The impact of rising electricity tariffs on the urban poor

A South African case study

Lana Franks
FRNLAN003

Supervisor: Gisela Prasad

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Department of Mechanical Engineering

University of Cape Town

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Declaration of authenticity

I, Lana Franks, hereby declare that the above thesis is my original and unaided work and that apart from appropriate guidance from my supervisor, I have received no assistance. The above thesis has not been submitted in the past or been submitted at any other university.

Signature: Signed by candidate

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LIST OF ABBREVIATIONS AND ACRONYMS

CPI	Consumer Price Index
EA	Enumeration Area
FBE	Free Basic Electricity
IES	Income and Expenditure Survey
INEP	Integrated National Electrification Programme
LPG	Liquid Petroleum Gas
LSM	Living Standards Measure
MEPI	Multidimensional Energy Poverty Indicator
NERSA	National Electricity Regulator of South Africa
NUMSA	National Union of Metal Workers of South Africa
OPHI	Oxford Human development Initiative
SAARF	South African Audience Research Foundation

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II. Executive Summary

Historically, South Africans have benefited from relatively cheap electricity where tariffs have not been cost reflective and kept below inflation. Tariff structures have not fully accounted for the cost of investing in new infrastructure for generating, transmitting and finally distributing electricity to the end user. This has partly contributed to an inadequate and constrained electricity supply that is insufficient to meet the growing energy demand in South Africa e.g. the 2008 rolling blackouts (Tait 2011) .

Since 2004 the average electricity tariff has however increased above inflation to be able to invest in Eskom's New Build Programme. The increases between 2008 and 2011 were particularly high, in the range of 16 – 22% in real terms. The National Electricity Regulator of South Africa approved an 'above inflation' annual average increase of 8% on the 1 April 2013 for Eskom customers and 1 July for municipal customers (NERSA 2013). The sectors however, do not experience the same degree of increase. This study aims to measure the increases experienced by urban poor households and determine the effect of the increases on their energy choices. It was initiated mainly to address concerns that Eskom's tariff increases may affect the access and long-term affordability of electricity for the poor.

Electricity is foundational to society's ability to function well and without it essential services such as lighting, cooking and virtually anything electronic, will be negatively affected. Thus, any threat to service delivery on the side of the utility and affordability on the side of the customer should both be addressed by pro-poor policies. Eberhard and PDG (2010:2) made a compelling argument that if Eskom cannot extend their generation capacity, which is partly financed through a tariff, then this is not pro-poor. Increasing tariffs so that it is more cost reflective is essential to achieve the objective of meeting the growing electricity demand in the face of an ageing electricity network and a historically cheap electricity price. Tariff increases are inevitable. The real question therefore is how to balance the needs of the utility and the customer; the price of service delivery and the level of affordability, especially for the poor.

Since society functions as a system of interconnected parts a holistic, system's thinking approach, has been necessary in exploring the research question.

This is reflected throughout the entire report which is interlaced with nuances of history, economics, socio-economics, social theory and technology.

Increases in electricity tariffs could potentially cause poor households to either increase their expenditure to maintain consumption; change their behaviour through energy savings; or compromise their health and safety by switching back to unsafe and inefficient fuels such as paraffin or wood (Gassmann 2012; Human Science Research Council and Department of Energy 2012). To explore this in detail a mixed methods research methodology was used for the study. The method included a qualitative approach using a household survey to assess households' perception of past and future tariff increases, as well as capture the changes to their energy choices in view of these increases. Imizamo Yethu informal settlement in Hout Bay, Cape Town, was selected for the survey; forty households were interviewed using an in-depth questionnaire. This was accompanied by a range of quantitative techniques to analyse three main datasets, viz. the City of Cape Town electricity tariffs between 2006/07 and 2013/14 ; the income, energy and food expenditure data from the Income and Expenditure Survey (IES) 2010/11 and 2005/06 ; and the electricity consumption history of households in the case study.

In a scenario where poor households are confronted with an annual real increase in electricity tariffs, the study has considered five hypotheses that encapsulate the ways in which they may respond to it.

i. Households maintain their electricity consumption showing no significant difference in consumption before and after tariff increases. They would therefore pay extra for electricity most likely at the sacrifice of other competing budgetary items such as food or transport.
ii. Households reduce their electricity consumption through saving electricity by means of efficiency or deprivation.
iii. Households substitute electricity with unsafe fuels such as paraffin.
iv. Households substitute electricity with other modern fuels such as gas.
v. Households reduce their electricity purchases but continue to use electricity through meter-tampering/theft.

The study has eleven main findings:

1. Poor urban households who have their own electricity connections and receive free basic electricity subsidy have largely been shielded from tariff increases, experiencing a minimal real increase from year to year.
2. Poor urban households who share electricity meters have however been negatively affected by tariff increases, having to cut back on food to pay more for electricity. The tariff is not the problem however sharing a meter is which results from the complexities of human settlement in the townships.
3. Educating poor households on how the inclining block tariff works will assist them to better manage their energy consumption and retain their free basic electricity subsidy, thus avoiding paying more for electricity than is necessary.
4. In response to tariff increases, 73% of households in the Imizamo Yethu sample have reported that they pay extra to maintain their electricity consumption, some at the sacrifice of food. The tariff however is not the fundamental problem.
5. Households in Imizamo Yethu incorrectly perceive paraffin to be cheaper for cooking meals such as samp and for space heating.
6. Nationally, real increases in income allowed households to buffer the effect of rising tariffs and maintain a constant energy expenditure ratio between 2005 and 2011.
7. Nationally, roughly 3.5 million eligible households do not receive their free basic electricity subsidy largely due to an institutional failure on the side of both Eskom and Municipal distributors.
8. If poor households in informal settlements face 'above inflation' tariff increases in the future, paraffin use will rise.
9. It is unlikely that the use of LPG will rise as an alternative fuel among black African households in informal settlements, without dispelling the fear factor through awareness campaigns.
10. Existing energy poverty indicators applied in South Africa, such as the energy expenditure ratio, are inadequate for effectively measuring and tracking energy poverty over time.
11. Analysing the impact of rising electricity tariffs on the poor should not be done in isolation. A systems thinking approach is necessary to understand the triple effect of an increase in food, transport and electricity costs and

understand the difficult task poor households have to cope with the rising cost of living.

Based on these findings, the study makes six strong recommendations:

1. The complex relationship between human settlement and energy needs to be further explored.
2. An energy-use communication strategy should be designed to educate households on how the tariff works and also equip them to make good energy choices.
3. A paraffin study needs to be conducted that determines firstly the extent of paraffin use in South Africa and investigates the prevalence among black African households compared to other population groups. Second, a lifecycle cost analysis of electric heaters versus paraffin heaters needs to be done to determine the total cost over the lifetime of the appliance. Third, the dangers of using paraffin need to be reinforced in informal settlements, providing alternative safe solutions to space heating needs such as electric heaters, hot water bottles, blankets, and gas.
4. Further research is required to investigate the tariff increases in other municipalities in South Africa, since municipalities have the right to implement different surcharges resulting in multiple tariff structures across South Africa. The analytical techniques used to assess the tariff history in the City of Cape Town municipality could be used to assess the increases experienced by urban and rural households, particularly in provinces where free basic electricity is not implemented effectively.
5. The extent and cost of sharing an electricity meter should be further explored and quantified in all the large provinces in South Africa such as Gauteng, KwaZulu-Natal and Western Cape that have the largest proportions of households in informal settlements.
6. Existing energy poverty indicators used in South Africa should be improved upon, such as developing a multidimensional energy poverty indicator (MEPI) similar to what has been initiated by the Oxford Poverty and Human Development Initiative (OPHI). This will more adequately track energy poverty over time.

PART A: BACKGROUND AND LITERATURE REVIEW

1 Introduction

1.1 Rationale for study

This dissertation aims to measure the impact of rising electricity tariffs on urban poor households in South Africa. It was initiated mainly to address the collective concern of the general public, trade unions, various lobby groups and the energy poverty research community, that Eskom's tariff increases may negatively affect the access and long-term affordability of electricity for the poor.

The South African government has continued to voice a constitutional commitment to ensure electricity access for all households. Despite setbacks to achieving this goal by 2012, it has a renewed commitment of 92% by 2014 (Mbeki 2004; Human Science Research Council and Department of Energy 2012). In addition to access, it has sought to provide households with 50kWh of free basic electricity to mitigate the affordability constraints experienced by poorer households (Prasad, Ranninger, Abbot, Dingley, Goodman, Lloyd, Mwakasonde, Nkomo, Sparks, Stuart, Thom, White, Barbeton, Dekenah, Heunis and Pauw 2002). Rising electricity costs could thus be a possible barrier to fulfilling the government's commitment of providing affordable energy services to poor South African citizens; for this main reason this study is important and has implications for both households and policy makers.

1.2 Hypotheses

This study makes a clear distinction between the nominal versus real increase in tariffs, expenditure and income. Measuring the impact of a real price increase in electricity, on the energy choices of the poor, is the main focus of this study. A 'systems thinking' approach will further illuminate the knock-on effects accompanying a change in household energy. Thus, in a scenario where poor households are confronted with an annual real increase in electricity tariffs, the study will consider five hypotheses that describe the ways in which households may respond:

i. Households maintain their electricity consumption showing no significant difference in consumption before and after tariff increases. They would therefore pay extra for electricity most likely at the sacrifice of other main budgetary items such as food or transport (Hypothesis 1).

ii. Households reduce their electricity consumption through saving electricity by means of energy efficient behaviour and/or technology; or energy deprivation where they live without the essential energy service (Hypothesis 2).

iii. Households reduce their electricity consumption through substitution with unsafe fuels such as paraffin (Hypothesis 3).

iv. Households reduce their electricity consumption through substitution with alternative modern fuels such as liquid petroleum gas (LPG) (Hypothesis 4).

v. Households reduce their electricity purchases but continue to use electricity through meter-tampering/theft (Hypothesis 5).

1.3 Research Methodology

1.3.1 Review of relevant literature

The literature review aims to highlight some of the major findings thus far pertaining to the access, use and affordability of electricity for the poor, in addition to other factors that have bearing on how their income is allocated (the triple effect of a rise in food, transport and electricity costs). This is a systems thinking approach which considers the multidimensional nature of poverty.

Both South African and international studies are reviewed. The South African research gives a strong local context for the electricity access, tariffs and consumption of the poor (mainly urban highlighted) and non-poor (serving as a comparative case), in addition to their income and expenditures. International studies, such as Gassmann (2012) (Kyrgyz Republic) and Keener and Banerjee (2005) (Ghana), together with a South African study by the Human Science Research Council and Department of Energy (2012), provide a range of research methodologies that have been used in the past to answer a similar research question; this has assisted in developing the research method used in this study.

1.3.2 Analysis of City of Cape Town's domestic tariff history

The historical tariff increases experienced by domestic urban customers residing within the City of Cape Town municipal district will be analysed and discussed as a case study, in Part B of the thesis. This will include both an in-depth and comparative analysis between different customer categories, i.e. low, medium and high-purchase customers as defined by the study.

1.3.3 Analysis of the national Income and Expenditure Survey

The IES conducted by Statistics South Africa (2011b) every five years has produced a rich source of data, some of which serves as pertinent comparative and baseline data for this study. The comprehensive dataset spans across gender, population groups, income deciles, expenditure deciles, provinces and settlements. For the purpose of this study's focus on the urban poor, the data will largely be extracted from the published 2010/11 and 2005/06 report (Statistics South Africa 2006; Statistics South Africa 2011b). In the analytical section (Part B) of this study, 2010/11 and 2005/06 will be compared in real terms to investigate if energy expenditure has changed over the five year period and whether the electricity tariff increases have had a notable or insignificant impact on spending.

1.3.4 Design of local survey for Imizamo Yethu informal settlement

1.3.4.1 Questionnaire design

The questionnaire was chiefly designed to determine how households perceive the price of electricity, what choices they have made to meet their energy needs and whether these choices were affected by the recent electricity tariff increases (12 months prior to the survey to reduce recall problems). It was guided by the following subsidiary research questions:

Income and expenditure of the poor

i) Who are the poor? What is the income bracket?

ii) What do the poor use for lighting, cooking, water heating and space heating?

iii) Does electricity compete with other essential budgetary items such as food?

Impact of rising tariffs on the poor

iv) How have the poor responded to recent tariff increases?

v) Have rising electricity costs reduced their food expenditure?

vi) Have they reverted back to using inefficient and unsafe fuels such as paraffin, candles and or wood?

Affordability margin of electricity for the poor

vii) At what price does electricity become unaffordable for the poor? What are they willing to pay to maintain their existing consumption?

viii) Are existing policies and subsidies sufficient to protect the poor?

Informing pro-poor policies for the future

ix) What projections can be made into the future that can inform pro-poor policy in view of increasing tariffs?

x) What are other affordable modern fuels that can be accessed by the poor? Is LPG a viable substitute and are the poor interested in it?

The questionnaire was designed for a 45min to 1 hour interview with a knowledgeable adult member. Based on the prevailing culture in South African townships, this would generally be the mother in the household; she most often does the cooking and bathes the children, and may therefore have a better sense of electricity costs and general food expenditure.

1.3.4.2 The sample universe

The sample universe for the survey firstly includes only permanent South African residents of the Imizamo Yethu settlement who have access to electricity. According to Census 2011, at least 80% of households in Imizamo Yethu have access to electricity (Statistics South Africa 2011a). This includes

both households who have their own electricity meters and those who obtain access to electricity via extension cords.

Secondly, it is desirable to include relatively equal numbers of households who share meters and those do not share as a comparative study. It has been speculated that those who share meters are charged more by private sellers and therefore bear higher electricity costs. This study aimed to verify this with evidence from the sample.

Thirdly, since the sample size was small (40 households) it would thus be overly ambitious to assume that all the survey findings are representative of the entire urban poor population in South Africa. As far as possible, it will be made clear which findings are representative of a larger population where similar trends are likely to be found; these regions or where known, the specific settlements, will be listed and the number of affected households in each will be estimated using the Census 2011 household data.

Fourthly, the study narrowly focuses on assessing the impact on income poor households. In practice, it is difficult and somewhat intrusive to do a walk about in an unfamiliar community and enquire about household income at random as the qualifying feature for participation in the survey; income is considered personal. Although Imizamo Yethu is considered a low income community, not all the households fall within this income category. In this instance it is not possible to have both a randomised sample and a homogenous one where only income poor households are included. To overcome this, a comparative study is used which allowed the inclusion of both poor and non-poor households, selected at random. In this way the study will highlight whether the responses of poor households are different to that of the non-poor and in so doing elicit a unique case for the poor.

1.3.4.3 Sampling method

A random sample of households was selected in keeping with good practice (Human Science Research Council and Department of Energy 2012). To ensure a good representation of the community, there needed to be equal proportions of formal and informal housing, as well as households with their own electricity meters and those who share meters via extension cords. The areas in Imizamo Yethu are clearly demarcated as can be seen Figure 1: **A** –Informal dwellings on unproclaimed land with extension cords. **B** – Informal dwellings on proclaimed land with their own meters. **C**- Formal dwellings with their own meters; some of which included electric geysers.

