of electricity to customers at reduced costs. However, the demand of electricity in South Africa (SA) is still increasing, which results in load shedding where different cities, towns and villages are switched off due to high demand of electricity. The DSM in Eskom has emerged as a major component of planning and operations. It includes the planning, implementation and monitoring of Eskom activities to encourage customers to modify their patterns of electricity usage (<http://www.eskom.co.za>).

1.2 Background

The research on the management of electricity usage will be done in Polokwane area, which includes Dendron, Mokopane, Gilead and Mankweng. At the moment the country is experiencing the load shedding due to the lack of capacity in Eskom generating stations. For the country and the economy to grow well the customers, the residential, industrial and mining must help in using electricity wisely. The three power stations that were mothballed are: Komati, Camden and Grootvlei in Witbank. The total mega watt (MW) of the three power stations which are Komati, Camden and Grootvlei is 3612MW. All the three power stations Komati, Camden and Grootvlei which were decommissioned while Eskom had excess capacity in 1980 will be fully returned to service by the last quarter of 2011. The four newly build power stations that are currently under construction are Medupi 4 200 Mega Watts (MW) and 6 units in Lephalale and the first unit will be in operation by the first quarter of 2011 and the last unit in 2015 Ingula in Drakensburg near Ladysmith in Kwazulu Natal Province (1330 MW) and the whole power station is expected to be fully operational in 2012 Ankerlig (600 MW) near Cape Town and Gourikwa (450 MW) near Mosselbay outside Petro SA. The current status of installed capacity at all power stations in SA is 400000 MW and the peak load in July 2008 was around 375000 MW. The reason why the research will only be done on the household is because there are many customers who do not have any knowledge about how electricity can be used wisely in their homes. The peak hours of electricity usage is between 7:00am – 10:00am and 18:00pm – 21:00pm. The message of electricity saving on television channels shows different colour coding about the status of electricity. Green indicates that the supply is greater than the demand and 1900 MW is left as reserve, Yellow indicates that the supply is greater than the demand and 1 000MW is left as reserve, Orange indicates that the actual supply is less than the required supply and the shortage is between 100MW and 200MW and load shedding will occur. Brown indicates that the shortage is more than 3 000MW and load shedding will occur in the whole country. The households in SA use 17.5% during off peak hours and 30% during peak hours (70000MW-120000MW). The households in the area of Polokwane are

consuming 320 MW Mokopane consume 80MW, Dendron consume 80 MW, Gilead consume 100 MW and Mankweng consume 70 MW. The total capacity for all the areas is 650 MW which is 0.54% of the total households in the country. If the households in Polokwane area where the research will be conducted can save 30% from 650 MW which is equivalent to 195 MW it will help Eskom, because 195 MW is equivalent to two units in a power station. Eskom Demand Side Management (DSM) works closely with energy saving companies (ESCO), to implement technology solutions among clients in order for the mines, industries, commercial and agricultural markets to save electricity. The mines are using between 30% and 37%, and the industries are using between 25% and 33 % (100000MW -132000MW). The research on households will make a big impact by reducing the chances of load shedding during the shortage of supply.
(<http://www.eskom.dsm.co.za>).

1.3 Problem statement

The demand of electricity in South Africa by industries, farmers, mines and households is increasing everyday due to new projects, single customer connection, electrification and new developments in townships, suburbs and rural areas. The high demand of electricity in 2008 resulted in load shedding in summer and winter.

1.3.1 The main research problem

To investigate the high demand of electricity by households in Polokwane area which contributed to the load shedding that was experienced in 2008 in South Africa.

1.4 Aims and objectives of the study

1.4.1 Aim of the study

- To investigate how the households customers use electricity in the neighbourhood of Polokwane which consist of Dendron, Mokopane, Gilead and Mankweng?

1.4.2 Objectives of the study

The objectives of the study are outlined as follows:

1.4.2.1 To investigate how the households are using electricity in their homes at the moment around Polokwane.

1.4.2.2 To highlight the electricity usage problems within the Polokwane areas.

1.4.2.3 To reduce the continuous high electricity demand during the peak periods in the Polokwane areas.

1.4.3 The investigation will be guided by the following questions:

1.4.3.1 What contribution can the customers give to reduce the risk of load shedding in the country?

1.4.3.2 Which problems are there in Polokwane areas in connection with the usage of electricity by households customers?

1.4.3.3 What advice can be given to customers to use electricity wisely and save Eskom and the country to avoid load shedding?

1.4.3.4 What other alternative source of energy can be used to reduce the overloading on the power stations?

1.5 Assumptions

The study will be conducted under the following assumptions:

1.5.1 That if the household's customers use electricity wisely and other alternative sources of electricity like solar geysers, the load shedding problem will be addressed.

1.6 Significance of the study

The study will help Eskom on how the household's customers can help to reduce the risk of overloading and load shedding.

1.7 Format of the study

Chapter 2

The chapter will focus on literature review and previous research on electricity demand by household's customers.

Chapter 3

The chapter covers how the research was designed and how data was collected.

1.8 Conclusion

If all households can work together to save electricity, then power outages due to load shedding will be restricted to a bare minimum, while consumers would definitely enjoy the additional benefit of lower electricity bills, less load shedding with more money to spend on other necessities.

Chapter 2- Literature review on electricity demand by households

2.1 Introduction

This chapter introduces the reader to the concept of electricity usage by households and gives an overview of electricity usage as suggested by some authors.

2.2 Literature review

2.2.1 Energy supply and demand management and conservation

Energy supply and demand management (ESDM) denote the set of activities by which the energy plans and policies are implemented. These measures influence, guide and control the production and consumption of energy, so as to maximize the resulting national welfare. It makes it easier for the energy policy maker to ensure adequate supply-demand balances, by preventing major economic disruptions and consequent reductions in benefits to the gross domestic product. The load shedding that was experienced in 2008 in SA affected the growth of the economy, which automatically affected the national income due to low production. Energy supply management (ESM) includes the identification and optimal exploitation of all energy sources; project planning, transformation, refining and distribution of energy, substitution of one form of energy for another and operation and maintenance of supply systems. The soft tools of demand management including pricing, taxation, financial incentives and subsidies and education are more useful in the medium and long term (Bhatia, Munashinghe, Anandalingam, deLucia & Lesser 1990:30).

2.2.2 Alternative Generation of Energy Sources

Alternative sources of energy include solar energy, wind energy, hydro power and nuclear power

2.2.2.1 Solar energy

Cities are constantly expanding their boundaries and their populations around the world. The increased industrialization and urbanization of the recent years have dramatically affected the number of urban buildings leading to the major effects on energy consumption. Buildings are the largest consumers of energy. Solar radiation use in dense urban environments is often constrained because of its limited availability, which is the result of shading from neighbouring buildings, limitations in choice of building orientation, urban regulation constraints, constraints of size and limited space for solar collection compared with the area of the buildings (Gordon 2001:13)

Solar energy can reduce the need for significant quantities of conventional energy used to serve the building's environmental systems. They reduce air pollution and operating costs. Solar energy is another source of clean energy that is environmentally friendly and recommended around the world. Eskom is offering a rebated solar heating program to the South African households which promote the use of solar water heating technology. Using heat from the sun to supply hot water is environmentally friendly and can decrease the monthly electricity account of households by nearly half. This source of energy is not reliable to meet the energy demand in South Africa due to the changes in weather condition that can affect the supply due to different seasons. Solar heating is one of the cheapest renewable technologies and it has been readily adopted worldwide. In South Africa (SA) it is estimated that 18% of generated energy is used to heat water for the domestic, commercial and industrial sectors. The implementation of solar water heating technologies can assist in alleviating SA's dependence on fossil fuels (Breedenkamp 2009:64).

2.2.2.2 Wind energy

Wind energy is the fastest growing energy industry in the world, with cumulative installed capacity reaching in excess of 120 gig watts (GW). Wind energy conversion system converts the energy in moving air to electricity.

Wind turbines generating electricity range from battery charging systems of about 100 Watts to large multi-megawatt systems supplying power to electrical networks. Wind powered water pumps are common in SA, with an estimated 30 000 systems installed (Breedenkamp 2009:70). Human efforts to harness wind for energy date back to the ancient times when it was used by sails to propel ships as well as boats. On a later stage, the wind energy served the mankind by energising his grain grinding mills and water pumps. The Babylonian emperor Mammurabi planned to use the wind power for his ambitious irrigation projects during the seventeenth century. By the 13th century, grain grinding mills were very popular in most of Europe. In the later years cheaper and more reliable electricity generated from fossil fuels based plants became available. When electricity generated from wind costed 12 to 30 cents per kilowatt hour in 1940, the same generated from other sources was available at 3 to 6 cents per kilowatt hour. Cost of electricity from fossil fuels further declined bellow 3 cents per kilowatt hour in 1970 (Mathew 2006: 5). The United States entrusted its National Aeronautics and Space Administration (NASA), with the development of large wind turbines. These types of projects were stopped by mid 1980's due to various reasons. Energy available from wind is basically kinetic energy of large masses of air moving over the earth's surface. Blades of wind turbine receive kinetic energy which is then transformed to mechanical or electrical depending on the end usage. The efficiency of converting wind to other forms of energy greatly depends on the efficiency with which the rotor interacts with the wind stream. (Mathew 2006: 11). In South Africa there is a new wind energy power station called Sere Wind Farm energy located at Koekenap near Ludzville, north of Olifants River, the power station was under study. The lack of information on wind frequencies and wind speed along the South African coast is a challenge to the development of wind energy. The project is awaiting the license from national electricity regulator by Eskom. Capital prices for wind energy in Europe and America in 2008 were costing 1800 Euro per MW. The project in South Africa has been put on hold until required funding is granted.

2.2.2.2.1 Global leaders in wind energy generation

COUNTRY	INSTALLED CAPACITY MEASURED IN MEGAWATTS (MW)
1. Germany	14609
2. United States of America	6352
3. Spain	6202
4. Denmark	3115
5. India	2120

2.2.2.3 Hydro power

Hydro power is the electricity generated from water. In South Africa there is a substation in Olifantsfontein near Kemptonpark called Apollo Substation. The substation is getting power from Cahora Bassa Dam situated in the Tete province in Mozambique. The Cahora Bassa Dam system is the largest hydroelectric power station in Southern Africa with the capacity of 5x 415 MW turbines. The system contains two converter stations, one at Songo in Mozambique and another at Apollo in South Africa. There are two parallel lines between these two substations. The high voltage direct current (HVDC) lines work at 533 KV. In 2006, Cahora Bassa transmitted the capacity of 1920 megawatts (MW) of power, but the power station is capable of higher production. The Apollo substation in Olifantsfontein near R21 road in Gauteng province of South Africa is converting 533 KV (HVDC) to 132 KV alternating current (AC) and converted from 533 KV to 132 KV by power transformers and distributed to the customers. There is also a new hydro power station that is planned to be erected between Nebo and Steelpoort river valley in Limpopo province. The capacity of the power station is a 1500 MW pumped storage which will be called Tubatse pumped storage scheme. Eskom has put the

construction of the power station on hold due to the reduction in electricity demand in 2008. The project has been put on hold until further notice.