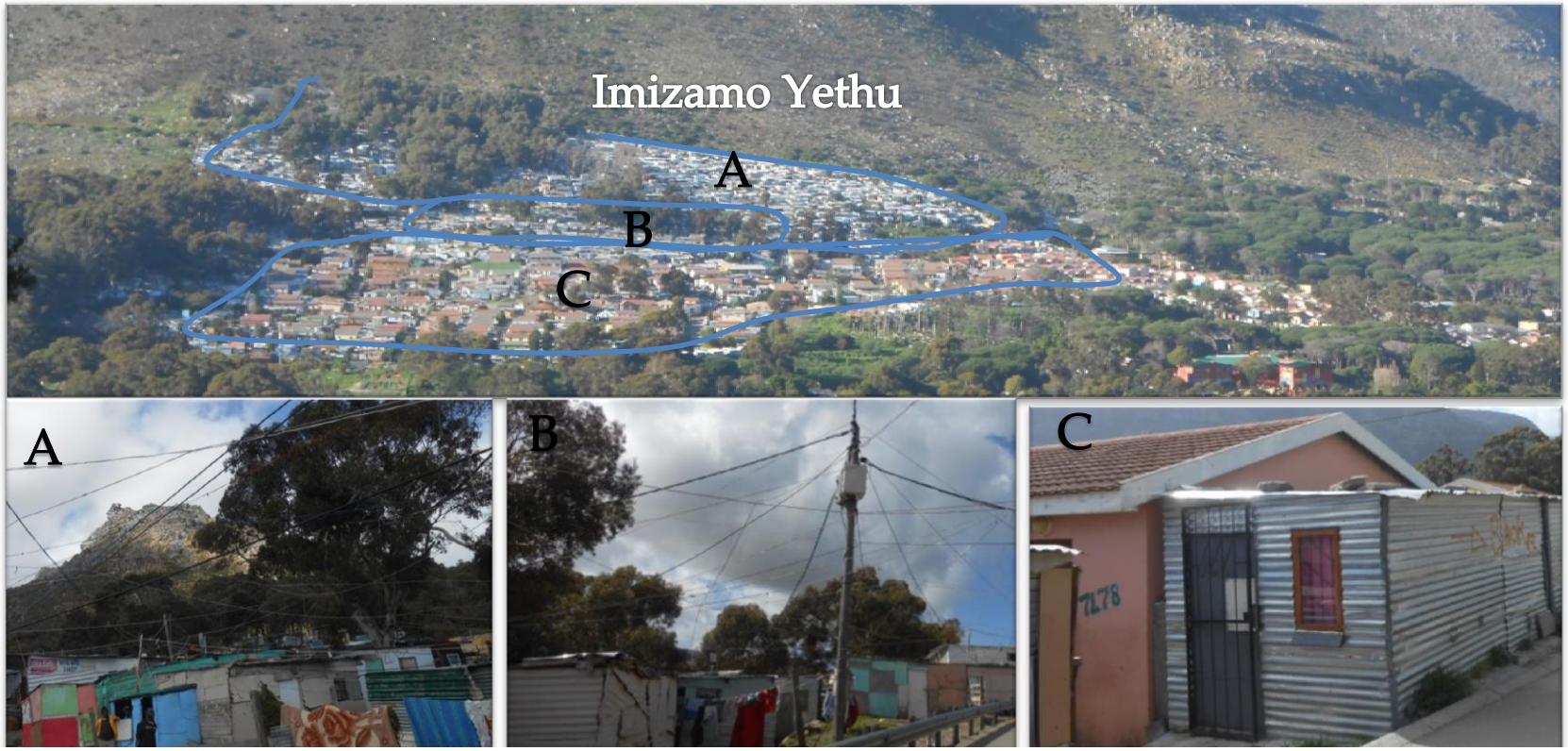


Figure 1: Photos of the different areas in Imizamo Yethu that were sampled

One fieldworker from the community, who had experience with household surveys, was employed to assist with interviews. The questionnaire was discussed in detail, giving the fieldworker an opportunity to ask questions of clarity before interviews began.

Figure 2: An illustration of multiple numbers on an informal dwelling in Imizamo Yethu

Formal dwellings are permanent structures made of brick and built within areas zoned for housing. Informal dwellings are less-permanent structures constructed mainly with corrugated iron, wood and cardboard and commonly referred to as a shack. In Imizamo Yethu, there are shacks built on proclaimed land (land approved for settlement), in backyards within formal sections and thirdly on unproclaimed land (land not approved for settlement/or zoned for housing).

The number of dwellings in each section was estimated using an official map with street names and house numbers for section C. In addition, the City of Cape Town personnel who are involved in numbering the structures were consulted to assist with estimations for the newer sections excluded from the map. The estimated number of dwellings for each section was entered into Excel to generate a random table of numbers of relatively equal size, i.e. 13 x A, 12 x B, 12 x C.1 (geysers), 13x C.2 (no geysers), a total of 50.

The budget allowed for a total of 50 households to be interviewed, but only 40 households could be interviewed within the allocated time. Finding the dwelling numbers presented a challenge as can be seen in Figure 2. It is common for informal dwellings to have more than one number; the brick houses also do not follow an ordered numbering system. To address this matter, the nearest dwelling was chosen to avoid compromising the randomisation generated by Excel. This included cases where the head of the household was not available. In addition, follow-up interviews were scheduled in cases where answers in questionnaires were missing or needed further clarity; this further impacted on time.

1.3.4.4 Data capturing

A total of 40 questionnaires were uploaded into SPSS version 21 as the primary database. The database, excluding the personal details of households such as surnames, street addresses and contact numbers, can be made available to the public domain on request.

The individual questionnaires were given a unique number with the prefix 'zam'. Throughout the report these unique numbers will be used to identify households.

1.3.5 Analyse and discuss Imizamo Yethu survey results

The analysis will follow a similar approach to that of Keener and Banerjee (2005), where response are analysed in conjunction with the actual electricity purchasing history. When referring to prepayment metres a purchasing history is not necessarily the same as a consumption history. The municipality is only able to capture the number of units purchased in a month and not how much of the units were consumed at the box; whereas a credit meter records the actual consumption history of households. The thesis will therefore refer to a purchasing history that is only indicative of consumption levels. These will serve to supplement the findings of the questionnaire survey and double check whether what households stated as a response to tariff increases is in fact what the data shows, i.e. which of the hypotheses holds true for the household.

This study largely focuses on assessing the changes to a household's electricity purchases for the most recent tariff change on the 1 July 2012 for the City of Cape Town customers. The Revenue Protection department furnished all the electricity consumption data (July 2009 to July 2013) for the participants for whom meter numbers were available at the time of enquiry, see ANNEXURE 2 (City of Cape Town 2013a).

1.4 Contextual Background

1.4.1 The politics of energy in South Africa

South Africa is a country in transition. Nineteen years into its democracy, the newly elected South African government continues to face the great task of transforming its historically fragmented society. The vision cast by the governing political leaders since their inception has been to eradicate the effects of apartheid, where poverty, injustice and inequality are abolished in all spheres of society. As such, the post-apartheid government has made some impressive progress in stimulating economic growth and providing access to formal housing, electricity services and piped water for those previously deprived of such basic services (Ntsebeza and Hall 2007). In so doing, multidimensional poverty, as measured in non-monetary terms to include deprivations in health, education and living standard, has declined considerably since 1993 (Finn, Leibbrandt and Woolard 2013).

The Census 2011 data provides evidence of progress, showing improved access to basic services since 1996. One such improvement is electricity access and the increased affordability of using it through the free basic electricity (FBE) subsidy. Marquard (2006) emphasises that the apartheid government neglected the basic needs of the majority of non-white South Africans, leaving them to live in sub-optimal conditions outside of the developed urban spaces. They were thus far from income-earning opportunities and a secure electricity grid amongst other basic amenities.

The new dispensation therefore must be marked by improvements in the living standards of these historically disenfranchised communities. Prasad, Ranninger et al. (2002) and Eberhard and PDG (2010) highlight the essential role subsidised access to electricity plays in improving the living standards of the poor, which includes access to learning through efficient lighting; access to communication and entertainment through television and cellphone charging; and improved health and safety through access to modern fuels.

According to the national Census data, electricity access has improved from a low of 58.2% in 1996 to a high of 84% in 2011 (Statistics South Africa 2011a). These achievements should not be undermined and yet at the same time cannot be allowed to overshadow the great task that lies ahead in reaching the 3.4 million households who have not yet been electrified (Eberhard and PDG 2010). The goal post for universal electricity access as shifted from 2012 to an

intermediary goal of 92% by 2014 (Human Science Research Council and Department of Energy 2012).

Not all indigent households receive the FBE subsidy due largely to implementation failure at a municipal level (South African Local Goverment Association 2012). Eberhard and PDG (2010) projected that about R4 billion (2010 Rands) per annum will be needed in the future to subsidise the cost of providing 50kWh of FBE to the 4 million indigent households who already have been electrified. Their study notes that in the context of increasing electricity costs, the full implementation of these policies could result in subsidies limited by fiscal and macro-economic constraints. Without subsidies the poor will struggle to make ends meet since poverty in South Africa is largely systemic in nature, rooted in politics, economics and social constructs.

Rank, Yoon and Hirschl (2003) argue against a common view that poverty is due mainly to personal failure such as personality traits or laziness. Instead they argue that systemic poverty is largely caused by a market failure, where a country's market structure fails to provide sufficient well-paying jobs to keep households out of poverty. This they call structural poverty. It is here where South Africa's transition has been the slowest, with dramatic increases in unemployment since 1993 (Leibbrandt and Levinsohn no date) The latest Census 2011 estimates unemployment to be roughly 31% of the employable population. Henceforth, though electricity access is a huge gain, it will fail to confer its inherent benefits to households who are too poor to afford its services.

To conclude, the politics of energy therefore forms part of the vision and constitutional mandate of the South African government to meet the basic needs of the poor, in the face a historic faulty foundation of economic inequality and social injustice. This kind of restitution is necessary. Subsidising the poor, is essential (Prasad, Ranninger et al. 2002; Eberhard and PDG 2010; Winkler, Simoes, La Rovere, Alam and Rahman 2011)

1.4.2 The relationship between energy and human settlement in Imizamo Yethu

The issue of land has great historical significance in South Africa - the complexity of human settlement in the Hout Bay township, Imizamo Yethu, bears testament to this. Under the 1913 Natives Land Act, the white

colonialists in South Africa took ownership of more than 90% of the land leaving the remaining marginal areas to the majority of the population to harness for their economic and social benefit (Ntsebeza and Hall 2007); an injustice, resulting in insurmountable and catastrophic social ills, which is beyond the scope of this thesis.

Figure 3: Shacks erected at the foot of the mountain in Imizamo Yethu

Since the late 1980's when the prohibition of black migration into urban areas was repealed, the influx of black African people into urban spaces grew rapidly. Urbanisation thus became the major cause of the sporadic growth of informal settlements in many major cities (Visagie 2008). The Imizamo Yethu township in the City of Cape Town municipal district, is one such settlement formed in 1991 (Oelofse and Dodson 1997). According to Census 2011, there are 6011 households in Imizamo Yethu, of which 3685 dwellings are shacks (not in backyard) of the kind in Figure 3 (Statistics South Africa 2011a). This is an increase of 1901 shacks (107%), calculated using Census 2001 data for Imizamo Yethu (Statistics South Africa 2001)

Figure 4 Shack commonly known as a 'backyard dwelling'

Imizamo Yethu is now home to a diverse populace, originating from many parts of rural Eastern Cape and even as far afield as Somalia, Zimbabwe and Malawi (economic refugees) (Statistics South Africa 2011a). They relocate in the hope of finding work to provide for themselves and the family members left behind in the villages. Migrants mainly live in shacks, which are informal dwellings often built with inferior building materials such as corrugated iron and common debris such as cardboard, plastics and wood. These less permanent materials make for ease of construction, accommodating the sporadic nature of human settlement in the townships (Cowan 2008a). To accommodate new settlers, home owners of formal dwellings rent out space in their backyards or on their front pavements (backyard dwelling) (Figure 4). Statistics South Africa (2011a)

report that at the time of the Census there were 903 shacks erected on the property of formal dwellings, who often share essential services such as electricity, water and ablution facilities. This is an increase of 312 shacks (53%) since 2001 (Statistics South Africa 2001).

Such unregulated and rapid human settlement, with its haphazard and unpredictable spatial arrangement has made service delivery problematic for the City of Cape Town(City of Cape Town 2013b). This is not unique to Imizamo Yethu; a visit to any of South Africa's informal settlements will reveal a similar dynamic formation with varying levels of spatial disorder (City of Cape Town 2013b).

Figure 5: An extension cord highlighted in black used for sharing a meter in Imizamo Yethu

Not every household who applies for an electricity connection is eligible for one. Households are only eligible for services if they are established on land approved for settlement by the city's local authorities. The term used is "Proclaimed Land". Donsekyake in Imizamo Yethu is a settlement established on "Unproclaimed Land". As a result no one living there has their own electricity meter, where possible they share with owners in other dwellings via lengthy extension cords (Visagie 2008), (Figure 5). These informal and unsafe extension cords are highlighted in. A maximum of three households in addition to the owner can be connected to one electricity meter via the extra sockets on the box in terms of available sockets (Figure 6). However, the majority of meters installed are rated at 40Amps and would restrict the number of additional households that can be connected to the box in terms of its rated current capacity; overloading the system would need to be further investigated to determine how many households could draw current from one meter box without affecting the reliability of supply.

Figure 6: Prepayment electricity meter (40 Amps) shared between the owner and three other households connected via extension cords in Imizamo Yethu

2 Literature review

There are five major questions are under consideration in the literature review:

i) Why and to what extent have average electricity tariffs risen in recent years?
ii) What are the income and expenditure trends of the urban poor in South Africa?
iii) How much electricity do the poor consume on average and does it meet their basic needs?
iv) What research methods have been used to determine the impact of rising electricity tariffs on the poor?
v) Are existing energy poverty indicators sensitive or responsive to the impact of rising tariffs on households?

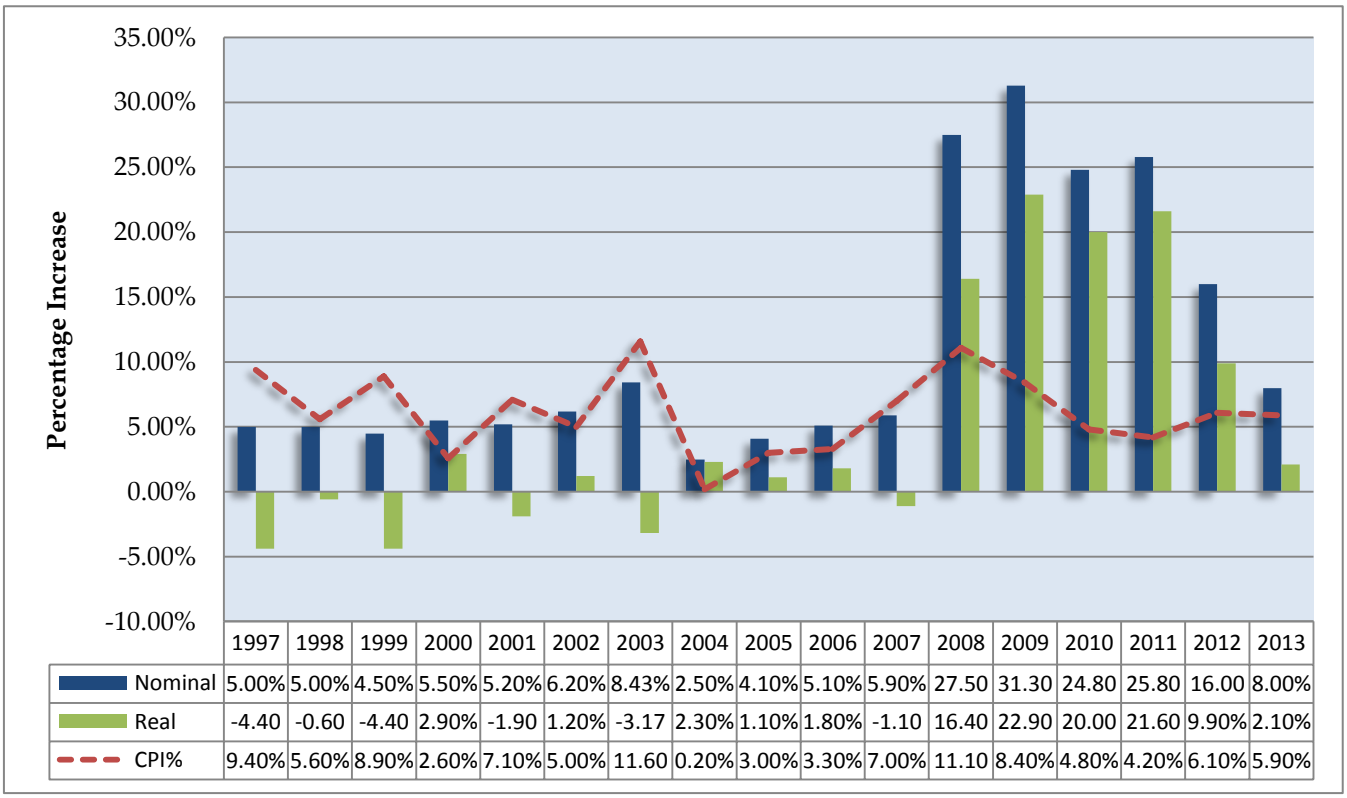
These questions will be addressed in the forthcoming sections.

2.1 A basic account of Eskom's average electricity tariff increases

Service delivery protests are not uncommon in South Africa. The start of 2013 saw passionate protests against Eskom's proposal to increase electricity tariffs by an average of 16%; concerns were raised for poor consumers for whom affordability of adequate electricity consumption is already a struggle. In view of the burden such a steep increase would place on customers, the National Energy Regulator of South Africa (NERSA), made a decision to only approve an average annual increase of 8% (NERSA 2013) for the next five years from 2013/2014 to 2017/2018. This 8% average increase however is greater than inflation, which thus continues to evoke fears in pro-poor lobby groups that higher electricity costs will reduce the affordability margin of electricity for the poor. As such, they've raised concerns that households may resort back to inefficient and unsafe alternative energy sources such as paraffin and candles (Bawa 2013). The National Union of Metalworkers of South Africa (NUMSA) has been chiefly concerned about the possibility of job losses within energy intensive industries such as the manufacturing and mining sectors. They argue that these job losses resulting from electricity price increases will further exacerbate unemployment and poverty in South Africa (NUMSA 2013)

Electricity tariffs will increase to recover the cost of generating, transmitting and distributing electricity – the increase aims to finance rising operating costs (coal prices have increased above inflation in recent years), replace and maintain ageing networks, and contribute to Eskom's 'new build

programme' which will be used to strengthen and expand its generation capacity to meet South Africa's growing electricity demand (Fin24 2012; Eskom 2013b). Prior to 2004, the average tariff increases have been below inflation or CPI% (Figure 7), providing the South Africa economy and households with a relatively low tariff, one that generally has not been cost reflective (Ramokgopa 2008; Eberhard and PDG 2010).Ideally, tariffs should be designed to recover costs to ensure longevity of the network and security of supply to meet the growing demand, thus avoiding a repeat of the 2008 national rolling blackouts (Eberhard and PDG 2010; Tait 2011). Eberhard and PDG (2010) argue that if Eskom cannot extend their generation capacity, which is partly financed through a tariff, then it does not promote pro-poor policy. A reliable electricity network is critical to economic development in South Africa; tariff increases are inevitable. The real question therefore is how to meet the needs of the utility while protecting the poor against affordability constraints (Eberhard and PDG 2010)



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Nominal	5.00%	5.00%	4.50%	5.50%	5.20%	6.20%	8.43%	2.50%	4.10%	5.10%	5.90%	27.50	31.30	24.80	25.80	16.00	8.00%
Real	-4.40	-0.60	-4.40	2.90%	-1.90	1.20%	-3.17	2.30%	1.10%	1.80%	-1.10	16.40	22.90	20.00	21.60	9.90%	2.10%
CPI%	9.40%	5.60%	8.90%	2.60%	7.10%	5.00%	11.60	0.20%	3.00%	3.30%	7.00%	11.10	8.40%	4.80%	4.20%	6.10%	5.90%

Source: [1]Own claculations based on Eskom (2012); Statistics South Africa (2012)

Figure 7: Eskom tariff increase compared to CPI (2012=100) between 1997 and 2013

[1] The formula used: Real increase (%) = Nominal increase. (%) - CPI increase (%). The Nominal increase taken from Eskom's tariff schedule but the CPI increase was recalculated using a more updated table with 2012 as the base year (CPI=100) in order remain consistent throughout the thesis.

From the plot in Figure 7, the increases in both real and nominal terms soared above inflation (CPI%) between 2008 and 2012, with the greatest spike in 2009 (Eskom 2012). Yet, in view of the historically low tariffs, those sharp nominal increases after 2008 worked to recover the loss in revenue due to under-pricing electricity in previous years. It has had to play 'catch-up' in order to become more cost reflective and thus closely matches the trend in inflation by the end of 2011 (Altman 2010). Although the average annual increase has been greater than inflation since 2004, the overall cumulative real increase between 2006/07 and 2013/14 has remained lower (Figure 8). However, in view of the future there is clearly an upward trend; shielding the poor against any adverse effects of real price increases should be considered when designing tariffs (Eberhard and PDG 2010).

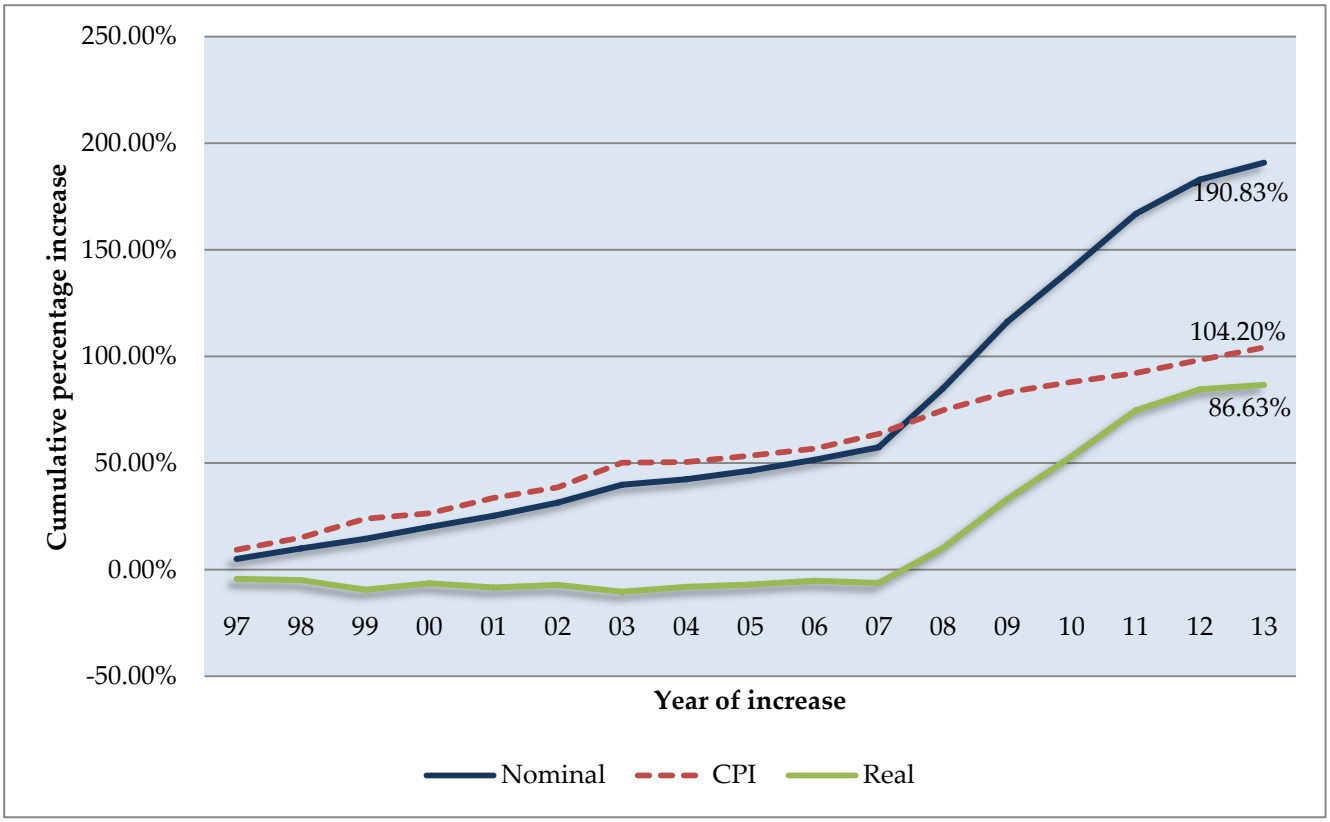


Figure 8: Cumulative increase in Eskom's average price of electricity between 1997 and 2013

Source: Own claculations based on Eskom (2012); Statistics South Africa (2012)

This study highlights the difference between nominal and real price increases. Making the distinction is critical to the arguments made in this study, showing that much of the negative reaction has been toward the nominal price increases. When reflecting on the real price increase, a different picture emerges. Comparing nominal values over time can be misleading, since the value of money, also referred to as the purchasing power of money, changes over time as a result of inflation. The bundle of goods we could buy for R50 in the year 2000 is worth R100 in 2012 using a CPI based in 2012; in other words R50 in 2000 is equal to R100 in 2012 (Statistics South Africa 2012). The CPI is used to convert the nominal Rand values for different years to a real Rand value in a common base year, as if time had not lapsed. Doing so removes the effect of inflation and allows for comparability. It is important to compare real values that have been deflated by CPI to obtain an accurate and true reflection of change. There are a few studies that have reported nominal increases in electricity tariffs, without declaring whether it is in nominal or real terms (Table 1). For the purpose of clarity, this study will make a clear distinction between real and nominal values. To ensure overall comparability and continuity, all Rand values will be in 2013 terms, unless otherwise stated.

Table 1: Studies that have reported nominal increases in electricity prices

Average electricity increase of 378% between 2001 and 2011 (Abrahams, Fischer, Martin and McDaid 2013).
Residential tariffs increased by 14.3% in 2010/11 and 16% in 2012/13 (Human Science Research Council and Department of Energy 2012).
The cost per kWh nearly doubled between 2009/11 and 2013/14 (Oxfam 2013).
Average tariffs increased by 77% between 2009/10 and 2012/13 and 100% between 2009/11 and 2013/14 (City of Cape Town 2013d)

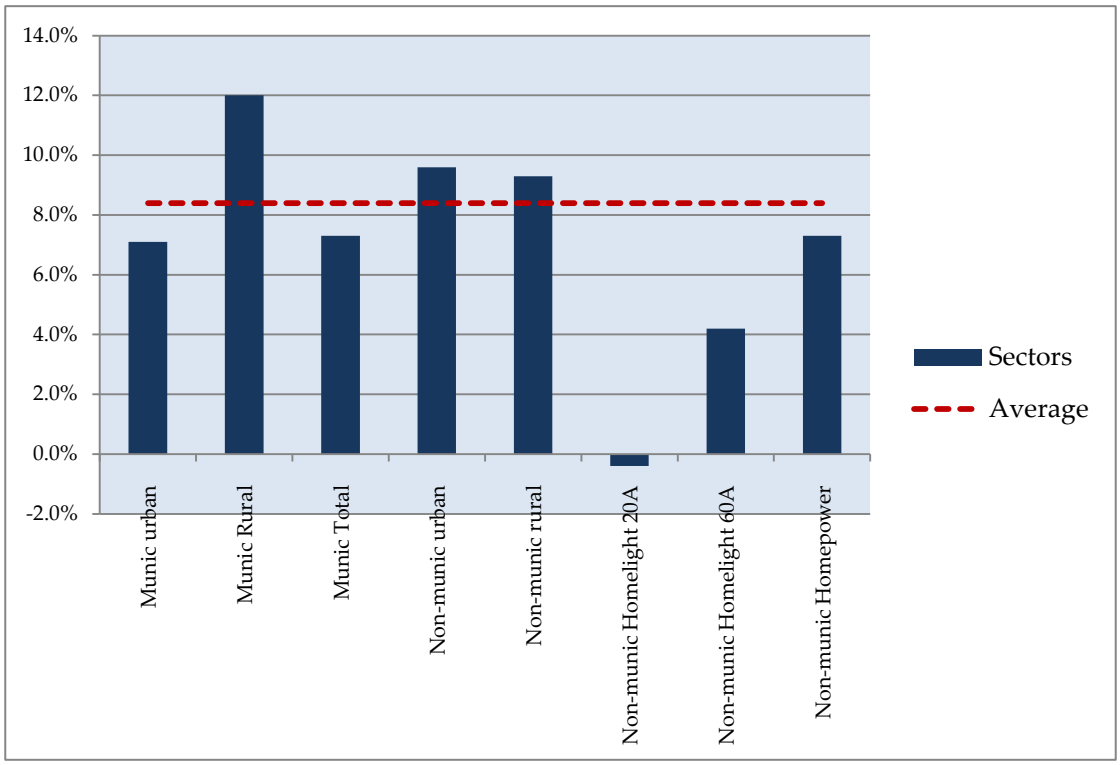


Figure 9: Eskom's 2013/14 average tariff increase by sectors

Source: Eskom (2013a)

Averages can also be misleading. It is thus important to segment the averages into its sectors to determine the subgroups that have experienced larger or lesser increases. In Figure 9, Eskom's 2013/14 average tariff increase of 8.4% has been segmented into its main sectors. It is clear that all not all customers will experience the same degree of increase. The Homelight 20A and Homelight 60A tariffs which are designed for Eskom's low-usage residential customers (mainly low income households), had the lowest nominal tariff increases at -0.4% and 4.2% respectively (Eberhard and PDG 2010; Eskom 2013a). They have thus been shielded from the impact of tariff increases for the year 2013/14. It is therefore important to analyse tariffs in real terms and by sector.

2.2 The income and expenditure of poor urban households in South Africa

From the vast literature on poverty, it is evident that poverty measurement has developed over the years to provide a wide-range of indicators with which to describe the conditions of the poor in society. 'Poverty becomes what has been measured and is available for analysis' Harris (2007:205). The tendency in research is thus to measure what is easier to do at the time, he argues. Household income has been one such indicator that has been comparatively easier to measure and is readily available in the many national

surveys, compared to more abstract yet vital dimensions of poverty, such as the influence of 'social relations', ' culture' or 'subjectivity' as highlighted in Du Toit (2005). Yet although income has historically been used as a measure of poverty from whence classifications such as "low, middle and high income households" arise, it has in recent years been criticised as a limited indicator of poverty, unable to account for the many deprivations suffered by the poor. This new research approach is known as 'multidimensional poverty' (Alkire and Foster 2011; Seth 2011; Finn, Leibbrandt et al. 2013).

Notwithstanding these new developments, income is an important financial consideration in this study. Income is one of the key determinants in a household's ability to purchase energy services and other basic needs such as food, clothes and transport services (Prasad 2006; Heunis and Dekenah 2010; Statistics South Africa 2011b).

2.2.1 Who are the urban poor?

The informal settlements in South Africa are the poorest sector of urban society, marred by overcrowding, poorly constructed shacks and poor access to services. The South African Audience Research Foundation (2011) has classified these urban dwellers as the lowest LSM groups of either 2,3 or 4 depending on their access to services, appliances, and household income. As the government housing program advances and the backlog is addressed, formal houses (accompanied by services) are eventually constructed on demarcated land within these settlements and assigned to those on the government's housing list. However, rapid urbanisation slows down service delivery , which further exacerbates the housing backlog for poor South African citizens (Human Science Research Council and Department of Energy 2012)

The urban poor do not only reside in informal settlements. Poverty stretches beyond those borders into other low income suburbs (examples in Cape Town are Delft, Tafelsig and Gugulethu) that include mainly black African and coloured/mixed race people who are very poor. This section aims to elicit the defining traits of the urban poor in terms of their income, expenditure and access to services. Some of the data will be specific to informal settlements to remain consistent with the case study but others will be a more general description of low income households. This depends on

the availability of data for informal settlements, since the distinction between urban formal and informal was only introduced in the IES (2011b). The main difference between informal settlements and other low income suburbs is access to formal housing and adequate services. Their income and expenditure shares are closely matched. Thus, the national low income data is a good proxy for the urban poor as defined by this thesis.

2.2.2 The household income of the poor in South Africa

With limited income, households are faced with the difficult task of meeting their basic needs such as the need for food, clothing, shelter and energy. Thus, many poor households do not have sufficient resources to invest in other higher order needs such as further education, which stifles their ability to make progress (Maslow's (1943) hierarchy of needs includes higher order needs such as reaching personal potential, fulfilment, developing talents and prestige). Limited income is a strong driver of these inhibiting factors, resulting in a vicious cycle of poverty that often affects generations, unless there is an intervention of some kind.

The majority of families residing in informal settlements are poor. Nationally, 80% of these households have an income of under R42 501 per annum, that is R3 542 per month in 2013 Rands, the majority of which earn less than R21 800 per annum or R1 818 per month(Table 2) (Statistics South Africa 2011a).

Table 2: Annual income of households in informal settlements as per Census 2011

Annual Income band (2013 Rands)	National Percentage	Cumulative Percentage
R0 – R21 800	56%	56%
R 21 801 - R 42 500	23%	80%
R 42 501 - R 85 100	13%	93%
R 85 101 - R 171 300	5%	98%
>R171 300	2%	100%

Source: Own calculations using [3]SuperCross software (Statistics South Africa 2011a)

[3]SuperCross is an interactive data program issued by Statistics South Africa that allows the user to do a variety of cross tabulations and filtering using Census 2011 data.