<http://www.eskom.co.za>

2.2.2.4 Nuclear power station

Nuclear energy is produced from uranium. Over half of the world's production of uranium is from mines in the following countries: Canada (35%), Australia (22%), Namibia (6.3%) and South Africa (2.5%). There are currently 439 nuclear power stations operational around the world. The largest number is 118 situated in North America and it supplies about 20% of the continent's electricity. In France 77% of electricity comes from nuclear power stations. Nuclear power stations are currently providing 16 percent of the world's electricity. In South Africa there is only one nuclear power station called Koeberg, situated in Cape Town. Koeberg is responsible for the supply of electricity of the Western Cape. Koeberg supplies 6% of South Africa's energy demands. Uranium is the key for exploitation of nuclear energy. The early reactors developed in the 1950-60's are generally referred to as first generation reactors and only few are still running today. The best known radical new design is the Pebble Bed Modular Reactor which uses helium as coolant, at a very high temperature to drive a turbine directly. There are a number of more advanced designs on the drawing board that incorporate the more complex fuel and operating cycles. This group of reactors is being designed for the future when uranium is less readily available and the need to develop new fuels is more urgent. This group of reactors is under design and development for potential deployment around the middle of the century and are collectively referred to as generation IV designs (Wood 2007:42). Post privatisation investment in the UK, electricity generation industry has been in several distinct phases. The United Kingdom currently has a stake in two reactor design, but is in the process of disposing of its interest. One is the Pebble Bed Modular reactor (PBMR) whose design and development are now being spearheaded by Eskom in South Africa which already has one nuclear power plant at Koeberg in Cape Town. The PBMR is very closely based on

high temperatures gas reactor designs with small spherical fuel elements made of graphite and uranium.

<http://www.eskom.co.za>

2.2.2.5 Coal power station

Coal is another raw material that is used to produce electricity around the world. The electricity in South African power stations is produced by coal. The percentage of power stations that are using coal is 80% and the 20% is produced from water and nuclear. Due to global warming around the world, coal is not a favourable source of energy production due to the emission of carbon dioxide which pollutes the environment.

2.2.3 South Africa's rural electrification

The rural electrification started after 1994 where the access of electricity was 30% and rural areas had less than 10%. Between 1994 -1999, 2.7 million households were connected to the grid. There are 1 344 rural schools, 495 clinics electrified through municipality power stations and solar energy in SA. And in November 2002 the electrification of rural areas was sitting at 50% and urban areas are sitting at 84%. The government of South Africa has put a target of 2012 where every household is expected to have electricity. According to the researcher in the target of electrification by the government there was nothing wrong except on Eskom's side. The experience of households in South Africa about the saving and usage of electricity is still low as compared to that of other countries like Cuba, because most people in the rural areas are illiterate. The current situation of load shedding in South Africa's contribution of energy saving by both industries and households customers will help Eskom to complete the building of power stations. The households of South Africa need to be educated about the usage of electricity so that load shedding can be eliminated in the country.

(<http://distribution.eskom.co.za/cpd/>)

2.2.4 Consumer Perspective

From the consumer's perspective, economic evaluations involving the end users of electricity are based on the idea that the consumption of energy is intrinsically valuable to customers. The net benefit of energy service to end users depends on a variety of components (Gellings & Chamberlin 1992: 272).

- The value and costs of energy.
- The cost of outages due to load shedding and other interruptions.
- Direct customer investment in electrical hardware

2.2.5 Australia's electricity market

The installed capacity of Australia's electricity producers comprises 44 900 MW and the independent producers contribute 5 200 MW. The market in Australia has five regions – the Queensland, Victoria, South Australia, New Wales and Tasmania. The energy regulator monitors the market to ensure that the power producers comply with the national electricity law. The national energy market is a compulsory wholesale pool, into which producers sell electricity. The main customers are retailers, who buy electricity and sell to business and household customers. In South Africa most municipalities does not have license to distribute and sell electricity to households. That is the reason why 91% of electricity is still produced by Eskom and 9% by different municipalities. The municipalities that are distributing electricity are mainly in the big cities, but in small towns the households and businesses are supplied by Eskom.

http://www.esaa.com.au/electricity_markets.html

2.2.6 Electricity demand in Japan

The electricity companies in Japan were set up in the 20th century. In 1951 Japan's electricity industry was organised according to US model of monopoly. Tokyo electric power supplies 24 million customers. The government of Japan's goal is to build more nuclear power stations. In South

Africa, the power stations are predominantly coal-produced. A bill was passed in 2003 to enable electricity suppliers to compete from 2005 for consumers using more than 50KW of electricity, such as small and medium businesses. The forecast, whether households and small businesses will gain from retail electricity supply or not was unknown. In most places where electricity was deregulated, retail electricity price increased for households and businesses. In South Africa, the households who are poor are given free units by government, whereas in Japan the subsidy of electricity does not exist. Blackouts also increased worldwide as a result of lower reserve level of generation capacity and privatisation of generating stations. The load shedding in Eskom is the result of government opting to privatise the power stations and stopped Eskom from building any further power station.

<http://www.wnfm.com>

2.2.7 Generation Capacity expansion in South Africa

The commencement for the return to service of three mothballed power stations: Camden, Komati and Grootvlei by the 30 November 2009. At Camden there are eight units rated in total at 1 552 MW (2x200MW, 5x 195MW and 1x 177MW). Three of the units went into commercial operation in 2007, adding 590MW to the system. The return to service of Camden after it was decommissioned is targeted for the middle of 2008 which was completed on the 31 July 2008 and it has added 900MW to the system which makes the total capacity of 1552 MW. If the consumers can use electricity wisely, this will help both the consumer and Eskom. The other power stations Grootvlei and Komati were not mentioned as to when they could be brought back in operation. This will definitely reduce the chances of load shedding, if the Camden power station can be in full operation. However the culture of saving electricity must still continue to be practiced by customers as this will enhance growth in the economy of the country.

The other future promise is the building of a new Medupi power station in Lephalale. Medupi is a coal fired power plant project comprising six units rated in total at 4788MW. The project started in May 2007. The first unit is expected in 2012, and with the world cup of soccer coming to South Africa, a

great deal of power saving need to be practiced so that the country can put itself on the map as the whole world will be watching South Africa and its capability to host such a massive event with minimal interruption of electricity (<http://www.eskom.dsm.co.za>).

2.2.8 South African government plan for universal access to electricity in 2012 by all households

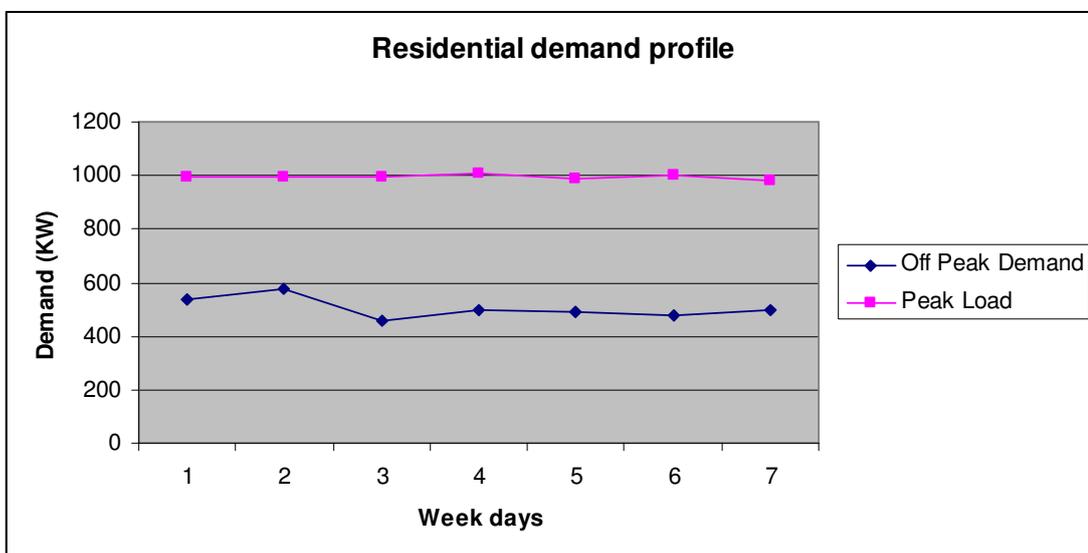
The South African off-grid electrification programme has been in operation for more than a year. Four of the original five cession holders have now started installations, the National Electricity Regulator has commenced paying capital subsidies and households in four different regions in the country are receiving solar electricity on a large scale. The process started in February 1999 when the South African (SA) Government department of minerals and energy (DME) issued a call for proposals. The South African government has planned to electrify all the houses by 2012. This is a big challenge to every South African because there is a shortage of electricity at the moment. In the rural areas of Limpopo province a lot of electrification projects are still needed. If government can review rural electrification to give Eskom a chance to build and complete power stations, the country can have less interruption of supply. There are many new power stations that are under construction at the moment, but the expected date of operation is 2012. If the government can review its target based on the time the power stations like Camden, Grootvlei and Komati are fully returned to service the load shedding can be avoided. With the saving of electricity by the households as well as the industrial areas, there will be enough reserves of capacity that will help Eskom and the country to have sufficient power before the return to service of other power stations. (<http://www.eskom.dsm.co.za>).

2.2.9 Demand Side Management in South Africa

2.2.9.1 Introduction to demand side

The term demand side management (DSM) was first used in the United States in the early 1980's to explain the planning and implementation of utility activities designed to influence the time, pattern or amount of electricity demand in ways that would increase customer satisfaction and co-incidentally produce desired changes in the utility's load shape. DSM as an alternative to system expansion as well as tangible means of providing customers with a valuable service was later adopted in the United Kingdom, Europe and Australia. DSM associated initiatives are practised, although not necessarily referred to as DSM programmes. In South Africa (SA), DSM is a relatively new concept. While Eskom formally recognised DSM in 1992 when integrated electricity planning was first introduced, the first DSM plan was only produced in 1994. Some municipalities and local service providers in SA, currently undertake activities seeking to produce desired changes in the utility's load shape. The South African government recognises the importance of energy efficiency towards the sustainable growth of the economy. SA has an extremely energy intensive economy with high dependence on the mining and base metals industries. The electricity sales growth has been consistently higher than the Gross Domestic Product (GDP), reflecting the energy intensive nature of the economy. The industrial electricity demand has always been consistent in consumption levels on an hourly, daily and annual basis with most plants operating continuously throughout the year. The residential sector made up less than 15% of total electricity sales until the late 1980's although this sector's morning and evening peak demand characteristics were clearly apparent at that time. Meeting this relatively low overall fluctuation in demand presented little problems for the installed base load coal fired generation plant. Residential (historically black) electrification programmes were initially embarked on in the 1980's and accelerated in the 1990's with Eskom's electrification for all initiatives gathering momentum in the mid 1990 to late 1990's. The final target for

the additional connections by 2007 was 5 million. An additional 2 million households have been connected to date, with annual household connection rate being in the order of around 450 000. The impact on the system level demand profile has been high, with the proportion of energy sales to the residential sector as a whole increased from 15% to 20% in only 10 years. The peak demand has risen even more higher, with the residential sector contribution being over 30% due to the peaky nature of this load (Shuma-lwisi 2003:1-2).



New residential demand profile – Monday to Sunday (above)

End use contribution is made up mainly of cooking, water heating, space heating and lighting. Historically coal, wood, paraffin and liquid petroleum gas were the primary household energy sources. The cost as well as availability of all gas types to date has, however, prevented its widespread use.

2.2.9.2 Electricity supply implications of electrification

With electricity consumption growth in the electrification sector expected to be above 15% per annum over the next ten years, the implications for

Eskom are profound. New generating power stations need to be constructed to meet the growth.

2.3 Analysis of alternative energy sources

2.3.1 Alternative energy sources

(a) Solar energy

- Solar energy is another source of clean energy that is environmentally friendly that is recommended around the world.
- Eskom is offering a rebated solar heating program to the South African households which promote the use of solar water heating technology.
- Using heat from the sun to supply hot water is environmentally friendly and can decrease the monthly electricity account of households by nearly half.
- This source of energy is not reliable to meet the energy demand in South Africa due to the changes in weather condition that can affect the supply due to different seasons.

(b) Wind energy

- Wind energy is another source of energy which is environmentally friendly.
- However in South Africa it is a big challenge due to lack of consistent wind, which makes it unreliable.
- The technology required to produce wind energy is very expensive

(c) Hydro energy

- This source of energy is recommended and environmentally friendly.

- Countries around the world which have abundant amount of water use hydro-power stations to generate electricity.
- However, due to changes in seasons, this source of energy cannot be reliable due to the fact that drought might occur and there will be shortage of electricity that will affect the energy supply.
- South Africa is importing a lot of energy from Mozambique at Cahora Bassa dam, which is one of the countries that has good rains during summer and the dams are full of water to the required level that will last the winter season.

(d) Nuclear energy

- Nuclear is an efficient way of generating electricity, which uses small amount of uranium to produce a lot of energy.
- Due to the advancement of technology, nuclear energy is safe and reliable.
- It uses fewer amounts of raw materials as compared to the coal fired power stations.
- It also produces very small volume of waste.

(e) Coal power station

- Coal power stations are the mostly used source of energy to generate electricity around the world.
- The energy produced from coal is reliable but not environmentally friendly.
- The recent world summit for environmental studies which was held in Copenhagen on the 16-18 December 2009 where the head of states were debating on how countries can commit themselves in reducing the carbon emissions due to the impact that is caused by coal fired power stations and other sources of energy around the world.
- Eskom in South Africa also applied for a \$3, 75 billion for the funding of Medupi coal fired power station in Lephalale in Limpopo

Province was granted due to the fact that the power station would use the super critical technology with lower carbon emission and the shortage of electricity in the country due to the economy growth and also for the country being in the developing stage.

- The power station will supply 10% of the electricity demand of South Africa with an output of 4 800MW (Megawatts).

2.3.2 South Africa's rural electrification

- The government of South Africa has set a target that by 2012 every household will have electricity.
- The biggest area where many households were not electrified was in rural areas.
- The plans for electrification of rural areas were put in place and executed, but the expansion of generation capacity was not executed, which resulted to load shedding that was experienced in 2008.
- The growth of economy in South Africa also resulted in many job opportunities in rural areas like clinics, shopping malls and local municipalities, which add more load to the national grid.

2.3.3 Consumer perspective

- The consumer perspective about the electricity price hikes is because of poor management in Eskom.
- The consumers in rural areas still have a perception that the government should subsidise the households in order for them to afford electricity tariffs based on their income.
- The consumers who are wealthy in urban and rural areas do not understand why they should be restricted to use electricity whereas they are paying for it.
- Eskom is responsible for the energy crisis alone in South Africa due to lack of skills.

2.3.4 Australia's electricity market

- The electricity in Australia is boosted by the independent power producers.
- In the case of South Africa, Eskom is producing more than 90% of electricity in South Africa and it was regarded as the cheapest electricity in the world in 2008.
- The lower tariffs of electricity was scaring independent power producers because of lower profit margins.
- With the new tariffs introduced in 2009 and 2010 in South Africa by NERSA, many independent power producers will be attracted to invest in generation of electricity.

2.3.5 Electricity demand in Japan

- The electricity supply in Japan was boosted by the integration of projects.
- On the other side when the homes were electrified, the power stations were constructed.
- The nuclear power stations were constructed in order to produce more capacity to meet the increase in demand.

2.3.6 Generation capacity expansion in South Africa

- The projects of building and return to service of power stations in Eskom was started after the crisis of load shedding affected the power utility and the country as a whole.
- There was no integration of projects when the rural and urban areas were electrified.
- There was no enough spare capacity at the generating stations of the power utility to meet the demand in case of emergency situations.

2.3.7 South African government plan for universal access to electricity by 2012

- The SA government started a good initiative to improve the lives of previously disadvantaged communities.
- The electrification programmes started while the building of power stations by Eskom was put on hold by government.
- The target of 2012 access to electricity by the government was progressing well while the building of power stations not in progress.
- The electrification of many households and the economic growth of South Africa resulted in capacity shortage and load shedding around the country.

2.4 Comparison and reviews of the various authors

- According to the study undertaken by Gordon, most of the households in South Africa are still using electricity from the municipality and Eskom to boil water inside the geysers. The alternative and cheaper source of energy is solar system. The solar heating system can reduce the overloading in the power stations and help the customers to reduce their monthly electricity bills in their homes. Solar energy is a good source of energy because there is no emission of carbon dioxide in to the environment. It is just natural gas.
- According to the views of Mathew, in Europe and America wind power stations have been build to reduce the overloading and load shedding on the power utilities. But the challenge in South Africa is the funding of the power stations, because SA is still a developing country and the amount of money required to build wind power stations will require Eskom to ask for more funding from other countries. Wind energy is a good source of energy because there is no emission of carbon dioxide in to the environment. It is just natural gas.

- According to Shuma-Iwisi, the SA government, municipalities and Eskom realised the importance of demand side management in 1992 due to the increase of electricity demand from households, industries and mines. The government and utilities are running promotions to make consumers aware of using electricity effectively and efficiently in order to avoid load shedding.

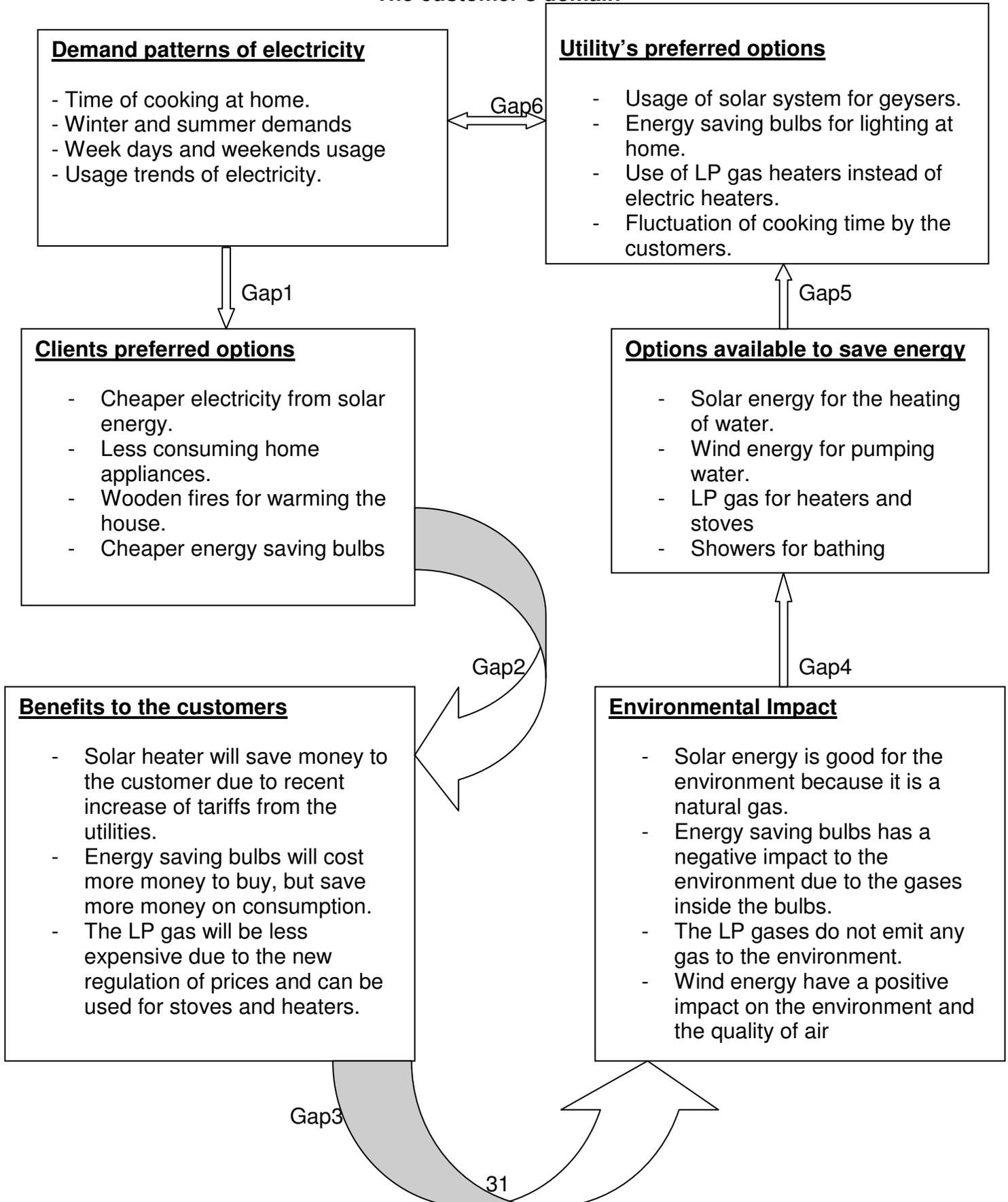
2.5 The meaning and purpose of others views on the topic

- The meaning and the purpose of their view is to give the researcher what has been achieved about the similar studies done.
- The views of other authors are to give the researcher the findings from their studies.
- The views of other authors are to guide the researcher on how to search for the new solution that has not been discovered.
- The purpose of the others is to help the researcher to come up with the different findings or solution.
- To help the researcher to structure the questionnaire properly.

2.1 Framework to address the problem of electricity demands by households

Fig 2.1

The customer's domain



The operation's domain

Derived and adapted from Chambers et al. (2007:542) who obtained it from Parasuraman et.al

The customer's domain and the operation's domain in determining the perceived quality, showing how the gap between customers' expectations and their perception of a product or service could be explained by one or more gaps elsewhere in the model

The gaps are explained as follows:

- Gap 1 indicates the customer's preferred options of cheaper and affordable electricity. But the challenge is the willingness of the customers to install solar heated geysers as well as the energy saving bulbs at their homes. If this gap is not closed, the country will still have the threat of load shedding.
- Gap 2 indicates the benefit to the customers for using solar heated geysers, LP gases and energy saving bulbs. By using these types of methods will save the customers a great deal of money in their houses and reduce the risk of load shedding. This gap depends on the affordability from the customer's side especially with many challenges in the rural areas due to lack of economic activities.
- Gap 3 indicates the benefits of using natural gases like solar energy and wind energy to produce electricity. These sources of energy help the environment from pollution and also the people as well as other living species to have quality air and healthy environment. This gap is important, but will not be investigated in this study.
- Gap 4 indicates that the usage of showers as well in the households that cannot afford solar geysers or LP gases for bathing or cooking will help to reduce the loading on the utilities power

stations. If this gap can be closed by all the households around the country it can save Eskom 3 000 megawatts (MW). This gap is important and it will be investigated.

- Gap 5 indicates the usage time of electricity for cooking by the households and also the usage of energy saving bulbs as compared to the incandescent bulbs. This is a big challenge in urban and rural areas because the highest amount of consumption is between 05:00PM- 19:00PM due to the number of people returning from work. This gap is important and it will be investigated.
- Gap 6 indicates the time of the day and the season in which electricity is demanded. The highest demand of electricity is in winter, but the peak times for households are still from 05:00PM- 19:00PM during the week and also on weekends. This gap will be investigated because majority of the people are not working on Saturday and Sunday.

The model will be used to identify what the urban and rural households customers are not using efficiently to reduce the risk of load shedding of electricity in winter and summer. The researcher will use the identified gaps to suggest solutions and recommendations to the municipality and Eskom customer care managers.

2.6 Assessing alternative source of energy and demand patterns (Gap1, 2, 4, 5&6)

The alternative source of energy is another way of reducing the electricity demands by households in order to minimise the risk of load shedding on the generating stations from different utilities which include Eskom and other independent power producers. If the five gaps are not investigated properly, the researcher will not achieve the intended objective in the research.