Furthermore in South Africa, there has historically been a great gap between the incomes of the rich and poor. This inequality is evident in Figure 10, which shows a very disproportionate distribution of income between the upper 30% compared to the bottom 70% of the population.

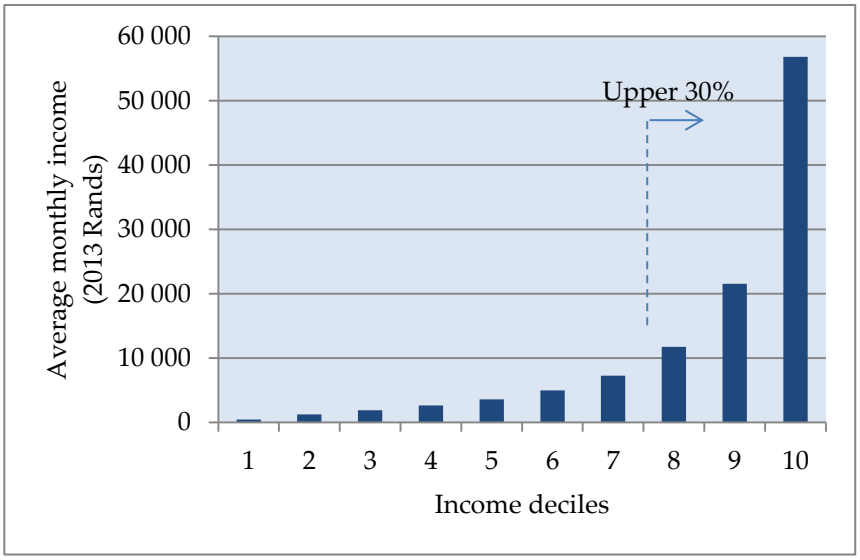


Figure 10: Average monthly household income of South Africans in 2010/2011

Source: [4]Own calculations using Statistics South Africa (2011b)

[4] The annual incomes in reported in Statistics South Africa (2011b) are given in Mar 2011 Rands. This was converted to a monthly income in 2013 Rands using the CPI table; CPI for June 2013 = 102.9 and CPI for Mar 2011 = 91.3

2.2.3 The triple effect of electricity, transport and food price increases on the expenditure of the urban poor

In addressing the combined effect of price increases on poor households, it is first important to discuss what is known as the 'systems thinking approach' to analysis. Households function and make decisions within a system (Gassmann 2012). In this instance, a systems thinking approach firstly assumes equilibrium and the interconnectivity of a number of key facets of a household such as the need for adequate housing, food, transport, energy, education and clothing. This implies that a disturbance in one part of the system (a change in an expenditure share for example) affects what income is available for another and thus the system needs to reconfigure itself until stability is reached again (relative to the condition prior to disturbance). Electricity expenditure should thus not be assessed in isolation; it is important to know what else is affected within the system (Gassmann 2012) .

Secondly, it assumes no significant real growth in income to compensate for an increase in prices of essential goods. This assumption is based on the prevalence of structural poverty in South Africa, which inhibits income earning opportunities and growth for many poor households (Leibbrandt and Levinsohn no date). There are however exceptions to this in informal settlements which will be explored in the case study – an example of some enterprising households who increase their income by re-selling electricity.

Intuitively, without surplus income, an increase in the cost of one good tabled on a household budget such as electricity leaves the household with three main options. First, the household could decide to pay extra for that good and therefore decrease expenditure of one or more other goods (Gassmann 2012). Second, the household could decide to not pay extra and therefore will need to decrease the consumption of that good either through efficiency or deprivation if the former is limited (Gassmann 2012). Third, the household may choose to substitute a portion of that good with what is perceived as a more affordable good, either of better or lesser quality without changing the objective, such as being able to cook whether with electricity or paraffin for example (Gassmann 2012).

For low income households, the proportion of income spent on food, housing and transport ranks highest out of twelve main expenditure groups,

(Figure 11). This is in contrast to high income households where food ranks fourth; housing first and transport is second (Figure 12). The full table can be found in ANNEXURE1.

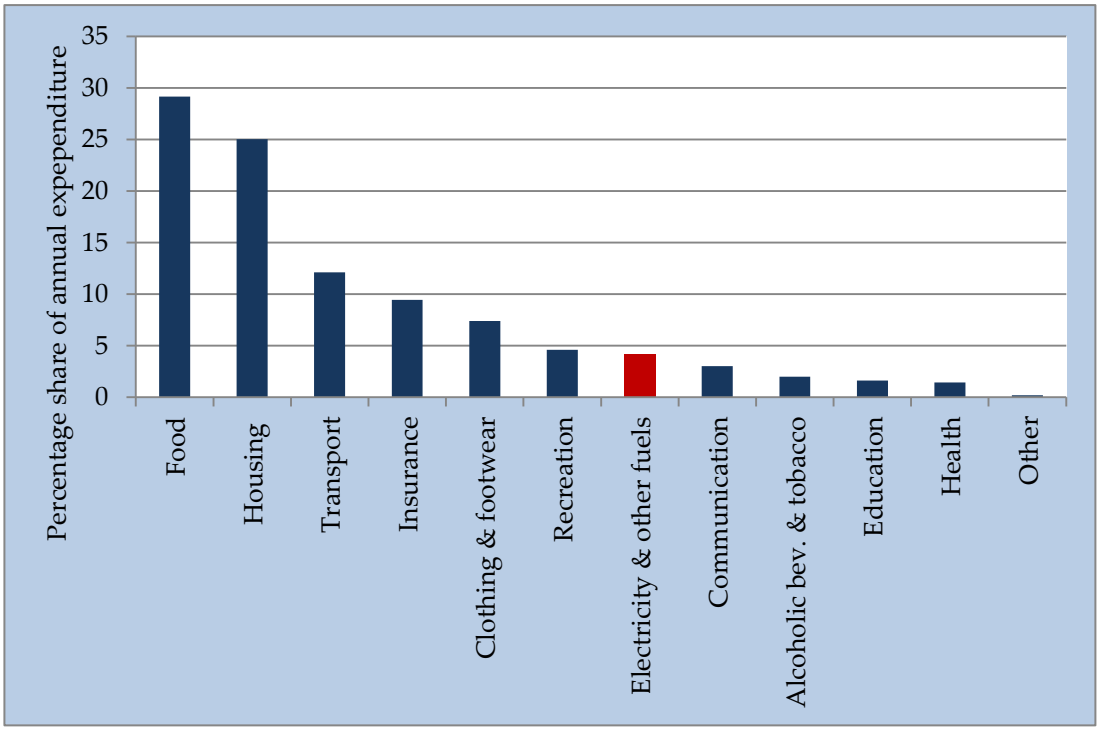


Figure 11: The main expenditure of the average low income household in South Africa

Source: [5]Own calculations using Statistics South Africa (2011b)

[5] Some categories of a similar nature were combined to simplify the graph such as Recreation, Culture and Restaurants were merged into one called Recreation.

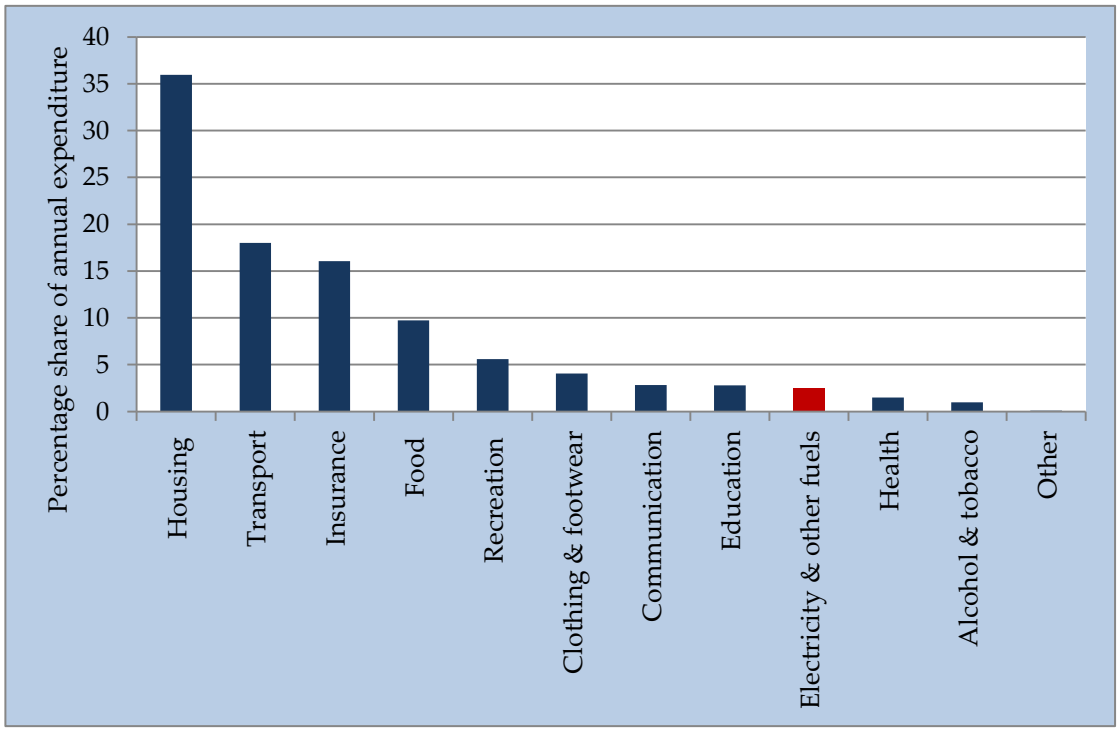


Figure 12: The main expenditure of the average high income household in South Africa

Source: Own calculations using Statistics South Africa (2011b)

Total energy expenditure ranks seventh for low income households, before education; in contrast to high income households where energy ranks ninth, after education. It is interesting to note the difference in ranking order of education. Moreover, for low income households, more income is spent on alcoholic beverages and tobacco than on education. The misuse and overindulgence of alcohol and substances in low income communities has had widespread and devastating negative social consequences and is indicative of the multidimensional and cyclic nature of poverty. Swart (2012) from the Paraffin Association of Southern Africa (PASASA) highlighted the link between paraffin-related accidents and alcohol abuse in the home, which is worth the mention in the context of a systems thinking approach where one part of a system has bearing on another. Very few things, if any, can be analysed in isolation without considering a broader context or system boundary; thus seeking out those significant causal relationships is vital to understanding and addressing poverty.

It is highly probable that urban households are experiencing a triple disturbance to the system in the form of a simultaneous increase in electricity and transport, and their knock-on effect on food prices. The poor have very

little discretionary expenses, R1993 compared to R16 594 for higher income households (Table 3).

Table 3: Annual average household discretionary expenditure as per IES 2010/11

Discretionary expenses	Annual average for lower income households (2013 Rands)	Annual average for Higher income households (2013 Rands)
Clothing and footwear	2 624	8 718
Alcoholic beverages and tobacco	668	2 050
Recreation and culture	440	8 461
Restaurants and hotels	885	6 083
Total	1 993	16 594

Source: [6]Own calculations using Statistics South Africa (2011b).

If it is not possible for a household to cut back on their non-essential expenses, they may be faced with the difficult task of sacrificing one of their major necessities to pay extra for another.

Transport is one of the top expenditures for low income households, and comprises mainly of public services such as mini-bus taxis, buses and trains; private vehicle ownership is low compared to high income households. According to the data from Statistics South Africa (2011b), a mere 11.5% of vehicles in South Africa are owned by the bottom 50% of households, arranged according to income. Jennings and Covary (2007) highlight that mini-bus taxis are used by the majority of public transport commuters. The problem facing low income households is that taxi and bus services are susceptible to the frequent oil/petrol price shocks and once the fares increase, they do not drop again. In addition, there is a knock-on effect on food delivery costs which push up the retail prices (Fin24 2013; SABC 2013).

Likewise, electricity tariff increases not only affect households directly but also indirectly through raising food prices, even if only slightly. Large increases in industrial and commercial electricity tariffs will increase food production, processing and retail costs (in addition to other goods). According to Altman (2010), this knock-on effect on the price of the goods however, would be minimal. Their study predicted that a 35% increase in tariffs would increase the average producer index (a measure of the change in

[6] Converted 2011 Rands into 2013 Rands using CPI table.

the price of a good) by only 1.3% above the norm. An earlier study by Altman, Davies, Mather, Fleming and Harris (2008), show that electricity accounts for less than 2% of the total expenditure of 77% of all major industries except mining, chemical and accommodation, where electricity contributes about 4% to the total cost. Moreover, electricity costs in the main food related industries such as meat, grain mills, bakeries, dairy and agriculture, contribute 1.8%, 0.9%, 1.4%, 1.1% and 0.6% respectively to the total cost of the industry (Altman, Davies et al. 2008). These studies would thus suggest that although electricity tariff increases affect households indirectly through increased food prices or producer price index, this impact has been small.

Considering the large expenditure share that food constitutes on the household budget of the poor, this study would argue that the Altman, Davies et al. (2008) finding may only be a justifiable argument for middle and high income households. Statistics South Africa (2011b) show that lower income households dedicate most of their income to food (Figure 11) of which bread, samp and other maize products make up the largest portion thereof , at just over 30% (Figure 13). Food expenditure is ranked first out of twelve other budgetary items. This is in contrast to higher income households where food expenditure is ranked fourth (Figure 12)). By deduction, it would therefore appear that in the event of above normal increases to food driven by both a rise in electricity costs and transport costs, there would be a larger threat to the poor compared to the wealthy who have more room to adjust their discretionary expenses.

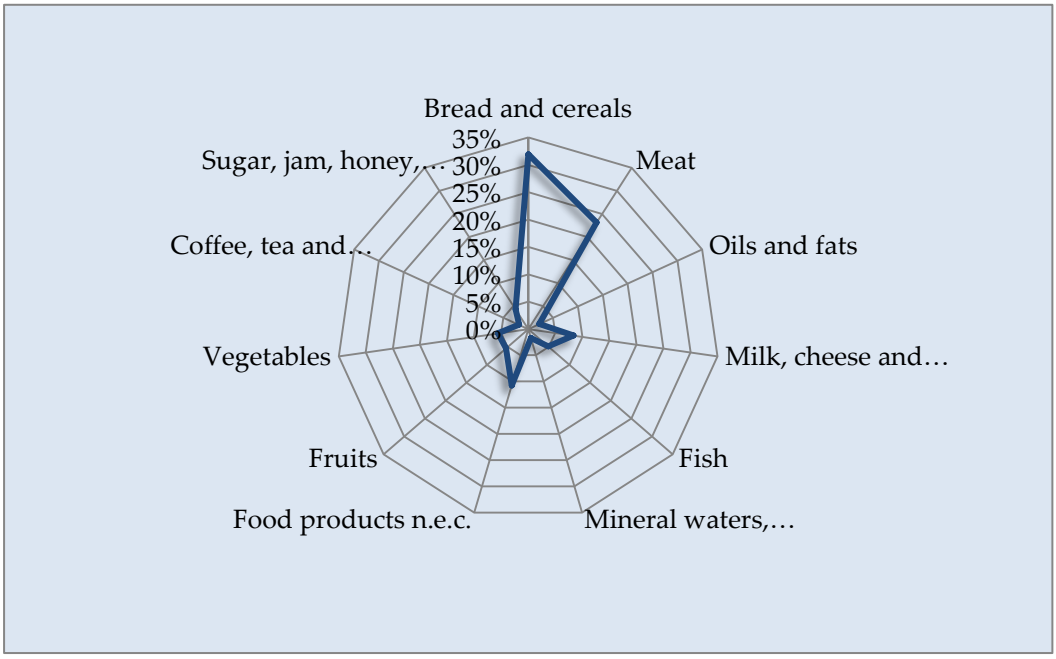


Figure 13: The percentage shares of food expenditure for low income households in South Africa

Source: Statistics South Africa (2011b)

2.3 Electricity access and consumption in low income households

In 2011, sixteen years after the electrification programme commenced in 1995, 89.1% of urban households had access to electricity according to Census 2011 (Statistics South Africa 2011a). This is in comparison to the Prasad (2006) estimate of 77.2% in 2001; a growth of 11.9%. The percentages in urban informal settlements are lower however - only 39% of households in these settlements have access to electricity (electricity for lighting is used as a proxy for access) (Statistics South Africa 2011a). The rest use inefficient and unsafe fuels such as candles or paraffin.

The large urban hubs in South Africa attract many rural migrants, resulting in densely populated informal settlements with major service delivery backlogs and difficulties. The most popular of these are found in Gauteng, KwaZulu-Natal and Western Cape. These three provinces alone house about 800 000 of the one million households living in informal settlements.

The Census 2011 reports on the main energy source used by households for lighting, cooking and heating. Table 4 shows that over 90% of all urban informal households in South Africa, with [8]access to electricity, used electricity to meet their basic lighting and cooking needs. Between 65 – 74%, used electricity for space heating (Statistics South Africa 2011a).

Table 4: Number and percentage of urban informal households with access to electricity, who use electricity for cooking and space heating in South Africa

	Urban informal		
	Number of households	Percentage of households with access	
Income Category (2013 Rands)	**Access to electricity**	**Cooking**	**Heating**
Low 1 (R0 - R21 800)	228 375	92%	65%
Low 2 (R 21 801 - R 42 500)	95 277	93%	64%
Middle 1 (R 42 501 - R 85 100)	54 405	93%	67%
Middle 2 (R 85 101 - R 171 300)	18 750	95%	72%
High (>R171 300)	9 285	92%	74%

Source: Own calculations using SuperCross (Statistics South Africa 2011a)

Lloyd, Cowan and Mohlakoana (2004) highlight that in Khayelitsha, only 68% of the electrified households in their survey were using electricity for cooking,

[8] Electricity access includes both households who have formal electricity connection and those who are informally connected with extension cords. The question asked in Census 2011 is "What main fuel is used for lighting?" and does not distinguish between those who have mains connection and those who do not.

and 24% used paraffin; although 92% said they preferred to use electricity. The disparity between what they used in practice versus what they desired to use was directly related to limited household income. Lloyd, Cowan et al. (2004) found that households with incomes in excess of R3350 (2013 Rands) per month were more likely to use electricity for cooking. When considering the Census 2011 data however, the use of electricity for cooking seems to have grown nationally among even the poorest households.

Statistics South Africa (2011a) does not specifically mention water heating, but for this study, based on fieldwork and general observations, it will be assumed that for the majority of households the fuels used for cooking and water heating are the same. Cowan (2008a) show that poor households with access to electricity often use a kettle or stoves to heat water for hot drinks and bathing. Electric geysers are not very common or are not often used compared to high income households where water heating is estimated to account for 40% of the electricity bill (Cowan 2008b; Donev, van Sark, Blok and Dintchev 2012).

In informal settlements, a smaller percentage of households use electricity for space heating compared to cooking (Table 4). Lloyd, Cowan et al. (2004) reports that only 12% of households in the Khayelitsha study used electric heaters for their space heating needs although 75% preferred electricity; others used paraffin heaters, heat from their paraffin stoves or blankets to keep warm. The difference between the 2004 sample and the 2011 Census data for informal settlements may be attributed to the number of years after electrification, with a growing trend in the direction of households' fuel preference.

The NRS 034 Load Research Project conducted in South Africa between 1994 and 2009 set out to determine the electrical load profiles for a range of residential customers across income bands and geographical location. By 2009, over one billion load readings had been collected for over 7000 customers, with accompanying household information such as income, education and appliance ownership (Dekenah 2010). Heunis and Dekenah (2010) used the empirical data for the period between 1994 and 2004 to develop a load prediction model for residential consumers in South Africa for the different household income levels.

Heunis and Dekenah (2010) show that electricity consumption is positively correlated with household income; as income increases the electricity consumption also increases (Figure 14). The graph shows that for households with an income of under R18 000 per annum (2007 Rands) or R26 000 (2013 Rand), the electricity consumption would be under 200kWh per month, roughly ten years after electrification. These consumption levels are in a similar order of magnitude as that of Borchers, Qasa, Gaunt, Mavhungu, Winkler, Afrane-Okese and Thom (2000), who evaluated a number of electrification projects in low income areas five years after electrification; they found an average consumption level of 132kWh per month.

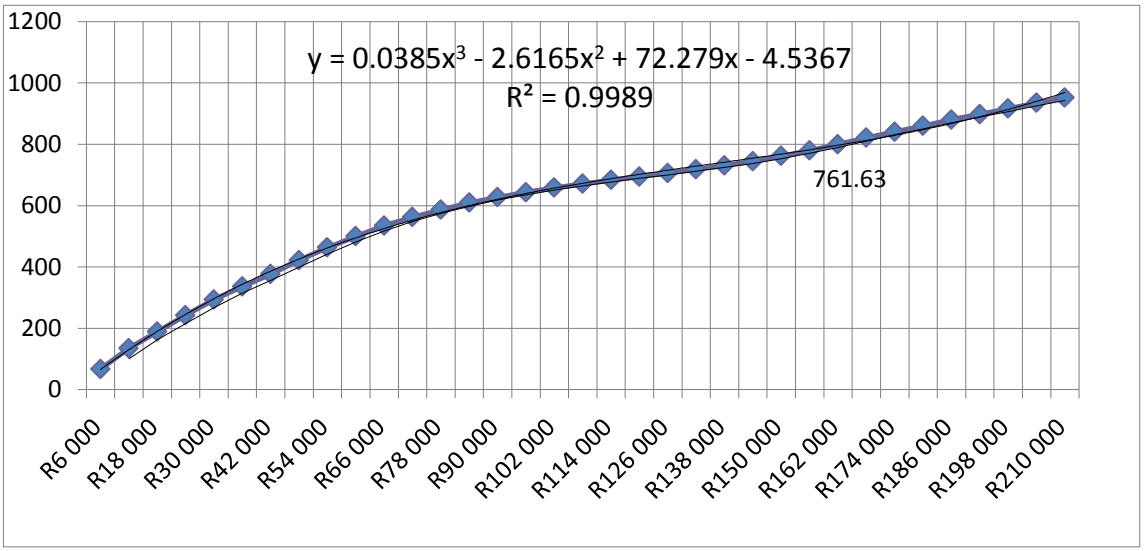


Figure 14: The Heunis and Dekenah (2010) load prediction graph showing electricity consumption (kWh) versus annual household income (2007 Rands)

Source: Heunis and Dekenah (2010)

2.4 An overview of research methodologies used to determine the impact of rising tariffs on the poor

2.4.1 Qualitative research methodology

A contemporary study conducted by the Human Science Research Council and Department of Energy (2012) investigated how households' responded to electricity tariff increases for the 12 month period prior to the survey. A total of 500 locations were selected according to the Census 2001 Enumerator Areas (EAs) and represented different income groups, ethnicities, geographical areas and settlement types. In each EA, 7 households were

randomly sampled, of which 3004 (realised sample) of the 3500 (ideal sample) households were interviewed.

The study commenced in September 2011 and thus by deduction would include the tariff increase on 1 April 2010 and 2011 for Eskom customers, and the 1 June 2010 and 2011 for Municipal customers. The report did not make this distinction. The Human Science Research Council and Department of Energy (2012) identified three main strategies that households could employ to cope with increased electricity tariffs. Households were asked to choose from one of these options or provide an alternative strategy which the study had not considered. In the first strategy, households would pay extra to maintain the same level of electricity. In the second, households would reduce their electricity consumption without switching to other fuels. For the third strategy, households would reduce their electricity and supplement the energy with other fuels such gas, paraffin and coal. The results can be seen in Table 5, which is segmented into population groups, settlement types, living standards and provinces.

Table 5: An example of a South Africa study to investigate the coping strategies of households in response to tariff increases

Segment	Maintain electricity and pay extra (%)	Reduce the amount of electricity (%)	Reduce the amount of electricity and switch to other fuels (%)	Other (%)	Don't know (%)
South Africa	29	41	26	1	4
Population group					
Black African	26	38	31	1	4
Coloured	35	46	15	2	2
Indian or Asian	23	72	4	1	1
White	40	47	8	1	4
Living standard level					
Low	15	18	45	3	19
Medium	25	38	32	1	3
High	36	47	13	1	3
Geographic location					
Urban formal	34	45	16	1	3
Urban informal	26	46	23	1	5
Rural, traditional authority areas	15	30	50	0	4
Farms	27	29	31	3	9
Province					
Western Province	49	36	13	1	1
Eastern Cape	22	31	41	0	7
Northern Cape	49	21	20	4	6
Free State	8	59	29	2	2
Kwazulu-Natal	14	64	22	1	0
North West	25	26	38	0	10
Gauteng	34	44	15	2	5
Mpumalanga	28	36	31	0	4
Limpopo	29	19	47	0	4

Source: (Human Science Research Council and Department of Energy 2012)

According to Statistics South Africa (2011b), the poorest segments include mainly households who live in urban informal settlements or traditional authority areas; these are highlighted in Table 5. Their responses to tariff increases and subsequent energy choices are influenced by a number of such as household income, culture, availability and cost of alternative fuels and awareness of energy efficiency strategies. The study shows 45% of

households with a low living standard and 50% of households from traditional areas substituted electricity with other fuels; whereas 46% of households who reside in informal settlements reported to have mainly reduced their electricity consumption through saving (Human Science Research Council and Department of Energy 2012). Between 15 – 26% reported to have paid extra to maintain their electricity consumption which suggests that the majority of poor households may be facing affordability constraints and could not afford to pay extra (Human Science Research Council and Department of Energy 2012). The Western Cape had the highest percentages of households that reported paying extra to maintain their electricity consumption (Human Science Research Council and Department of Energy 2012) .

The research approach used by the Human Science Research Council and Department of Energy (2012) is qualitative in nature and offers some interesting results on how households perceive tariff increases. In South Africa the utility (or happiness) of the poor in regard to service delivery is an important political consideration that should not be overlooked. However, the study does have some limitations. Firstly, the actual consumption history was not retrieved for any of the households in order to determine whether there was a significant change in consumption after tariff increases. This could have been used to validate the households' reported response, since a survey of this nature may elicit exaggerated responses from participants. Secondly, no actual expenditure data was declared to determine what the actual change in Rands is after the tariff increase. The results therefore rely heavily on the ability of households to accurately recall their average expenditure before and after increases. The results published in Human Science Research Council and Department of Energy (2012) should therefore be interpreted as a household's 'best estimate' of their consumption in response to tariff increases, in the absence of actual records. This qualitative approach to analysing changes in electricity consumption has an inherent recall bias that negatively affects the significance of the results.

2.4.2 Quantitative research methodology

Gassmann (2012) used a quantitative approach to determine the strategies households employed to cope with rising tariffs. The study took place in the Kyrgyz Republic, a low income country in Central Asia. The three main

strategies explored by the Human Science Research Council and Department of Energy (2012) was also explored in the Gassmann (2012) study, viz. households maintain consumption and pay extra; or reduce consumption through saving; or switch to other fuel. Theft was mentioned as a fourth response to tariff increases but this was not elaborated on.

Instead of the qualitative approach, Gassmann (2012) extracted actual energy expenditure data from the 2009 Kyrgyz Integrated Household Survey which is a panel survey conducted over 12 months. Data was collected from 5000 households, who recorded their expenditure in diaries, with additional household information captured in questionnaires. The questions and method of recording is similar to the Income and Expenditure Survey (IES) conducted by Statistics South Africa (2011b) every five years, and the National Income Dynamics panel Survey (NIDS) conducted by Southern African Labour and Development Research Unit (2008). With actual electricity expenditure data available, Gassmann (2012) could firstly estimate the consumption in kWh using the average unit cost of electricity before the tariff increase

The Gassmann (2012) study had two main shortfalls. Firstly, it did not have an adequate consumption history for households that spanned across the reform period, in order to determine the actual change in consumption after the tariff increase. Secondly, it did not have qualitative data for analysing how households were feeling or how they perceived the tariff increases. This was the one of the strengths of the qualitative approach of the Human Science Research Council and Department of Energy (2012) study.

2.4.3 Mixed methods research methodology

Thus far, two approaches were considered for assessing the impact of rising tariffs on the poor, viz. qualitative and quantitative research methods. The first elicits the households' perception and experience of tariff increases and the other uses an evidence based approach with actual expenditure data to further predict households' response to changes in price. The next method is a combination of the two, generally referred to as a mixed methods approach, which Ercikan and Roth (2006) view as complementary methods rather than mutually exclusive or opposing.

Keener and Banerjee (2005) implemented a mixed methods approach to assess the impact of a 72% increase in electricity tariffs in Ghana. They focussed on addressing the poverty and social impacts within this high electricity price scenario. This included a new analysis of existing national surveys and a special localised survey consisting of 318 participants. Together, these surveys were used as the data pool from which to extract complementary qualitative and quantitative information.

Firstly, Keener and Banerjee (2005) used the latest national household survey for Ghana to extract household incomes by quintiles together with corresponding energy sources used for lighting, the main indicator of a households access to electricity. Intuitively, Keener and Banerjee (2005) argue that those who have access to electricity will be most affected by electricity tariff increases. Figure 15 is an illustration of the results that can be obtained from national household survey data. They deduced that the poorest of the poor, those below the poverty line in Ghana, are unlikely to be affected by electricity price increases but rather price increases to kerosene for example. In addition, further segmentation of the results by settlement type, highlighted that 7% of rural poor households use electricity for lighting compared to 54% of urban poor. The rest depend on kerosene. Thus through segmentation, l Keener and Banerjee (2005) were able to identify the urban poor as the group most affected by tariff increases in Ghana.

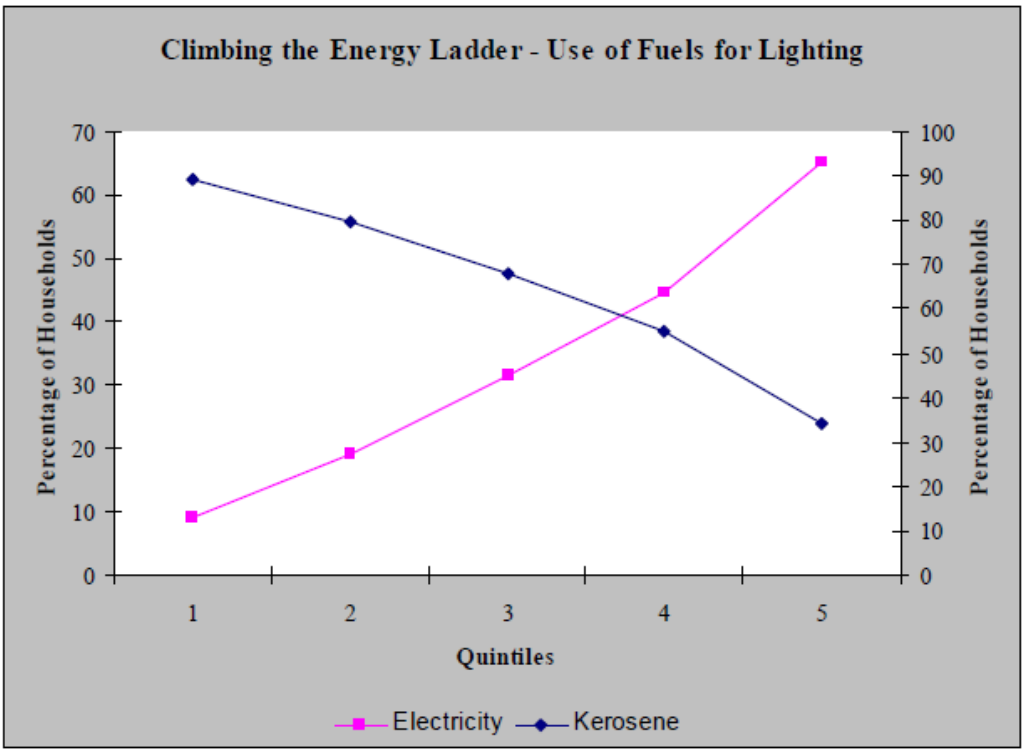


Figure 15: Proportion of households using electricity and kerosene for lighting by income quintiles in Ghana

Source:Keener and Banerjee (2005)

Secondly, Keener and Banerjee (2005) supplemented the findings from the national survey with an in-depth survey including both the poor and non-poor. The in-depth survey made use of questionnaires, focus groups and informant interviews to assess the experiences and perceptions of households as well as key stakeholders. In addition, the households' electricity consumption history was retrieved to assess possible changes in consumption over time. This could be matched to each households reported response, although the changes in consumption in kWh was unfortunately not explicitly shown in the results for each household (Table 6) (Keener and Banerjee 2005). The consumption data for all the residential customers supplied by the Ghanaian utility were instead reported, comparing average annual change in consumption for the same month, i.e. February 2002 and February 2003.