- According to Bredenkamp (2009:64) solar heating is one of the cheapest renewable technologies which have been readily adopted worldwide. The sun emits massive amounts of energy and while some parts of Europe only receives up to 2.5 Kilowatt hours per square metre (KWh/m²), South Africa receives up to 6.5 KWh/m². In South Africa it is estimated that 18% of generated energy is used to heat water for the households, commercial and industrial sectors. Current statistics show that while more than 4.2 million electric geysers are installed in South Africa, over four million homes are without geysers.
- Wind energy is the fastest growing energy in the world. Wind energy is in its infancy in South Africa. Wind turbines generating electricity range from battery charging systems of 100W to large multi-megawatt systems supplying power to electrical networks. Wind powered water pumps are common in South Africa with an estimated 30 000 systems installed. It is reported that these systems originally imported are now produced locally to such a high standard that they have made significant inroads into the export market. It is possible that a similar pattern of local industry development could emerge in the large scale of wind turbine market (Bredenkamp (2009:70). This source of energy is environmentally good. The purpose of the investigation is to find out the followings:
 - What source of energy is used by the households to heat the water?
 - What source of energy is used to pump the water?
 - What time do the households arrive at home from work?
 - What time do they prepare their meals?
 - What time do they take their bath when leaving for work?

This kind of analysis is very important because it will help the customers who are willing to save money by using electricity wisely, which in turn will help to close the gaps during the peak hours and also when there is a shortage of energy during emergency situations. It is important to analyse the electricity usage with regard to the utility's goals and objectives before the decision is made and these could save more money, time and resources.

2.7 Model of consumer behaviour

According to Lamb et al (2008:67) consumers' product and service preference and buying patterns change constantly. Consumer behaviour describes how the consumers make purchase decision and how they use and dispose the purchased services or goods.

The buyer behaviour is influenced by three sets of variables:

a) Individual factors

- The customers have a perception that they pay for electricity and therefore they can use electricity as they wish.
- The customers need motivation for contributing positively towards using electricity wisely.
- Customers should learn that although the incandescent are cheaper than energy saving, the reward for their money on energy saving bulb is beneficial.
- The customer's belief that buying electric geysers is cheaper than buying solar energy heaters because of the price value of a solar heated geyser being unaffordable.

b) Social factors

- The culture of the South African people who lives in the suburbs and townships ignores the message of saving electricity even if the message is transmitted via television or radio.
- This is the kind of message that the researcher also wants the households to understand the meaning and the impact if people are not willing to change from the way they have been doing things in their homes.
- The South African culture in the use of electricity is to leave the television sets on even if there is nobody at home so that when the person come back home, will only press the remote buttons.

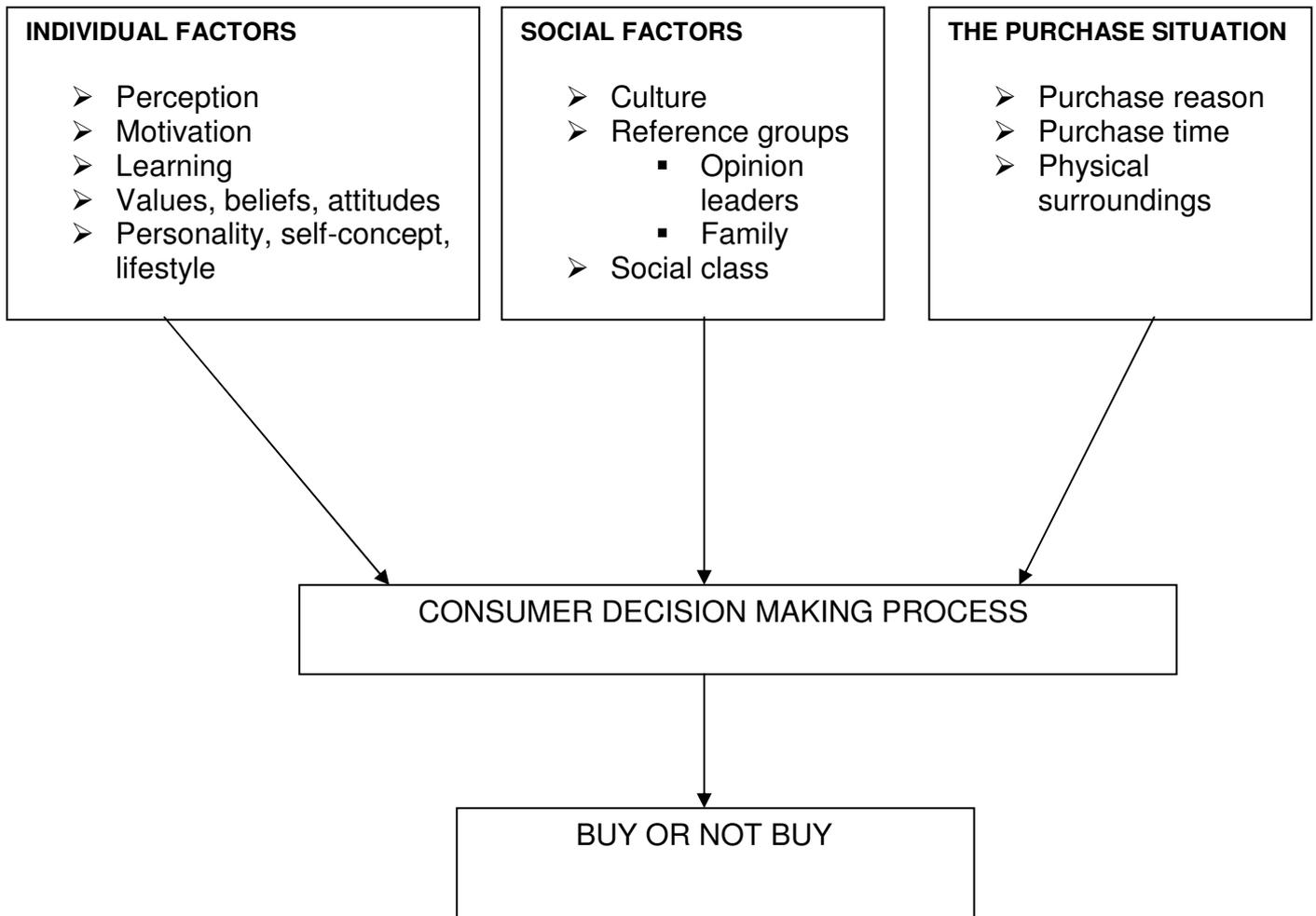
c) The prevailing purchase situation

- The majority of people are still living under poverty in South Africa, and many of the households look at the price more than the value when purchasing electrical appliances like the incandescent bulb and energy saving bulbs.
- The purchase of households in the urban areas are in such a way that one house is bigger than the family of four people living in it, but consumes more electricity exceeding the average maximum demand estimated at 4KVA (Kilo Volts Amperes) per customer.
- The size of geysers that households buy is bigger than the required size for one family.
- The whole consumer behaviour model is summarised on figure 2.2 bellow and the factors that help the consumer to make the buying decision.

2.8 Electricity demand development strategy in Polokwane area

This part of the study provides guidelines on how question 1.4.3.4 in chapter 1 will be addressed.

Figure 2.2 Model of consumer behaviour



2.9 Assessing the electricity demands and usage patterns by households

Electricity usage assessment is for the purposes of determining the actual household's usage of electrical appliances. The assessment in Eskom is done at the substations and power stations level in order to build new generation and distribution stations to cope with the increase of demand. The purpose of the analysis is to find out the following:

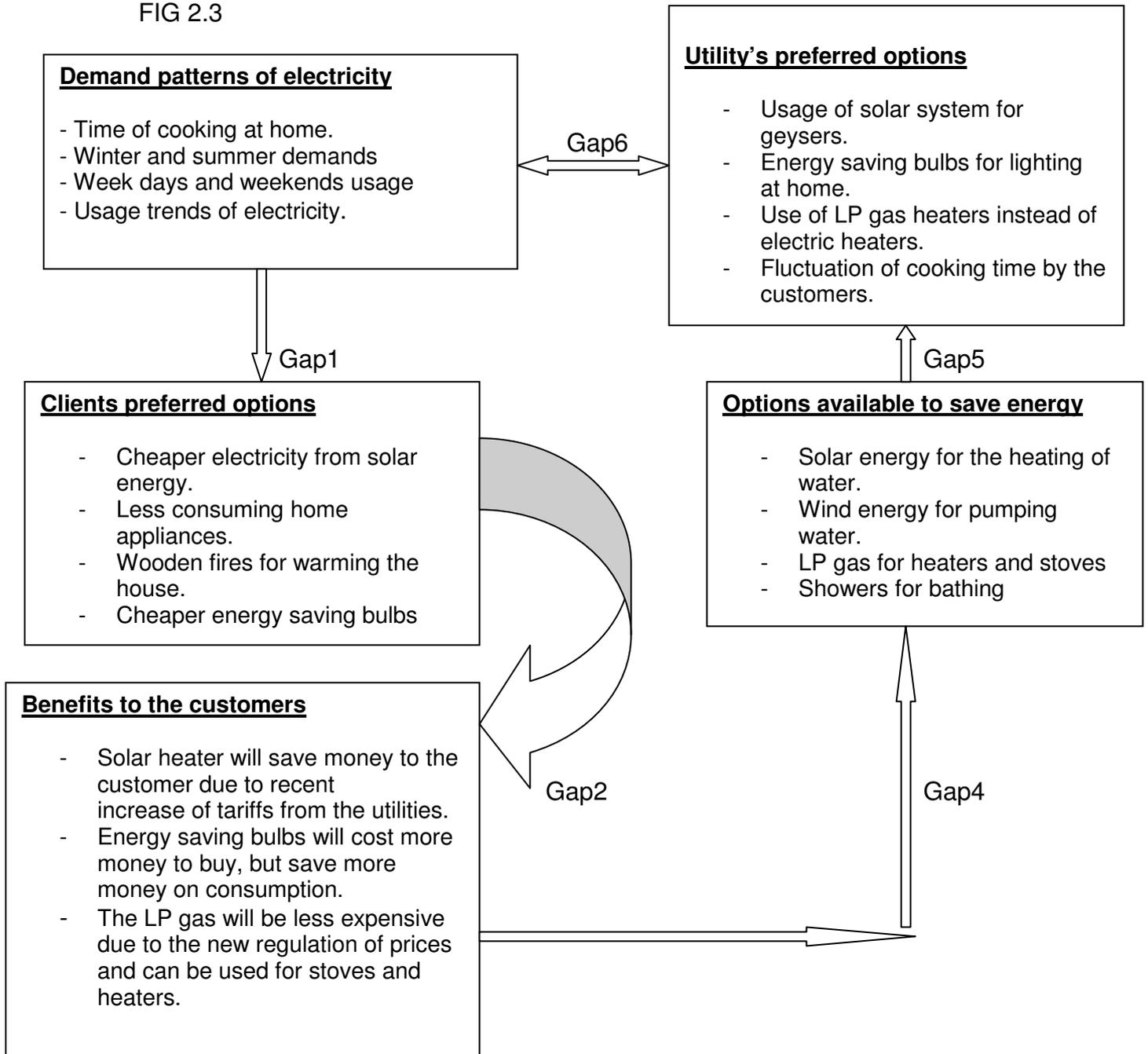
- 2.7.1 What kind of appliances are households using?
- 2.7.2 What kind of bulbs are customers in both rural and urban areas using?
- 2.7.3 What time do they knock off at work?

- 2.7.4 What time do they cook during the week and on weekends?
- 2.7.5 What type of energy do they use to boil water inside their geysers and to cook food?
- 2.7.6 What type of method do they use when taking a bath?
- 2.7.7 How much do they spend on electricity bill per month?
- 2.7.8 What kind of heating system do they use in winter?
- 2.7.9 Do they know the risk of doing load shedding based on the colours that are shown on the television screens on SABC about the current status of demand every night?

The behaviour of households customers in rural and urban areas differ based on their income level. The researcher will be looking at the appliances that are used by the households in order to look at the impact of their usage to the national grid and the risk of load shedding.

2.10 Framework for analysis conclusion

FIG 2.3



The household's customers can play a big role in reducing the risk of load shedding and contribute to the economic growth of the country. This goal can be achieved if every household's customer can use electricity wisely and save a lot of money for their own benefit and the benefit of the country.

Chapter 3

Research design and methodology

3.1 Introduction

Data will be collected at Mankweng, Polokwane, Mokopane, Dendron and Gilead. The customers will be assured confidentiality of the information sought as it would be used only for study purposes. Preparations will then be made to distribute questionnaires and to have them completed. The appointments to conduct interviews with the household's customers will be arranged.

3.2 Research design

The study is designed in such a way that it will follow the quantitative approach of investigation with the focus on collecting more detailed information from the households as much as possible. The type of research that will be used is quantitative because it will give answers about the demand patterns of electricity by households with the purpose of explaining, predicting and controlling the usage of electricity by household's customers Leedy and Ormrod (2005:94).

The research for the management of electricity usage by household customers will be conducted in Polokwane and the surrounding areas. The towns where the research will be conducted are: Polokwane, Dendron, Mokopane, Mankweng and Gilead. The focus will mainly be on the households in urban and rural areas in the city of Polokwane and the surrounding areas.

3.3 Research Methods

The research will be conducted through one-on-one interview with household's customers via questionnaire and telephone conversation. The

interview questions will be structured in such a way that they capture the essence of the core problem under investigation. Primary data will be collected from customers by means of highly structured questionnaires. One questionnaire will be developed for both rural, townships and urban areas.

Gray (2004:25) states that the choice of research methodology is determined by a combination of several factors for example, whether the researcher believes that there is some sort of external truth out there that needs discovering, or whether the task of research is to explore and unpick people's multiple perspectives in natural and field settings.

3.4 Sampling

Cluster sampling will be used to select 200 households' customers in the five areas mentioned in 3.1 above. Forty households will be selected from the five areas of Polokwane which include: Polokwane Municipality, Dendron, Gilead, Mokopane and Mankweng. The households will be chosen from different electricity accounts. The customers that will be chosen will be the 20Amperes, 60A and the customers who are using more than 60A. The appointments will be arranged by the researcher telephonically. The researcher will distribute the questionnaire survey on the total sample via email or hand deliver and make appointments and follow-ups telephonically where necessary. The total population of Polokwane area is 57 600 people. The researcher randomly selected the sample as a representative of the total population of Polokwane area.

3.5 Data collection and analysis technique

A highly structured questionnaire will be designed and used for the collection of data in the four areas of Polokwane. There are very low cost in terms of time and money when using questionnaire. The Eskom customer services personnel will help the researcher to distribute questionnaires for the five areas mentioned. The other means of collecting

data from the majority of the households in other areas will be via the attendance of the road show with customer services, where the attendance is always more than two hundred people.

According to Leedy and Ormrod (2005:85) research design provides the overall structure for the procedures the researcher follows, the data the researcher collects, and the data analyses the researcher conducts. As this research is quantitative, the usage of electricity will be quantified by the responses from different household's customers about the behaviour of using electricity. The software that I will use to analyse data will be Microsoft excel. The Microsoft excel spreadsheet which has rows and columns will be used to insert data and analyse it and do the calculations on the software. The statistical technique for analysing data that will be used by the researcher will be correlation. According to Leedy and Ormrod (2005:265), correlation is the statistical process by which we discover the nature of relationships among different variables.

3.6 Delimitations

The delimitations of the research will be the exclusion of other household's customers in the areas where the research will be conducted. A further study could be conducted later whereby a bigger sample of households from different areas could be included.

CHAPTER 4

4. DATA COLLECTION, PRESENTATION AND ANALYSIS

4.1 INTRODUCTION

Data was collected in the five areas of Polokwane which included: Mokopane, Polokwane, Dendron, Gilead and Mankweng. The customers were chosen based on their account numbers and their meter size (e.g 60A). The household's customers were assured of confidentiality of the information sought as it were to be used for study purposes only. The permission was granted by Eskom after the topic was presented and approved by the study committee of Eskom bursaries. Preparations were then made to distribute questionnaires through emails and hardcopies with the help of Eskom customer care department. Then an appointment to conduct interviews with the households was made for a later date.

A questionnaire that was used to collect data had three sections: section 1 had questions that were based on biographical information of each participant. Section 2 was a scale whereby participants were to mark with a yes, no, partially and not applicable to the statement and give some remarks. Section 3 had open-ended questions which required the participants to give their inputs about the usage of electricity in their homes.

Further information was collected through the interviews that allowed the participants to give clarity on certain aspects; therefore the gaps that were left by the questionnaire were filled through interviews.

4.2 POPULATION AND SAMPLING

Since the research is quantitative, forty households were selected from the five areas of Polokwane which included: Mokopane, Dendron, Polokwane, Gilead and Mankweng. Section1 of the questionnaire described the population in the sense that it focused on biographical information of the

participants. All the 200 questionnaires that were distributed were all returned. Thus 100 percent of the households sample members participated in the study.

The biographical questions were posted as follows:

4.2.1 The gender of participants

The first requested question to the participants was to state their gender. The genders for all the five areas of Polokwane were as follows: Thus 101 males and 99 females. For Polokwane it was 25 females and 15 males, Mokopane 16 females and 24 males, Mankweng 20 males and 20 females, Gilead 24 females and 16 males and Dendron 14 females and 26 males. The total percentage is 49% females and 51% male's households.

Table 4.1 gender of household's participants

Area	Females	Males	Totals
Polokwane	25(63%)	15 (37%)	40
Mokopane	16 (40%)	24 (60%)	40
Mankweng	20 (50%)	20 (50%)	40
Gilead	24 (60%)	16 (40%)	40
Dendron	14 (35%)	26 (65%)	40
Totals	99 (49%)	101 (51%)	200

4.2.2 The ages of participants

The age of the households who participated ranged from 20 to 30 with 36%, 31 to 40 with 23%, 41-50 with 23% and 51-60 with 18%. The majority of the households in the Polokwane areas are youth. This is a big encouragement because the youth are the ones who will be affected by electricity shortage for a longer period of time if they don't apply the saving techniques in their homes.

Table 4.2 ages of participants

Areas	Age(20-30)	31-40	41-50	51-60	Totals
Polokwane	13 (33%)	7 (17%)	13(33%)	7 (17%)	40
Mokopane	16 (40%)	12 (30%)	4 (10%)	8 (20%)	40
Mankweng	17 (43%)	12 (30%)	9 (23%)	2 (4%)	40
Gilead	11 (28%)	6 (15%)	10 (25%)	13 (32%)	40
Dendron	14 (35%)	10 (25%)	10 (25%)	6 (15%)	40
Totals	71 (35.5%)	47 (23.5%)	46 (23%)	36 (18%)	200

4.2.3 The name of the area where the participants are residing

The five areas where the data was collected were divided into 40 households per area, which makes the total sample of 200.

4.2.4 The type of house where the participant is residing

The majority of the participants were private households at 94% and business households at 6%.

Table 4.3 type of house

Area	Business	Private	Totals
Polokwane	2 (5%)	38 (95%)	40
Mokopane	4 (10%)	36 (90%)	40
Mankweng	2 (5%)	38 (95%)	40
Gilead	2 (5%)	38 (95%)	40
Dendron	2 (5%)	38 (95%)	40
Totals	12 (6%)	188 (94%)	200

4.2.5 The size of electrical metre installed in the house.

The majority of households at 50% are using 20 Amperes metres and 48% are using 60A metres with only 2% using more than 60A. The urban areas are using the 60A in majority, while rural areas are predominantly 20A due to the economic activities that differ from the two areas.

Table 4.4 electric metre size

Area	20A Metre	60A Metre	More than 60A	Totals
Polokwane	17 (43%)	19 (48%)	4 (9%)	40
Mokopane	22 (55%)	18 (45%)	0 (0%)	40
Mankweng	19 (48%)	21 (52%)	0 (0%)	40
Gilead	27 (68%)	13 (32%)	0 (0%)	40
Dendron	15 (38%)	24 (60%)	1 (2%)	40
Totals	100 (50%)	95 (48%)	5 (2%)	200

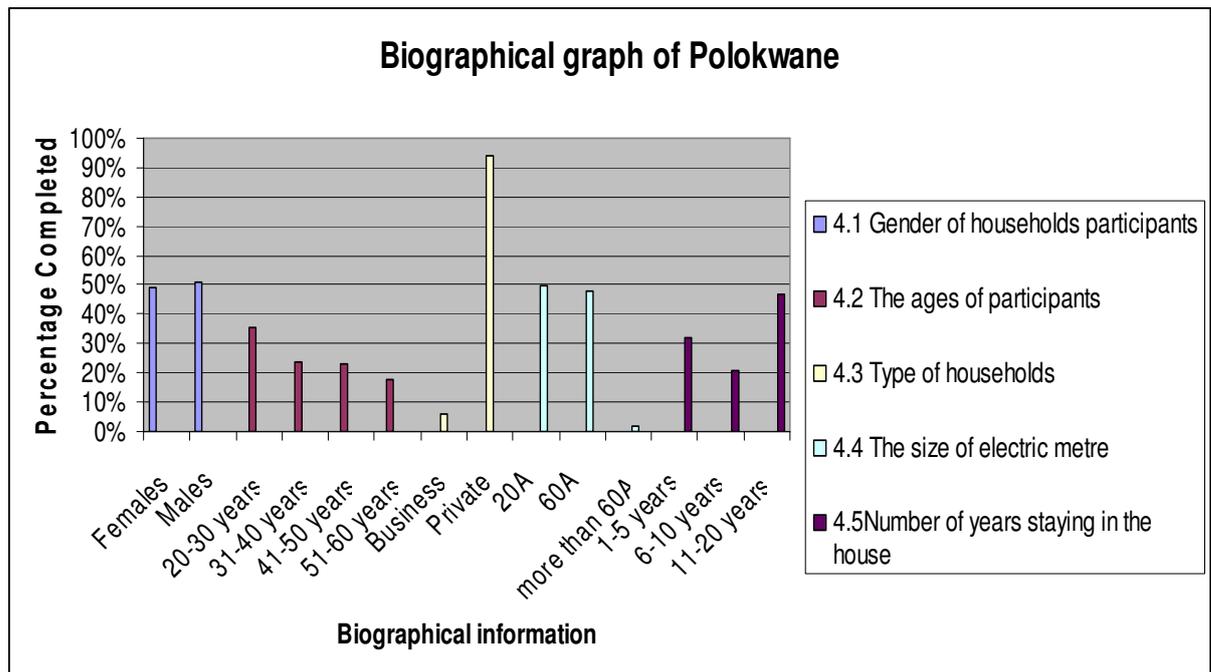
4.2.6 The number of years staying in the house.

Forty seven percent of the households have been staying between 11-20 years, thirty two percent for 1-5 years and 21% have been staying between 6-10 years. The majority of the households who completed the questionnaire have been staying in their houses for more than ten years.