Table 6: An excerpt of a Ghanaian study to investigate the coping strategies of households in response to tariff increases

Description of response to tariff increase	Total (N=90)
Did not make changes	47%
Bill is affordable	26%
Unaware of the link between price and conservation measures	61%
Other	13%
Made changes	53%
Borrow money	4%
Sold assets	4%
Disconnected	4%
Reduced number of electrical appliances	15%
Use of CFL bulbs	19%
Reduced use of lighting	38%
Reduced use of fan and other electrical appliances	4%
Switched to alternative sources of energy	4%
Combination of measures	8%

Source: Keener and Banerjee (2005)

The approach taken by Keener and Banerjee (2005) is exemplary and have effectively demonstrated the use of both national and local qualitative data and complementary quantitative data to determine the impact of rising tariffs on the poor.

2.5 A critique of energy poverty indicators used in South Africa

In the context of rising electricity tariffs both past and future, it is important to adequately measure and track the impact such increases have on households over time, particularly in terms of their energy expenditure and fuel switching. In the short term, Zang (2011) has found that the price response is largely inelastic among poorer households compared to the rich, which shows a heterogeneous response to rising energy costs. Households with an inelastic demand will pay what is required to maintain their consumption in the short term. In the long term however, households, will tend to show a more elastic response to price increase as they have had time to adjust and consider their options. This may be reflected in a reduction in electricity consumption either through efficiency, deprivation or fuel switching (Keener and Banerjee 2005;

Gassmann 2012). Along with fuel switching comes inefficient and unsafe appliances such as paraffin flame stoves that is prone to exploding under high cooking temperatures causing injury and fires in informal settlements (Lloyd 2002; Lloyd and Truran 2008; Swart 2012). Furthermore Gassmann (2012) highlights the little room many of the poor (generally low energy users) have to reduce their consumption to an adequate level where basic needs or safety are not compromised.

In general, when measuring poverty using a specific indicator, Seth (2011) reasons that it is important to understand the properties or axioms which the indicator is based on, in other words, how that measure will respond under certain events or data transformations. If for example the income of four households are measured against a poverty line, z, and the income of the second household drops to below z, the poverty indicator should ideally show that poverty has increased. A good indicator is therefore one that is sensitive to the changes in poverty the society may experience over time (Seth 2011).

There are two main steps involved in poverty measurement: Identification and Aggregation (Sen 1976). These steps are used for both unidimensional poverty measurement involving one indicator, and multidimensional measurement involving a few indicators which collapse to form one composite measure. Firstly, identification answers the question, 'Who is poor?', and this process dichotomises the population into two distinct groups, the 'poor' and 'non-poor'. Secondly, Aggregation answers the question, 'How poor is this society?' This step summarises the information of the poor into a single index that gives an indication of the level of poverty in the society (Seth, 2011).

In the study by the Human Science Research Council and Department of Energy (2012), three main indicators were used to describe the state of energy poverty in South Africa, viz. the energy expenditure ratio, the subjective approach, and thirdly a combination between household income and the thermal inefficiency of the dwelling. The 'expenditure approach' identifies a household as energy poor if that household spends more than 10% of their net income on domestic energy (Human Science Research Council and Department of Energy 2012). In the 'subjective approach' a household is energy poor if they themselves regard the amount of energy used for lighting, cooking or heating as less than adequate (Human Science Research Council

and Department of Energy 2012). Finally, the 'low income and thermal inefficiency measure', considers a household as energy poor if it lives on less than 60% of South Africa's median per capita income (R600 at the time of study) and lives in a dwelling of substandard quality (Human Science Research Council and Department of Energy 2012).

After households are identified through these dichotomous measures, the households are aggregated using a headcount ratio where the total number of "poor" households is divided by the total number of households in the sample. The results are compared below in Figure 16.

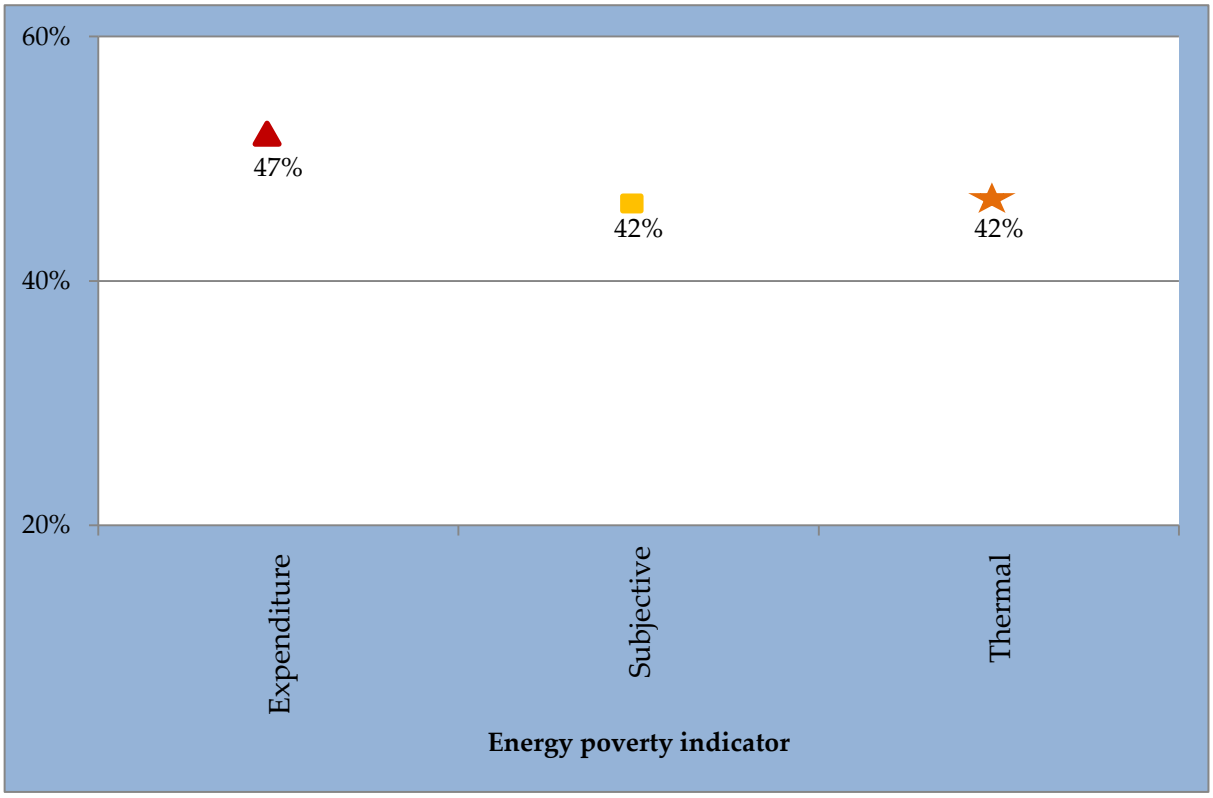


Figure 16: Comparing the percentage of households who are energy poor in South Africa using different poverty indicators

Source: Data from Human Science Research Council and Department of Energy (2012)

A number of reputable studies regard the headcount ratio as a simple but rather shallow indicator of poverty (Pachauri and Spreng 2003; Khandker, Barnes and Samad 2010). In general this is a major limitation of unidimensional poverty measurement, in that it hides the depth and width of deprivations associated with it (Seth 2011). All three energy poverty

indicators used by the Human Science Research Council and Department of Energy (2012) are unidimensional and inadequate for determining the impact of rising electricity tariffs on poverty, in terms of their energy expenditure and associated fuel use. The energy expenditure approach is more closely associated with the impact of rising electricity costs, and will be further critiqued with the hope of indicating areas of improvement. The study found that in South Africa, 47% of households spent more than 10% of their income on energy in 2011 (Human Science Research Council and Department of Energy 2012). Assuming that the 10% measure is valid as a poverty line, despite criticism from Pachauri and Spreng (2003) that it is a somewhat arbitrary number, three further weaknesses will be highlighted.

Firstly, though it would be useful for policy makers to know that nearly half of the population is energy poor, Seth (2011) suggests that approaches such as these that use a simple poverty line to identify the poor and a headcount to aggregate it, encourages policy makers with limited welfare budgets, to assist the marginally poor first. This would be done at the expense of assisting the severely poor in order to reduce the overall poverty indicator. For example if it's possible through policy intervention for households at 11% to cross the poverty line and drop to 9%, the headcount drops.

Secondly, if due to an increase in energy expenditure or a decrement in income, a poor household's expenditure ratio increases from 25% to 35% between 2011 and 2013 for example, the headcount ratio will not change. The worsening condition of the poor in this instance will go undetected using a headcount. At any given time, the indicator will only reveal the number of households below the poverty line but hide the depth of their poverty and their progressive deprivation over time. Simply knowing how many of the households are energy poor is not enough to devise appropriate intervention programs that adequately addresses the different levels of deprivation. According to Alkire and Foster (2011) and Seth (2011) the 'monotonicity axiom' is required to detect a progressive deprivation over time and a simple headcount ratio does not satisfy this axiom. Examples of indicators that satisfy monotonicity include the [9]poverty gap ratio and the squared poverty gap ratio.

[9] In part, gap ratios calculate how far a household is from the poverty line, i.e. the distance or gap, and will therefore detect any movement towards or away from this line over time.

Thirdly, the energy expenditure indicator does not distinguish between the types of fuels used by a household. Instead it only aggregates the cost of fuels used, the proportions are not revealed by this unidimensional indicator. Mixed fuel use is prominent among poor households and may include a range of fuels such as electricity, firewood and paraffin. The choice of fuels depends on a range of variables including settlement type, culture and availability of energy source (Masera, Saatkamp and Kammen 2000; Human Science Research Council and Department of Energy 2012). If the poor switch from electricity to firewood collected for cooking, in reaction to electricity price increases, the energy costs may decrease but the level of deprivation in terms of efficiency, health and opportunity cost has increased (this also depends on the technology used which presents further complexity). The poverty indicator would drop if such a household's expenditure drops to below 10%; that household would mistakenly be considered non-poor by the poverty line. An energy poverty indicator should be sensitive to changes in energy expenditure and its associated energy source, being able to measure and respond to worsening deprivations or genuine improvements.

To achieve this and in addition avoid a 'dashboard approach' with several separate indicators to monitor; composite or multidimensional energy poverty indicators should be explored as an alternative approach to improve on the aforementioned weaknesses (Alkire and Yalonetzky 2011; Nussbaumer, Bazilian, Modi and Yumkella 2011). The current research by Nussbaumer, Bazilian et al. (2011) is still in its early stages and as yet is inadequate for measuring the impact of rising electricity costs on energy poverty. Such research and development is beyond the scope of this study and will be included in the recommendations.

PART B: DATA ANALYSIS

3 Defining poverty in the context of this study

Energy poverty, which is the deprivation of adequate and affordable access to modern energy, finds itself nestled within the broad study of poverty. Electricity is a modern energy source that enables the poor to meet their basic needs for lighting, cooking and heating, which produce benefits such as education, communication, safety and entertainment. Growth in household income drives appliance ownership that further leads to greater levels of electricity consumption, which for many equates to increased comfort and affluence (Heunis and Dekenah 2010; South African Audience Research Foundation 2011). It can thus be argued that since income is strongly correlated with electricity consumption, it should continue to be incorporated as indicator in energy poverty research, while remaining cognisant of its limitations. Sen (2010) argues that income should not be used on its own, complementary dimensions to income should be sought and developed to enhance a deeper understanding of poverty.

Thus, to compensate for the limitation of using income in a unidimensional way, the South African Audience Research Foundation (SAARF) has developed a useful segmentation tool that has been gaining popularity in South Africa for categorising households according to a living standards measure (LSM). Each living standard has a typical service level, dwelling type, appliance ownership and monthly imputed income associated with it (South African Audience Research Foundation 2011). Income is thus not merely that which is obtained from wages, salaries or grants. Statistics South Africa (2011a) uses a similar approach where for example an imputed rental income is included for households within subsidised housing who generally live rent-free There are instances where even informal dwellings have imputed rental incomes associated with it (Statistics South Africa 2011b).

For the purpose of this study, Table 7 will be foundational in categorising households into three broad wealth categories namely Low (1 and 2), Middle (1 and 2) and High income households. These are based firstly on the LSM descriptions of increased access to adequate housing, services and appliance ownership (a proxy for electricity consumption). This approach accounts for the multidimensional nature of poverty, thus avoiding a mere unidimensional description. The imputed income associated with each LSM is then matched with Census 2011 income categories affording the study with access to key national data.

The study's concern is for the poor, which in terms of Table 7 will largely comprise of households from Low 1 and Low 2, with a small proportion from Middle 1. Middle 1 is included to account for households who may have higher incomes but large household sizes and thus lower income per capita values. Income per capita is particularly important when considering the food expenditure of the poor. Food expenditure is a key role player in a scenario where poor households are faced with higher energy costs and are required to make a decision on how to spend their limited income.

Table 7: Defining wealth categories for this study

LSM	Settlement and dwelling type	Services and appliance ownership on average	Average monthly (or annual) household income as per SAARF 2011 (2011 Rands)	Wealth Categories (as defined by this study)	Matching Census 2011 monthly (or annual) household income (2013 Rands)
1	Small urban/rural. Traditional hut.	Minimal access to services. Radio.	R1 369 (R16 428)	Low 1	R0 – R1 817 (R0 - R21 800)
2	Small urban/rural. Shack, [10]matchbox and traditional hut.	Communal access to water. Radio and stove.	R1 952 (R23 424)	Low 2	R1 818 – R3 542 (R21 801 - R42 500)
3	Small urban/rural. Shack, matchbox and traditional hut.	Water on plot or communal. Radio and stove.	R2 545 (R30 540)	Low 2	
4	Small urban/rural. Shack, matchbox and traditional hut.	Electricity, water on plot or communal, non-flush toilet. TV set, electric hotplate.	R3 141 (R37 692)	Low 2	
5	Small urban/rural. House, matchbox/matchbox improved.	Electricity, water on plot, flush toilet outside. TV sets, hi-fi/radio, stove, fridge.	R4 200 (R50 400)	Middle 1	R3 543 – R7 092 (R 42 501 - R 85 100)
6	Large urban. House/townhouse, cluster house	Electricity, water in home, flush toilet in home. TV set, stove, fridge/freezer, microwave oven.	R6 454 (R77 448)	Middle 1	
7 Low	Urban (no description of dwelling)	Full access to services. Owns more durables.	R9 768 (117 216)	Middle 2	R7 093 – R14 275 (R 85 101 - R 171 300)
7 High	Urban	Full access to services. Owns more durables.	R12 311 (R147 732)	Middle 2	
8 -10	Urban	Full access to services. Full ownership of durables.	>R14 275 (>R171 300)	High	>R14 275 (>R171 300)

Source: South African Audience Research Foundation (2011) and Statistics South Africa (2011a)

[10] A 'matchbox' is a term used to describe the small subsidised house built during the South African governments Reconstruction and Development programme.

These wealth categories can be applied to other studies that use income as a means of categorising households, such as the electricity consumption model designed by Heunis and Dekenah (2010). Applying a mean to further summarise the electricity consumption of Low income households, i.e. Low 1 and Low 2, gives an average of 158kWh. This study together with Borchers, Qasa et al. (2000) show that the average annual electricity consumption for low income households is approximately 150kWh per month.