Table 4.5 Period of occupation of the house

Area	1-5 years	6-10 years	11-20 years	Totals
Polokwane	13 (33%)	9 (23%)	18 (44%)	40
Mokopane	20 (50%)	6 (15%)	14 (35%)	40
Mankweng	15 (38%)	9 (23%)	16 (39%)	40
Gilead	6 (15%)	9 (23%)	25 (62%)	40
Dendron	9 (23%)	8 (20%)	23 (57%)	40
Totals	63 (32%)	41 (21%)	96 (47%)	200

Fig 1.1 Summary of the biographical information for five Polokwane areas



4.3 Contribution of customers to reduce load shedding

Table 4.6 Energy saving bulbs

Areas	Question	Y (yes)	N(NO)	P(partially)	NA(not applicable)	Remarks
Polokwane	4.1 Do you think that energy saving bulbs can save you money on your monthly electricity bill?	33(82.5%)	4(10%)	2(5%)	1(2.5%)	They take time to switch on. They save energy and good for the eyes.
Mokopane		34(85%)	6(15%)	0 (0%)	0 (0%)	
Mankweng		33(82.5%)	3(7.5%)	1(2.5%)	3 (7.5%)	
Gilead		35(87.5%)	1(2.5%)	1(2.5%)	3(7.5%)	
Dendron		37(92.5%)	1(2.5%)	1(2.5%)	1(2.5%)	
Totals		172(86%)	15(7.5%)	5(2.5%)	8(4%)	

4.3.1 Energy saving bulbs

From the above table 86% (gap 2 which is the appliances that consume less electricity) from the total sample of 200 households agree that the energy

saving bulbs save money to their monthly electricity bill from all five areas, 7.5% does not agree that the energy saving bulbs can save them money. However 4% does not use energy saving bulbs because they take time to switch on and 2.5% believe that the energy saving bulbs can save very little money. The majority of households at 86% in all the five areas of Polokwane agree that energy saving bulbs save energy and they can contribute by using energy saving bulbs at their homes. The advantage of energy saving bulbs is that they use only 20% of what the incandescent light can use.

The majority of households can contribute by using energy saving bulb at their homes. The advantage of energy saving bulbs is that they use only 20% of what the incandescent light can use. Customers can also contribute by installing geyser blankets in their homes. The customers who are able to knock off early can cook earlier before 16:00pm to reduce the risk of load shedding. The majority of households at 86% in all the five areas of Polokwane agree that energy saving bulbs save energy.

Table 4.7 Electric geyser blanket

Areas	Question	Y (yes)	N(NO)	P(partially)	NA(not applicable)	Remarks
Polokwane	4.2 Is your electric geyser covered with a geyser blanket?	4(10%)	22(55%)	1(2.5%)	13(32.5%)	We are not aware of the geyser blanket and where do you get it?
Mokopane		4(10%)	18(45%)	0(0%)	18(45%)	
Mankweng		7(17.5%)	20(50%)	0(0%)	13(32.5%)	
Gilead		2(5%)	18(45%)	0(0%)	20(50%)	
Dendron		4(10%)	15(37.5%)	1(2.5%)	20(50%)	
Totals		21(10.5%)	93(46.5%)	2(1%)	84(42%)	

4.3.2 The use of electric blankets

Only 10.5% of the households in the four areas have their geysers covered with the geyser blanket (gap 2) which will benefit them in winter and summer because a geyser is one of the highest consuming appliances in the house.

The majority of the households at 46.5% does not have geyser blanket with the highest percentage of 55% in Polokwane where the households have more appliances than any other areas around Polokwane. Only 42% of the households do not have electric geysers and majority of the households are from Dendron and Gilead at 50% each followed by Mokopane with 45% because the areas are predominantly rural with Mokopane being semi-urban. Only 1% of the household's geysers are partially covered with the blanket. This is a big gap that needs to be closed by both Eskom and the municipality by educating people about the importance and benefits of covering the geyser with a blanket to save energy consumption and pay less to their monthly bills. Eskom Customer services department together with the municipalities should educate people about the importance of using a geyser blanket in both rural and urban areas.

Customers can also contribute by installing geyser blankets on the electric geysers in their homes.

The electric blanket saves more energy than using an electric heater. When customers buy electric blanket, the customers should make sure that the blanket has a temperature control and also an auto shutoff. The electric blanket saves a lot of money on the customer's monthly electric bill. The households should also buy a decent comforter so that the comforter can help to keep the heat under the cover, so that the electric heating blanket does not run the whole night to keep the customer warm.

Table 4.10 the use of gas

Areas	Question	Y (yes)	N(NO)	P(partially)	NA(not applicable)	Remarks
Polokwane	4.5 Is gas used for cooking?	16(40%)	17(42.5%)	5(12.5%)	2(5%)	Use fire wood. Only gas stove for cooking.
Mokopane		26(65%)	4(10%)	0(0%)	10(25%)	
Mankweng		14(35%)	19(47.5%)	0(0%)	7(17.5%)	
Gilead		18(45%)	10(25%)	6(15%)	6(15%)	
Dendron		21(52.5%)	8(20%)	1(2.5%)	10(25%)	
Totals		95(47.5%)	58(29%)	12(6%)	35(17.5%)	

4.3.3 The use of gas for cooking

The number of households who are using gas stoves for cooking is 47.5% with the majority in Mokopane and Dendron. Mankweng and Polokwane are the lowest. Twenty nine percent (29%) of the households are not using gas (gap 4) and other households in the rural areas are using wood fire for their cooking (gap 5). The 17.5% of the households does not have gas stove with 6% of the households using the gas stove partially. With the new regulation of Liquefied Petroleum (LP) gas by the government, many households will use the gas stove if customer services can make the customers aware of the opportunity and benefits.

Table 4.13 Application of energy saving tips

Areas	Question	Y (yes)	N(NO)	P(partially)	NA(not applicable)	Remarks
Polokwane	4.8 Does the application of energy saving tips save money to your monthly bill?	31(77.5%)	5(12.5%)	4(10%)	0(0%)	Especially the energy saving bulbs.
Mokopane		38(95%)	2(5%)	0(0%)	0(0%)	
Mankweng		28(70%)	5(12.5%)	2(5%)	5(12.5%)	
Gilead		32(80%)	3(7.5%)	2(5%)	3(7.5%)	
Dendron		31(77.5%)	2(5%)	2(5%)	5(12.5%)	
Totals		160(80%)	17(8.5%)	10(5%)	13(6.5%)	

4.3.4 The use of energy saving tips

The majority of households at 80% agree that the energy saving tips that are given to the customers during the road shows and on the media are helping to reduce their monthly bills, while 8.5% disagree that the application of energy saving tips save money from their monthly bills. The majority of households who agree are in Mokopane and Gilead and Mankweng is the lowest at 70% with Polokwane and Dendron in the middle at 77.5% each. The minority of households estimated at 5% partially agree and 6.5% say that the energy saving tips are not applicable. The other households at 6.5% say that the

applications of energy saving tips are not applicable on their side. It is also encouraging to see that other households can see the benefits of energy saving bulbs on their monthly electricity bills.

The customers who use less consuming appliances will get less monthly electricity bills. The chances of Eskom to do load shedding will decrease. Customers who install the solar heating systems and heating pumps can get the rebate from Eskom and their monthly electricity bills will be very low. The country will not experience the load shedding that was experienced in 2008. Eskom will have enough time to build more power stations that will sustain the country and benefit everyone. The majority of customers in all five areas of Polokwane agree that the less consuming appliances reduce the monthly bills but those appliances are expensive.

Table 4.9 compliance with the reduction of electrical appliances

Areas	Question	Y (yes)	N(NO)	P(partially)	NA(not applicable)	Remarks
Polokwane	4.4 Do you reduce the usage of appliances during the high electricity demand period?	33(82.5%)	5(12.5%)	1(2.5%)	1(2.5%)	In line with messages shown on TV and radio.
Mokopane		32(80%)	6(15%)	2(5%)	0(0%)	
Mankweng		33(82.5%)	3(7.5%)	2(5%)	2(5%)	
Gilead		26(65%)	8(20%)	0(0%)	6(15%)	
Dendron		33(82.5%)	2(5%)	5(12.5%)	0(0%)	
Totals		157(78.5%)	24(12%)	10(5%)	9(4.5%)	

4.3.5 Reduction in the use of electrical appliances

The majority of households at 78.5% are reducing their electricity demand when they see the messages of the electricity consumption status on the television and radios. The concern is in Gilead were they reduce their usage by 65% due to the lack of understanding and the consequences of not reducing electricity (gap 1) when advised to do so via radios and televisions. Only 12% of the households in the area of Polokwane are not contributing to the avoidance of load shedding (gap 6) especially during peak hours from

18:00pm – 21:00pm. The 4.5% of the households who are not getting the message is due to the shortage of televisions and radios in Mankweng and Gilead and other factors that might prevent them from getting the message. The 5% households who are partially reducing the usage of appliances is due to the lack of understanding of the impact it causes to other people and the country as a whole.

Table 4.11 Status of electrical appliance when not in use

Areas	Question	Y (yes)	N(NO)	P(partially)	NA(not applicable)	Remarks
Polokwane	4.6 Are electrical appliances switched off when not in use?	35(87.5%)	3(7.5%)	2(5%)	0(0%)	To save energy for those in need. For safety reasons.
Mokopane		36(90%)	4(10%)	0(0%)	0(0%)	
Mankweng		36(90%)	2(5%)	1(2.5%)	1(2.5%)	
Gilead		37(92.5%)	0(0%)	0(0%)	3(7.5%)	
Dendron		36(90%)	2(5%)	1(2.5%)	1(2.5%)	
Totals		180(90%)	11(5.5%)	4(2%)	5(2.5%)	

4.3.6 Switching off of Appliances

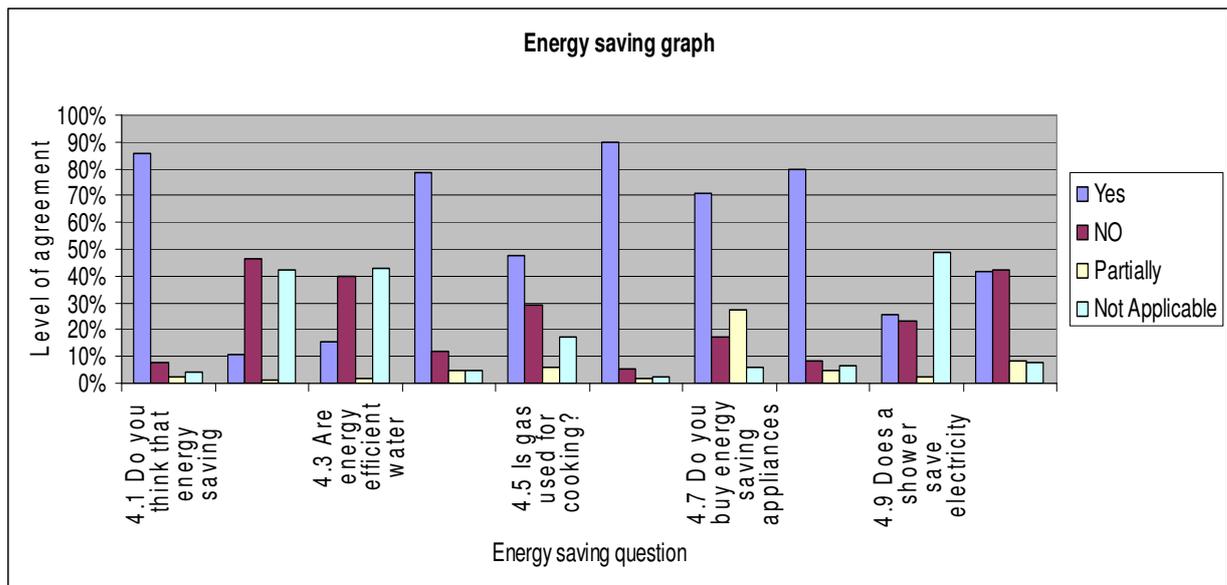
The majority of households at 90% switch off their appliances (gap 2) when they are not in use in the Polokwane area and 5.5% of the households do not switch off, with Polokwane being the highest at 5%. The 2% of households partially switch off their appliances and 2.5% are taking them out of the plugs for saving energy and safety reasons. The majority of the households have realised the benefits of switching off appliances when they receive the electricity bills at the end of the month.

4.3.7 Buying of Appliances

Table 4.12 Type of appliances you buy at home

Areas	Question	Y (yes)	N(NO)	P(partially)	NA(not applicable)	Remarks
Polokwane	4.7 Do you buy energy saving appliances at home?	26(65%)	8(20%)	4(10%)	2(5%)	Several. They are expensive.
Mokopane		34(85%)	6(15%)	0(0%)	0(0%)	
Mankweng		27(67.5%)	9(22.5%)	0(0%)	4(10%)	
Gilead		26(65%)	8(20%)	2(5%)	4(10%)	
Dendron		29(72.5%)	4(10%)	5(12.5%)	2(5%)	
Totals		142(71%)	35(17.5%)	11(27.5%)	12(6%)	

Fig 1.2 indicates the summary of energy saving appliances by households in the five areas of Polokwane from table 4.3.1 to 4.3.10 above.



The households who buy energy saving appliances is 71% (gap 1), with 27.5% partially buying the energy saving appliances. The 17.5% of households don't buy the energy saving appliances because the appliances are very expensive. The 6% of the households are not showing any interest in buying those appliances due to the issue of affordability. The highest percentages of the households who buy the energy saving appliances are Mokopane with 85% and Dendron with 72.5%. The energy saving appliance is expensive when you buy it but it saves a huge sum of money in the long term.

4.4 ELECTRICITY USAGE PROBLEMS

Table 4.8 Water heating

Areas	Question	Y (yes)	N(NO)	P(partially)	NA(not applicable)	Remarks
Polokwane	4.3 Are energy efficient water heating systems utilised (e.g solar, heat pump)?	3(7.5%)	23(57.5%)	1(2.5%)	13(32.5%)	
Mokopane		10(25%)	12(30%)	0	16(40%)	
Mankweng		8(20%)	18(45%)	1(2.5%)	13(32.5%)	
Gilead		5(12.5%)	15(37.5%)	0	20(50%)	
Dendron		3(7.5%)	12(30%)	1(2.5%)	24(60%)	
Totals		31(15.5%)	80(40%)	3(1.5%)	86(43%)	

4.4.1 Efficient methods of water heating

Forty three percent of the households do not have energy efficient water heating systems in their homes and 40% are not using energy efficient system (gap 4) like solar system for the geyser as an alternative source of energy, 15.5% use energy efficient water heating system to cut on monthly electricity consumption. Only 1.5% in the area of Polokwane, Mankweng and Dendron are partially using the energy efficient water heating system. Polokwane and Dendron are the lowest at 7.5% of using energy efficient water heating system and Polokwane households are the highest at 57.5%. The majority of the households are not using solar heating system because of the high cost of installation. The customer services departments need to educate the households about the long benefits of using solar heating systems during road shows. 4.3.3 The alternative source of energy that can be used by household's customers to reduce the overloading on the power stations. The usage of solar and wind energy for water heating and pumping. The use of liquid petroleum (LP) gas stove for cooking at home. Households can use wood fire for heating and cooking as well. These different sources of energy can be utilised on high consuming electrical appliances and reduce the monthly electricity bills.

Table 4.14 Bathroom energy saving appliances

Areas	Question	Y (yes)	N(NO)	P(partially)	NA(not applicable)	Remarks
Polokwane	4.9 Does a shower save electricity in your house?	11(27.5%)	7(17.5%)	1(2.5%)	21(52.5%)	No idea. Do not have shower.
Mokopane		8(20%)	6(15%)	2(5%)	24(60%)	
Mankweng		12(30%)	14(35%)	1(2.5%)	13(32.5%)	
Gilead		7(17.5%)	12(30%)	0(0%)	21(52.5%)	
Dendron		13(32.5%)	7(17.5%)	1(2.5%)	19(47.5%)	
Totals		51(25.5%)	46(23%)	5(2.5%)	98(49%)	

4.4.2 The use of water saving appliance in the house

The highest number of households at 49% does not have showers while 25.5% of the households agree that the shower (gap2) save electricity and 23% disagree that the shower saves electricity, with 2.5% which says that a shower saves electricity partially. The customer services people will have to work hard to educate the customers about the importance of using a shower instead of a bath.

Table 4.15 the use of heaters during cold weather

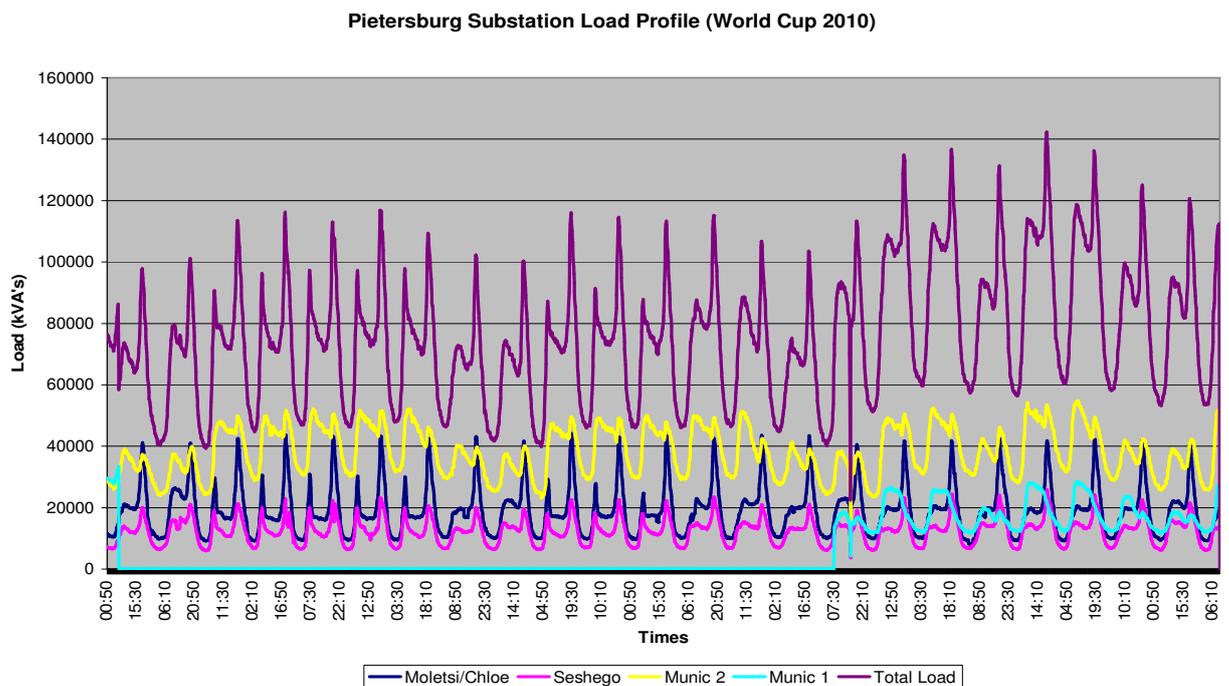
Areas	Question	Y (yes)	N(NO)	P(partially)	NA(not applicable)	Remarks
Polokwane	4.10 Do you use electric heater in winter?	15 (37.5%)	14 (35%)	9 (22.5%)	2 (5%)	Gas heater. Yes for few hours and switch it off.
Mokopane		12 (30%)	22 (53%)	2 (5%)	4 (10%)	
Mankweng		16 (40%)	21(52.5%)	0 (0%)	3 (7.5%)	
Gilead		10(25%)	21(52.5%)	5(12.5%)	4(10%)	
Dendron		30(75%)	6(15%)	1(2.5%)	3 (7.5%)	
Totals		83(41.5%)	84(42%)	17(8.5%)	16(8%)	

4.4.3 The use of heaters to warm the house

The number of households who are using electric heater in winter is 41.5%, with the majority in Dendron at 75%. The 42% of the customers are not using electric heaters in winter and 8.5% use it partially with only 8% that does not have the heater. It is encouraging to see that other households use gas heater (gap 4) in winter. Mokopane is the lowest user of electric heater at

30%. The demand patterns are indicated on the graph below for Polokwane during the world cup in June 2010.

Fig 1.3 indicates the load demand patterns and times of electricity consumption in Polokwane



The demand of electricity peaked up at 18:00pm – 20:00pm and also during the time when the games were playing during the night. The load is measured in kilo volt amps (KVA). One thousand KVA is equivalent to 1 megawatt. The load was taken for Moletsi (Gilead), Seshego and Municipality 1 and 2 (Polokwane city).

- Moletsi/Chloe (navy blue colour) is the load that is supplying the Gilead area. The highest demand on this area is 44MW at 17:50pm and the lowest demand is 8.3MW at 04:00am. The statement complies with the questionnaire of the usage times of electricity and majority of the households are using electricity between 18:00pm – 20:00pm.
- Seshego(purple colour) supplies the Polokwane location which is dominated by households. The highest demand is 23.3 MW at

19:00pm and the lowest demand is 6.1 MW. The reason why the demand of Seshego is lower than Moletsi/Chloe is because the geographical area of Moletsi/Chloe and customer base is very big.

- Munnic 2 (yellow colour) is the supply of Polokwane Municipality. The highest demand is 54meggawatts (MW) at 09:00AM with the lowest load at 24MW at 04:20am. The reason for the Municipality 2 to have high load in the morning is because the customers supplied by Municipality 2 are industries and businesses.
- Munic 1 (sky blue colour) supplies businesses and households in the Polokwane Municipality. The highest demand is 33MW at 06:30am with the lowest demand at 4MW at 15:40pm. The reason for the lowest demand during the day is because the households are still at work and the businesses are contributing to the load.
- The total load (dark brown colour) for the whole substation of Polokwane combines the demand for all four areas. The highest demand is 141MW at 18:40pm and the lowest demand is 39.6MW at 02:40am. Due to the number of households being higher in other areas, the contribution of households increase the risk of load shedding especially during peak hours. The peak hours of electricity are between 18:00pm and 20:00pm. The total demand falls within the peak hours of electricity in the area of Polokwane and the country as a whole.

4.5 FINDINGS ABOUT RESEARCH OBJECTIVES

The findings and discussions of the objectives from 1.4.2:

4.5.1 To investigate how the households use electricity in their homes at the moment around Polokwane

All the households in all five areas have indicated that they use electricity between 06:00AM – 08:00AM when preparing to bath and for breakfast to go to work, school or for other reasons. And the households in the five areas have also indicated that in the afternoon they use more electricity between

18:00pm – 20:00pm when they prepare for supper. All the households are using electricity at the above-mentioned times in summer and winter when they return from work and school. Only 0.5% of the households indicated that they use more electricity during school holidays. In Eskom systems, more electricity demand is higher during the times that were mentioned by the customers in the afternoon.

4.5.2 To highlight the electricity usage problems within the Polokwane areas

The majority of households in the urban and semi-urban areas of Polokwane, Mankweng and Mokopane are using the following appliances: Microwave, Electric stove, Geyser Iron, Kettle, Washing machine and swimming pool pumps. The households in Dendron and Gilead are using hot plates, water pumps, lights, television, iron and kettle. The households in the urban and semi urban areas are using electric geyser which are not covered by a geyser blankets. Some of the households in the rural part of the five Polokwane areas are using kettles to heat water than geysers. Due to changes of economic activities, many households in the rural areas are starting to install electric geysers which are one of the highest consuming appliances. The rural and urban areas are using more electricity at the same time during peak periods.