Table 8: Electricity consumption for households in different wealth categories

Results from Heunis and Dekenah (2010) Model (10 years after electrification)		**Wealth categories**	Mean (kWh/month)
Annual income (2013 Rands)	**Electricity (kWh/month)**	**(2013 Rands)**	
R 8 684	66.94	Low1 (R0 - 21 800)	158
R 17 367	134.84		
R 26 051	188.41	Low 2 (R21 801 - R42 500)	
R 34 734	242.18		
R 43 418	293.42	Middle 1 (R 42 501 - R85 100)	378
R 52 101	335.88		
R 60 785	376.53		
R 69 468	421.69		
R 78 152	463.01		
R 86 835	499.54	Middle 2 (R85 101 - R171 300)	607
R 95 519	534.32		
R 104 203	562.02		
R 112 886	586.16		
R 121 570	608.94		
R 130 253	627.02		
R 138 937	642.87		
R 147 620	658.11		
R 156 304	670.67		
R 164 987	683.35		
R 173 671	694.49	High (>R171 300)	

Source: [11]Own calculations using Heunis and Dekenah (2010) and Statistics South Africa (2011a)

[11] Heunis and Dekenah (2010) designed an Excel-based prediction model that was distributed to the participants at the Domestic Use of Energy conference in 2010. The income in the output table was in 2007 Rands. For this study the income was changed to 2013 Rands using CPI tables; Average CPI in 2007 = 71.1 and CPI in June 2013 = 102.9.

4 An analysis of electricity tariff increases in the City of Cape Town

When attempting to analyse tariff increases, two essential conditions are necessary for an accurate and thorough analysis. Firstly, all prices need to be deflated by CPI to allow for comparability over time in real terms as opposed to nominal terms. Secondly, the average percentage increase in tariffs for a specific year needs to be segmented since all sectors do not experience the same degree of increase. This can be done by using sector-specific tariffs.

In the residential sector, customers are usually categorised according to their average levels of consumption using a 12 month average. This study will classify users into three broad categories based on their average monthly electricity purchases:

1. Low-purchase customers, purchases up to 200kWh
2. Medium-purchase customers, 201 – 400 kWh
3. High-purchase customers, >400kWh

The definition excludes FBE which means that a household in category 1 may purchase 200kWh at their own expense and in addition should receive 50kWh of free units with their first purchase every month (the consumption may therefore be up to 250kWh per month which will be reflected on their purchasing history at the City of Cape Town). Low or medium-purchase customers who exceed a monthly purchasing average of 400kWh per month in any given year (a 12 month average) will not qualify for free basic units in the following billing year and will be seen as a high-purchase customer.

The price per unit of electricity differs according to these customer categories bracket and also depends on distributor. In South Africa, customers are supplied either by Eskom or by their municipality. Nationally, Eskom uses a uniform approach to tariffs designed for their residential customers, which is aligned with the Electricity Pricing Policy (Eberhard and PDG 2010). However, municipalities are free to add their own surcharge to electricity and as a result tariff structures are not the same, differing across municipal districts (Eberhard and PDG 2010). To complement the case study conducted in Imizamo Yethu, this study will comprise an in-depth analysis of tariff structures applicable to the City of Cape Town municipality only. The City of Cape Town's Lifeline tariff structures (previously known as Domestic 1) are similarly priced to Eskom's Homelight 20A and Homelight 60A tariff

structures, which are designed to assist poor households. Refer to ANNEXURE 5 for a graphical display of the development of tariff structures for the City of Cape Town, from 2006/2007 to 2013/2014.

What follows in the section is an analysis of the real increase in the cost of electricity for residential customers in the City of Cape Town, in both the subsidised and unsubsidised scenario.

4.1 The real increase in the cost of electricity

Studies have shown that poor households use an average of 150kWh of electricity per month which should place them within the low-purchase customer category (Borchers, Qasa et al. 2000; Prasad 2006; Heunis and Dekenah 2010). An Excel based calculator was designed to calculate the real cost of electricity for different years using the City of Cape Town tariff structures for the three customer categories; the output tables are in ANNEXURE 6. Table 9 below is an excerpt of the results using average consumption levels for the three groups as a means of comparing costs over time within groups and between groups.

The results show that all customers do not experience the same degree of increase; between 2006 and 2013 the cost of electricity applicable to low-purchase customers (e.g. 150kWh) rose from R71 to R81, which is a cumulative increase of R10 in real terms (2013 Rands). This is much less than the increase in tariffs applicable to high-purchase customers (e.g. 450kWh) whose tariffs in real terms almost doubled for the same time period, resulting in an increase of R313.

Table 9: The real increase in the cost of electricity for different customers between 2006/07 and 2013/14

BILLING YEAR	Low 150kWh (incl. FBE)		Medium 300kWh (incl. FBE)		High 450kWh (no FBE)	
	Cost	Increase	Cost	Increase	Cost	Increase
	2013 Rands	2013 Rands	2013 Rands	2013 Rands	2013 Rands	2013 Rands
2006/2007	71		178		321	
2007/2008	70	-1	176	-2	316	-5
2008/2009	71	1	179	3	370	54
2009/2010	74	3	185	6	478	108
2010/2011	77	3	217	32	556	78
2011/2012	78	1	231	14	608	52
2012/2013	79	1	240	9	629	21
2013/2014	81	2	247	7	634	5

Source: City of Cape Town Tariffs for 2006/07 to 2013/14

Ideally, based on individual household consumption, poor households with their own electricity connections or meters fall into the low-purchase customer category. Thus, they would generally have been shielded from steep increases in electricity over time with a rather uniform price between 2006 and 2013. However, there are cases where poor households share meters, as in Imizamo Yethu (Visagie 2008). In these cases, they form part of a shared network which can accommodate up to four households; the combined consumption then falls within either the medium or high-purchase customer category. It's the latter group which would be most problematic for the poor. Figure 17shows that high-purchase customers have experienced the greatest yearly increases in real terms, much larger than inflation especially between 2008/09 and 2011/12. Poor households in shared networks would thus not have been shielded from tariff increases as their counterparts have.

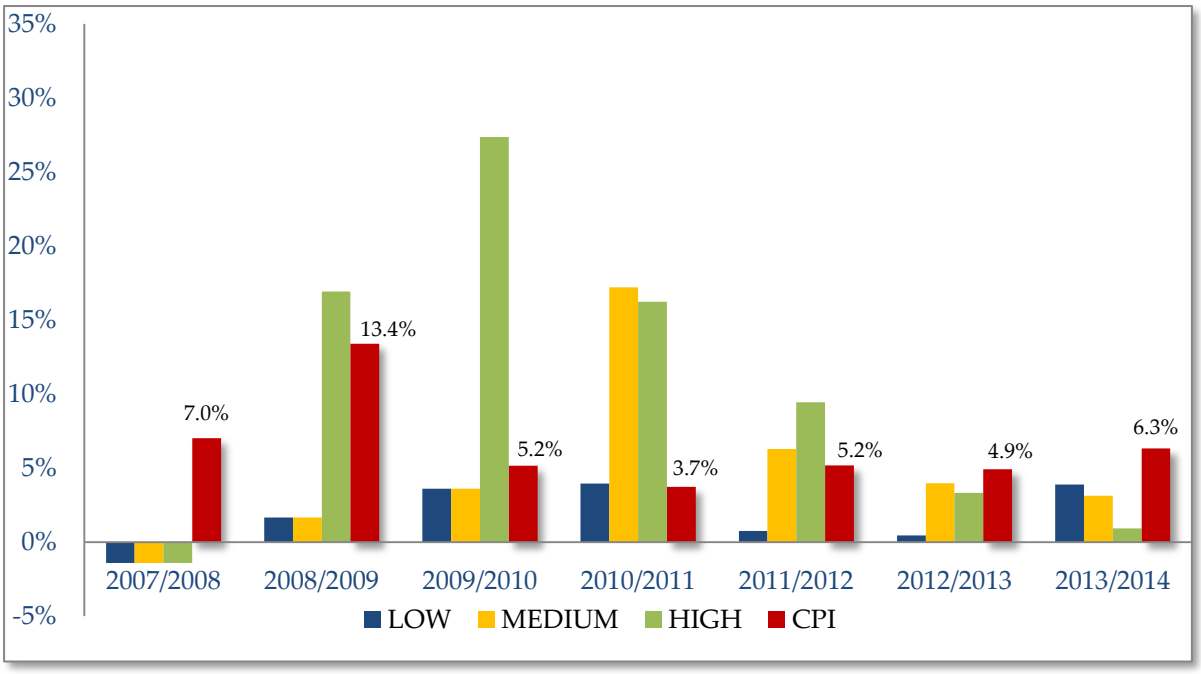


Figure 17: Real annual percentage increase in the cost of electricity for different customer categories

Source: Own calculation using City of Cape Town Tariffs for 2006/07 to 2013/14 and Statistics South Africa (2012)

Furthermore, Figure 18 shows that the tariff for high-purchase customers has soared above inflation since 2007, showing a cumulative real increase much larger than the tariffs applicable to low and medium-purchase customers.

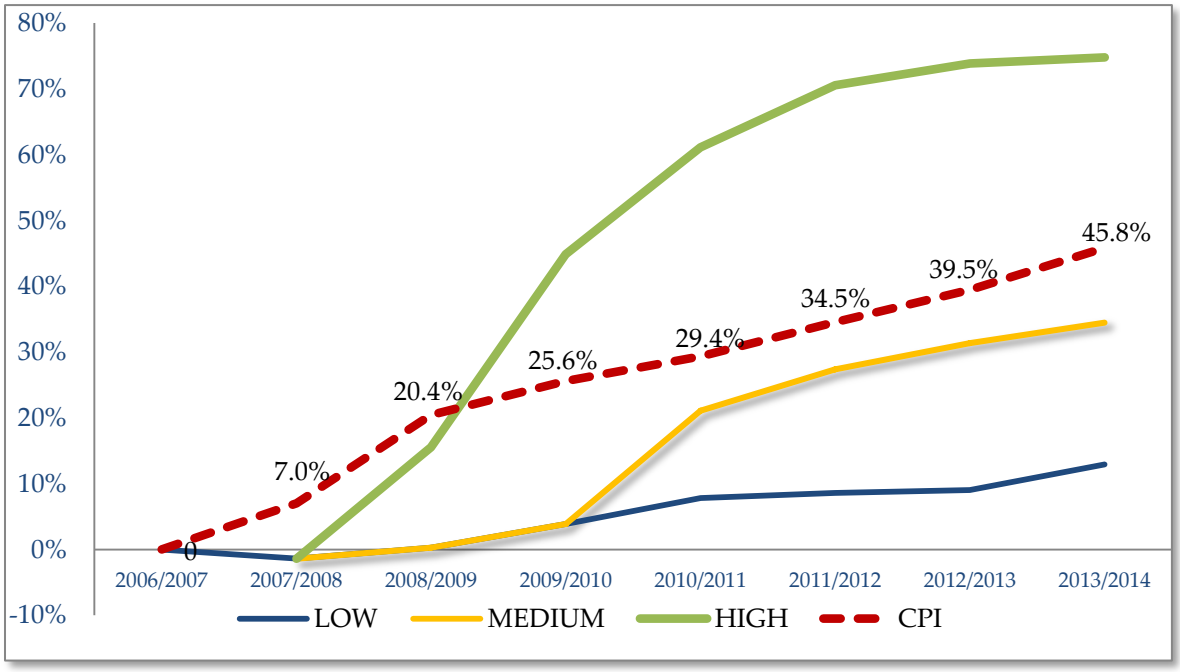


Figure 18: Real cumulative percentage increase in the cost of electricity between 2006/07 and 2013/14

Source: Own calculations using City of Cape Town Tariffs for 2006/07 to 2013/14 and Statistics South Africa (2012)

Lifeline tariffs shielded both low and medium customers. A lifeline tariff has a lower cost per unit of electricity. For example, in 2012/13 the charge in Block 1 of the inclining block tariff was 74.02c/kWh for low and medium purchases and 129.05c/kWh for high-purchases. In addition, lifeline customers receive a free basic electricity (FBE) subsidy historically valued at 50kWh or R37 (2013 Rands) per month. Prasad, Ranninger et al. (2002) designed the FBE subsidy to help poor households meet basic electricity services. It was first launched by government on 1 July 2003 (Republic of South Africa 2003). High-purchase customers do not qualify for the subsidy. As of 2013 the City of Cape Town has increased the subsidy to 60kWh or R54 (2013 Rands) for low-purchase customers and reduced it to 25kWh or R23 per month for medium customers (City of Cape Town 2013c)

Viewed in a different way, Table 10 compares the cost each customer group would pay for the same amount of energy, in other words their cost per unit of electricity, where a unit ranges between 150 – 600kWh, e.g. R78/150kWh for low-purchase customer compared to R205/150kWh for a high-purchase customer. Their costs correspond with their particular tariff structure, see ANNEXURE 5.

Table 10: Comparing the real cost per unit of electricity for different customers for 2012/13 and 2013/14

CUSTOMER	BILLING YEAR	150kWh 2013 Rands	300kWh 2013 Rands	450kWh 2013 Rands	600kWh 2013 Rands
LOW	2012/2013	78	240	435	648
	2013/2014	81	216	469	782
MEDIUM	2012/2013	78	240	435	648
	2013/2014	112	247	501	814
HIGH	2012/2013	204	416	629	841
	2013/2014	211	423	634	846

Source: Own calculations using City of Cape Town tariffs 2006/07 to 2013/14

It is clear that low and medium customers pay less per unit of electricity. Figure 20 is a graphical depiction of these costs. This cost difference is the lifeline subsidy which includes the FBE and lower tariff rates.

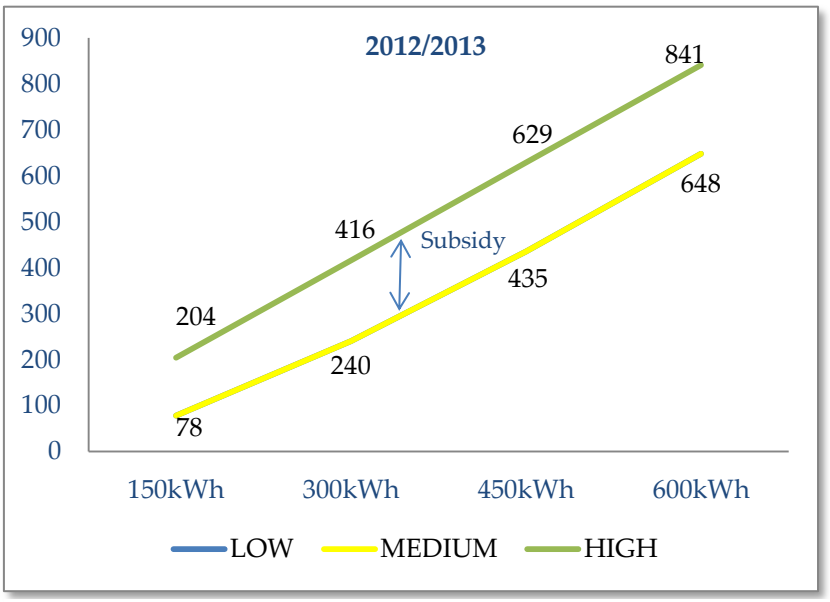


Figure 20: 2012/2013 lifeline subsidy for low and medium-purchase customers

Source: Own calculations using City of Cape Town tariffs 2006/07 to 2013/14

4.2 Estimating the number of households who receive FBE

Using national data from IES 2010/11 and the population data from Census 2011, it was possible to estimate the number of indigent or eligible households who should receive FBE (Statistics South Africa 2011b; Statistics South Africa 2011a). Firstly, Excel was used to manipulate the primary dataset for IES 2010/11 and filtered according to "Mains connection", "FBE" and "Income deciles" to calculate the percentage of electrified households who receive FBE. Secondly, these percentages were applied to the Census 2011 data in SuperCross which was filtered by "Households that use electricity for lighting" which is a proxy for electricity access, to estimate the number of households receiving FBE in South Africa by income deciles. This is tabled below in Table 11 and graphed in Figure 22 to illustrate a national picture, highlighting on the one hand regions that are most deprived of the subsidy and on the other, regions where implementation has been most successful.

Table 11: An estimation of the number of households who receive FBE in South Africa

Income deciles	Monthly Income (IES 2010/11)	Households with access to electricity (Census 2011)	Percentage of electrified households receiving FBE (IES 2010/11)	Households receiving FBE (Own calculations)
Deciles 1 - 5	<R4150	4 933 657	29%	1 407 098
Deciles 6 - 7	R4147 - R9528	3 108 246	28%	874 630
Deciles 8 - 10	>R9528	4 199 235	18%	752 342

Source: Calculated using data from Statistics South Africa (2011b) and Statistics South Africa (2011a)

An estimated 29% of households earning less than R4 150 per month receive FBE, which is a similar figure to Eberhard and PDG (2010) who reported that roughly only one third of eligible households receive FBE. Thus, 71% of low income households in South Africa, roughly 3.5 million (who already have access to electricity) do not receive the FBE subsidy. A fraction of these households are the urban poor who share electricity meters and have combined monthly averages that exceed the qualifying consumption limit; Imizamo Yethu is an example of that.