4.5.3 To reduce the continuous high electricity demand during the peak periods in Polokwane areas

The running of customer awareness campaigns in the urban area is a big challenge as indicated by the households in the four urban and semi-urban areas of Polokwane. From the load shedding experienced in 2008, the area of Polokwane is still showing no improvement on the electricity demand as indicated in fig 1.2 where the demand during the peak period is still very high. The contribution of the load also comes from the rural areas of Polokwane where customers are starting to install electric geysers in their homes.

4.6 Conclusion

The majority of the households who completed the questionnaire are males at 51% and females at 49% which is a balanced ratio. The majority of females are in Polokwane at 63% and Gilead at 60% while the males are in Dendron at 65% and Mokopane at 60%. The majority of the households who completed the questionnaires at 36% are between the ages of 20-30 with the lowest percentage of 18% between the ages of 51-60 years, which is good because the youth are the ones who completed at a higher percentage. All the five areas completed the questionnaire equally with 40 households per area. The private households who completed the questionnaire are sitting at 94% with business households at 6%. The usage of metres is balanced at 50% of the households using 20A metres and 48% of households using 60A metres, while 2% is using more than 60A. The majority of households at 47% lived in the house between the ages of 11-20 years. The majority of households are not aware of the geyser blanket as well as wind pump in the urban and rural areas, which is a gap that needs to be given attention by Eskom. Customer services department must liaise with the municipality in order to do road shows together in the urban areas because the rural people are the ones who have road shows. The urban areas are ignored because they are served by municipalities and Eskom assumes that municipalities will organise road shows.

CHAPTER 5

5.1 INTRODUCTION

During the data analysis the researcher came across some findings which are very relevant to the study. Recommendations are made and if they are implemented could help the households and Eskom to reduce the risk of load shedding and save money from the monthly bills of customers. The findings of the case study that was conducted in the five areas of Polokwane which included: Mokopane, Polokwane, Dendron, Gilead and Mankweng are discussed bellow as follows:

5.2 USE OF ELECTRICITY

5.2.1 The majority of the households in the area of Polokwane use more electricity between 06:00am – 08:00am in the morning and between 18:00pm – 20:00pm in the evening.

The main reason why electricity demand is very high in the morning is because households are preparing to go to work and school. In the afternoon many households are back at home and prepare for supper. Even though the other shops are closed, there are companies that operate for 24 hours like South African Brewery and when the households contribute to the demand, the risk of load shedding becomes very high. If the liquefied petroleum (LP) gases as well as the solar energy can be used by the households, the risk of load shedding will be reduced. The total load of Polokwane as indicated on figure 1.2 of chapter 4 shows that the demand peaks up between 18:00pm – 20:00pm. If other households can cook before 18:00pm and after 20:00pm, the risk of overloading and load shedding will be very low.

5.2.2 The five areas request road shows to educate households about electricity saving tips.

The households in all five areas of Polokwane are not covered by the road shows that are conducted by customer services. If Eskom customer services

can cover a lot of areas with their road shows, the demand of electricity on daily basis can decrease and reduce the risk of load shedding. The households in all four areas have complained about the communication of electricity tips not communicated in eleven official languages on national televisions. The continuous increase of electricity demand is an indication that road shows that have been conducted did not make any impact with regard to the reduction of load by households during the peak periods.

5.2.3 The majority of households in the rural areas want to upgrade their metres from 20A to 60A.

The majority of households in the rural areas had little knowledge about the size of metre and the impact when they increase their home appliances. The majority of households in the rural areas were only concerned about the installation cost and opted for 20A metres. Many households discovered that the 20A metre cannot handle the load of a stove and other electrical appliances at the same time and know there is an increase of applications in Eskom to increase from 20A to 60A.

5.2.4 Many households in the rural part of Dendron, Gilead and Mokopane are installing geysers in their homes.

When Eskom started to electrify the rural areas, there was an assumption that the usage of electricity in the rural areas would be very low and households would only use lights and hot plate for cooking. The majority of households in the rural areas are upgrading their metres to 60A and the purchase of high consumption electrical appliances like geysers, electric heaters are on the increase, causing the electricity demand to increase nationally and also increase the risk of load shedding.

5.2.5 Households in the Polokwane area are concerned about the disposal of energy saving bulbs

The households in the Polokwane area are worried about the risk that is posed by the energy saving bulbs due to the mercury that can cause problems to human health and the environment. The concern will also be given to the risk department so that the environmentalist together with health practitioners can go to the road shows together with customer services to explain and issue pamphlets about the risk and the disposal of the energy saving bulbs.

5.2.6 Communication gaps on television on advertisements the status of electricity

The medium of communication in Polokwane and the country as a whole is very important in order to make sure that the customers understand the message about electricity tips as well as the importance of saving electricity. This will reduce the demand of electricity during the peak hours and also reduce the risk of load shedding. The households in all four areas of Polokwane also complained about the use of other languages like Zulu and English to communicate with the people around Polokwane who are mostly speaking Sepedi, Venda and Tsonga.

5.3 ELECTRICITY USAGE PROBLEMS

5.3.1 Households are not installing solar geysers in their homes

The households in all five areas give the reason of high cost of installation of the solar geyser. Some households are in doubt that when the sun is not shining the risk of solar system is high, which will result in the unavailability of hot water. The cost of installing a solar system is a once off payment that will give the customer the benefit of lower electricity bill on monthly basis. The solar geyser will only cost the customers a lot of money during installation and the households customers will benefit from low cost of electricity and reduce the monthly water heating bill by an estimated 70%. LP gases as well can be used for cooking.

5.3.2 The majority of households in all the areas of Polokwane are not aware of the geyser blanket

Customer services department should educate customers about the importance of covering geysers with geyser blanket. The geyser blanket will keep the water warm for a very long time in summer and winter. The benefit to the customer will be the reduced monthly electricity bills.

The electric geyser contributes 39% of all households' electricity. Eskom customer services should educate households about the importance of switching off the geyser to clear the rumour of a geyser consuming more electricity when it was switched off.

5.3.3 The households want to earn points for saving electricity

Many households in all the five areas are of the view that customers who are making efforts to use electricity wisely must be rewarded by earning points on their electricity accounts. The awarding of points will encourage more customers to save electricity on daily basis. The households can visit this website for more information about saving tips:

http://www.eskomdsm.co.za/?q=energy_calculator. The website will help the households to calculate the consumption of different appliances in their homes. The appliances are divided by rooms, for example: kitchen appliances, sitting room appliances.

5.3.4 The households are concerned about illegal connections in all five Polokwane areas

The illegal connections cause problems for Eskom and the municipalities across the country. The households who connect to the system illegally cause the risk of high demand which cannot be predicted or planned by Eskom when the network of electricity is designed. The illegal connections also burn the transformers and cause blackouts to customers and also costing Eskom billions of money every year. The customers should report the illegal

connections to Eskom on the same number that is used to report electricity problems.

5.4 MOTIVATED RECOMMENDATIONS

From the findings discussed in this chapter the following recommendations are made:

5.4.1 Eskom customer services should educate customers about the geyser blanket

Many households in all the four areas of Polokwane are not aware of geyser blankets. Some households were asking about the places where they could find the geyser blankets and buy them. The geyser blankets save electricity for the customers and Eskom if customers can be made aware of the blanket and save energy to the country. The electric geyser contributes 39% of all households' electricity. Customer services should educate households about the importance of switching off the geyser to clear the rumour of a geyser costing more if it is switched off. The customer services department can work together with the municipalities in all the five areas to educate customers.

5.4.2 From all five areas of Polokwane households recommend that Eskom should use all eleven official languages when communicating the electricity saving tips

The households in all four areas have complained about the use of English and Zulu to communicate the electricity saving tips and the status of electricity usage around the country on national television. The message around the status of electricity that is broadcast on national television is not covering all the languages that are known by households.

5.4.3 The households should be encouraged to use the alternative source of energy for their home appliances

The households should consider the option of installing solar geyser for the heating of their water. The solar geyser will only cost the customers a lot of money once and the customers will benefit from low cost of electricity and reduce the monthly water heating bill by an estimated 70%. LP gases as well can be utilised on the stove for cooking. The cooking in most of the households is happening during the peak period which causes the demand of electricity to be very high.

5.4.4 There customer awareness campaign should be conducted ones every year in the five areas of Polokwane

The customer awareness campaign should be conducted once every year in all the areas of Polokwane to make more households aware of saving techniques. The households in all the five areas complained about lack of road shows to educate customers. The road shows will help to reach many customers and spread the message of saving tips that will benefit customers.

5.4.5 Solar heating systems installations should be encouraged among customers

Customer services department should encourage households to install solar heating systems in their homes in order to reduce monthly electricity bills. If the customers can install solar geysers in their homes, their electricity bills will be reducing by an estimated 39% every month.

5.5 CONCLUSION

The customers in all the five areas of Polokwane agree that the saving tips and the questionnaire of the research will help them to apply more electricity saving tips and save money to their monthly electricity bills. The education of more customers in both rural and urban areas of Polokwane will help to reduce the demand during peak periods and also when there is a shortage of supply from the Eskom generating stations, if customer services can run more

awareness campaigns in all areas which are supplied by Eskom and the municipalities.

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QUESTIONNAIRES ON:

MANAGEMENT OF ELECTRICITY USAGE BY HOUSEHOLD CUSTOMERS IN THE AREA OF POLOKWANE WHICH CONSIST OF THE FOLLOWING FIVE AREAS: DENDRON, GILEAD, POLOKWANE, MOKOPANE AND MANKWENG

1. Dear Participant

Thank you for taking your time to complete this questionnaire. It will take you about 20 minutes to complete.

2. General information

- This questionnaire does not test your competence or knowledge; your honest opinion is all that matters.
- There are no wrong and right answers
- Your name remains anonymous
- The questionnaire is divided into three sections, please complete all of them.

3. Section1 (Biographical Information)

Mark your choice with an "X" inside the box.

3.1 Gender Male Female

3.2 Age in years 20-30 31-40 41-50 51-60

3.3 State one the name of the five areas (e.g. Polokwane,Dendron, Gilead,Mankweng and Mokopane) _____

3.4 State whether if it is a business or private household _____

3.5 What is the size of your metre _____
(For example: 20A, 60Aor more than 60A)

3.7 How long have you been staying in years 1-5 6-10 11-20

4. SECTION 2

STATE TO WHAT EXTENT DO YOU AGREE OR DISAGREE WITH THE FOLLOWING STATEMENTS: MARK YOUR RESPONSES WITH AN "X".

PLEASE ANSWER THE FOLLOWING QUESTIONS AS TO HOW YOU USE YOUR ELECTRICITY AND ELECTRICAL APPLIANCES AT HOME

Questions of electricity usage	Please answer the following: Y =Yes, N= NO, NA=Not applicable, P=Partially				
	Y	N	P	NA	Remarks
1. Is the energy saving bulbs utilised?					
2. Is the temperature of the geyser set to the most efficient level?					
3. Are energy efficient water heating systems utilised (e.g solar, heat pump)?					
4. Do you know the peak period of electricity demand?					
5. Is gas utilised for cooking?					
6. Are electrical appliances switched off when not in use?					
7. Do you buy energy saving appliances at home?					
8. Will the application of energy saving tips save money to your monthly bill?					
9. Do you use a shower or a bath for bathing?					
10. Do you use electric heater in winter?					

5. SECTION3 (OPEN-ENDED QUESTIONS)

5.1 What time do you use more electricity in your house (gap6)?

5.2 What kind of electricity appliances do you prefer to use in your house (gap 1)?

5.3 What benefits do you get when using less consuming appliances (gap 2)?

5.4 What other alternative source of energy can you use in your home (gap 4)?

5.5 What kind of advice can you give Eskom to educate other household customers (gap 5)?

This marks the end of the questionnaires

Thank you very much for taking your time and dedication to complete this questionnaire.