The North West province and KwaZulu-Natal have some of the lowest implementation rates of FBE in the country; only 17% and 16% of indigent households receive FBE respectively. The South African Local Goverment Association (2012), presented some of the institutional challenges Eskom and municipal distributors have faced in effectively implementing the FBE subsidy. Among the cases listed is the municipality in the North West region, which they say have had difficulties with their FBE vending machines preventing customers from receiving their free tokens.

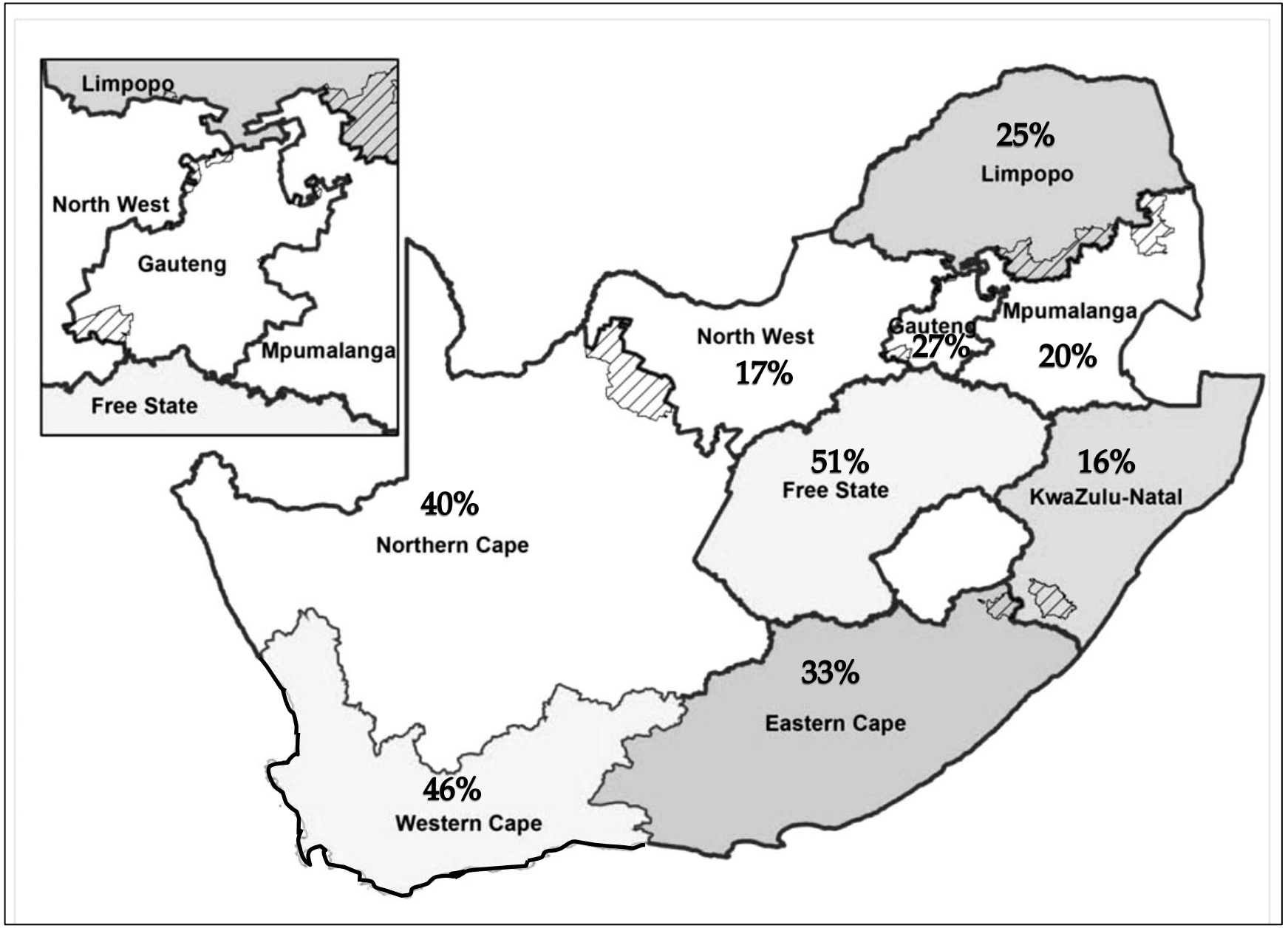
Without a subsidy, individually metered customers who use less than 150kWh per month (low-purchase tariff) have paid at least an extra R36 to R54 between 2006/2007 and 2013/2014, compared to those who receive FBE (Table 12).

Table 12: Comparing the real cost of 150kWh of electricity for metered customers with FBE versus those without FBE

Billing Year	With FBE	Without FBE	Cost Difference
	2013 Rands	2013 Rands	2013 Rands
2006/2007	71	107	36
2007/2008	70	105	35
2008/2009	71	107	36
2009/2010	74	111	37
2010/2011	77	115	38
2011/2012	78	116	38
2012/2013	79	117	38
2013/2014	81	135	54

Source: City of Cape Town tariffs for 2006/07 to 2013/14 and Statistics South Africa (2012)

Figure 22: Percentage of low income households (<R4150 per month) in South Africa who have access to electricity and receive FBE



5 Comparative study of the national Income and Expenditure Survey for 2010/11 and 2005/06

Ideally, statistical testing is used to investigate whether there are significant differences between two or more sets of data that is representative of a larger population. An Analysis of Variance (ANOVA) statistical test is an example of a test that could be used to check for significant variation or changes in the income and expenditures between IES 2010/11 and 2005/06. This can be analysed for different income groups, population groups, settlement types or regions. The primary data would be required to do such a test, however this was not accessible from Statistics South Africa at the time of this study.

Thus, a simple comparison will be done with the data that was available in Statistics South Africa (2011b) and Statistics South Africa (2006), using basic arithmetic and descriptive statistics . The results should therefore be interpreted conservatively and where noteworthy results are found it should be viewed as invitation for further study to soundly validate the findings. This will be included in the Recommendations.

5.1 Changes in monthly household income

When interpreting any changes in income over time, it is important to consider both the gains in percentage and the gains in actual Rand value, since a large gain in percentage does not always translate into a similarly large gain in Rands ((Statistics South Africa 2011b). In real terms, the average income of South African households has increased by 16.7%, between 2005/06 and 2010/11(Table 13) (Statistics South Africa 2011b). This implies that in general, the average South African household has become wealthier in monetary terms, albeit unequal and modest (Leibbrandt and Levinsohn no date). These real increases in income have the potential to buffer the adverse effects of a rise in the cost of living such as electricity tariff increases, and others.

Table 13: Comparison of average monthly household income of South Africans between 2010/11 and 2005/06 by population group

	IES 2010/11 (2013 Rands)	IES 2005/06 (2013 Rands)	Real Growth	Increase in Rand terms
South Africa	11 228	9 618	16.7%	1 610
Population group of household head				
Black African	6 540	4 863	34.5%	1 677
Coloured	13 073	10 241	27.7%	2 832
Indian/Asian	23 736	17 348	36.8%	6 388
White	36 349	36 216	0.4%	133

Source: Own calculations using Statistics South Africa (2011b) and Statistics South Africa (2006)

When segmenting the average increase into population groups (Table 13) and income deciles (Table 14) the inequality becomes startlingly clear. Unemployment and low paying jobs remains an unsolved problem in South Africa, resulting in fewer and even negative monetary gains for poorer households (Finn, Leibbrandt et al. 2013).

Table 14 compares the average monthly household income by deciles between 2010/11 and 2005/06, deflated by CPI to allow for comparability between the two years. There has been an overall growth in the income of South Africans, albeit modest and unequal. The poorest group, Low 1, has however been the exception to positive growth, rather experiencing a decrement in income that is most likely the result of unemployment. Based solely on monetary terms it suggests that these poor households who on average have less income, would generally have struggled to pay extra for electricity and other necessities between 2005 and 2011 if required. Households in Low 2 and up who have on average experienced an increase in income would have potentially been able to buffer the adverse effects of rising electricity costs. The extent to which this buffering occurs depends however on numerous variables that include the growth in income in Rand terms, the effect of combined price shocks of other competing priorities (transport, food), and also other non-monetary factors such as culture and social relations.

Table 14: Comparison of average monthly household income of South Africans between 2010/11 and 2005/06 by income deciles

Wealth categories as per study	Low 1		Low 2		Middle 1		Middle 2		High	
Income deciles	1	2	3	4	5	6	7	8	9	10
IES 10/11 (2013 Rands)	447	1 262	1 909	2 660	3 601	4 969	7 285	11 771	21 560	56 801
IES 05/06 (2013 Rands)	569	1 265	1 754	2 325	3 031	4 027	5 748	9 168	16 990	53 510
Increase in Rand terms (2013 Rands)	-122	-3	155	335	571	943	1 537	2 603	4 571	3 291
Real growth	-21%	0%	9%	14%	19%	23%	27%	28%	27%	6%

Source: Own calculations using Statistics South Africa (2011b) and Statistics South Africa (2006)

5.2 Changes in food expenditure

Food expenditure is the largest component of the household budget of the poor, (Figure 11) (Statistics South Africa 2011b). When a family is malnourished, surplus income is usually first used to buy more food to overcome hunger and meet the nutritional deficit of household members. Energy needs and food needs are strong competitors for many very poor families (Oxfam 2013). In cases where alcohol abuse is a problem, the surplus income may be misdirected to sustain a parent's alcohol addiction leaving other necessities unmet, such as having sufficient food to feed their children.

Nationally, between IES 2005/06 and IES 2010/11, the percentage of income spent on food remained relatively constant (less than 10% difference) for households at the 30th percentile (Table 15). This is may be connected to the average increase in income experienced by this upper 70% of South African households; so although households were spending more on food in actual Rand (a mean of R135), it was offset by the increase in their income. This suggests that households with additional income are likely to spend it on food. However, the bottom 30% of the population (Low 1) was not that fortunate to have such offsets. Instead, on average the percentage of income dedicated to food increased, since their income growth (-R122, R4 and R155) was too small to offset the increase in their food expenditure (R150, R163 and R190 respectively). With more income dedicated to food in Low 1 over the

five year period, it raises questions about what effect this may have had on their energy expenditure (Chapter 5.4).

Table 15: Comparison of the average monthly expenditure of South Africans on food between 2010/11 and 2005/06

Wealth categories	Income deciles	Percentage of income spent on food		Real growth in percentage of income spent	Food expenditure		Increase in Rand terms	Real growth in exp.
		IES 10/11	IES 05/06		IES 10/11	IES 05/06		
	#	%	%	%	2013 Rands	2013 Rands	2013 Rands	%
Low 1	1	143.9 [12]	86.6	57.3	643	493	150	30.4
	2	61.5	48.4	13.1	775	612	163	26.6
Low 2	3	45.8	39.0	6.8	875	685	190	27.7
	4	35.2	34.7	0.5	933	806	127	15.8
Middle 1	5	27.2	28.7	-1.5	981	871	110	12.6
	6	21.7	24.2	-2.5	1080	975	105	10.8
Middle 2	7	15.7	18.1	-2.4	1147	1043	104	10.0
	8	11.6	13.3	-1.7	1364	1217	147	12.1
High	9	7.4	9.3	-1.9	1585	1582	3	0.2
	10	3.7	4.5	-0.8	2075	2423	-348	-14.4
	Mean:	31.2	29.5	1.8	1022	887	135	16.7
	Median:	27.2	28.7	-1.5	981	871	127	13.0

Source: Own calculations using Statistics South Africa (2011b) and Statistics South Africa (2006)

5.3 Changes in transport expenditure

Transport is the third largest expenditure group for the average low income household in South Africa (Figure 11) (Statistics South Africa 2011b). Passenger road transport which consists mainly of mini-bus taxis and buses are most frequented by low and middle income households. To a lesser extent, transport costs include petrol for personal vehicles, which is a main expense rather for higher income households.

Both Table 16 and Table 17 show an overall sharp increase in the monthly expenditure of South Africans on transport. The increase of transport expenditure between 2010/11 and 2005/06 for the lower income households,

[12] Low income households spending 143% of their income on food may be due to debt and under-reported income (forgetfulness or mistrust) (Statistics South Africa 2011b).

i.e. Low 1, Low 2 and Middle 1 ranged between R77 to R146 per month, a real growth of up to 140% - 206% This is in addition to the increase in food expenditure. The combined increase of food and transport is thus in the range of R227 to R283 per month. The households in Middle 1 had higher average increase in income and therefore would be able to offset more of the increase compared to the poorest 30% of the population. These increases are two strong competitors for energy expenditure and will serve to limit surplus funds available to pay extra for electricity if need be. Protecting the poor against price hikes is thus crucial in inhibiting or completely preventing the triple effect of increases in food, transport and electricity costs.

Table 16: Comparison of the average monthly expenditure of South Africans on passenger road transport between 2010/11 and 2005/06

Wealth categories as per study	Low 1		Low 2		Middle 1		Middle 2		High	
Income deciles	1	2	3	4	5	6	7	8	9	10
IES 2010/2011 (2013 Rands)	115	125	152	188	224	245	283	302	213	86
IES 2005/2006 (2013 Rands)	37	50	59	77	86	99	134	139	116	68
Increase in Rand terms (2013 Rands)	77	76	93	111	138	146	149	162	97	18
Real growth	206%	153%	159%	144%	160%	147%	111%	116%	83%	26%

Source: Own calculations using Statistics South Africa (2011b) and Statistics South Africa (2006)

Table 17: Comparison of the average monthly expenditure of South Africans on transport fuels and lubricants between 2010/11 and 2005/06

Wealth categories as per study	Low 1		Low 2		Middle 1		Middle 2		High	
Income deciles	1	2	3	4	5	6	7	8	9	10
IES 2010/2011 (2013 Rands)	41	48	62	71	101	143	260	441	761	1 331
IES 2005/2006 (2013 Rands)	5	3	4	7	8	25	46	97	283	542
Increase in Rand terms (2013 Rands)	36	45	58	64	92	118	214	344	478	790
Real growth	703%	1392%	1384%	928%	1132%	475%	468%	355%	169%	146%

Source: Own calculations using Statistics South Africa (2011b) and Statistics South Africa (2006)

5.4 Changes in energy expenditure

The total energy expenditure is the sum of all the fuels that the average South African household uses for their domestic energy requirements. On a national scale the percentage of income spent on energy is below 10% (a common energy poverty line) for the majority of income deciles for both 2005/06 and 2010/11, with the exception of the poorest households at the 10th percentile in terms of income. This income decile grew in the proportion of income dedicated to energy, from 14% to 21%. Again, this is in part due to the decrement in income that raised the overall percentage of income used for energy; it is also due to the slight increase in energy expenditure of R15/month, which is much lower than the growth in the uppermost income deciles of over R100/month. The majority of low to low-middle income households experienced very little change to their overall energy expenditure. However, further segmentation of the total energy will uncover the drivers of change and consistency.

Table 18: Comparison of the average monthly expenditure of South Africans on total energy between 2010/11 and 2005/06

Wealth categories	Income deciles	Percentage of income spent on energy		Real growth in percentage of income spent	Energy expenditure		Increase in Rand terms	Real growth in exp.
		IES 10/11	IES 05/06		IES 10/11	IES 05/06		
	#	%	%	%	2013 Rands	2013 Rands	2013 Rands	%
Low 1	1	21.3	14.1	7.2	95	80	15	18.8
	2	8.0	8.4	-0.4	101	107	-6	-5.6
Low 2	3	6.6	6.9	-0.3	126	122	4	3.3
	4	4.9	5.7	-0.8	131	134	-3	-2.2
Middle 1	5	4.1	4.6	-0.5	149	140	9	6.4
	6	3.4	3.5	-0.1	171	143	28	19.6
Middle 2	7	2.8	2.7	0.1	201	156	45	28.8
	8	2.4	2.2	0.2	281	204	77	37.7
High	9	2.0	1.8	0.2	424	305	119	39.0
	10	1.1	0.8	0.3	627	419	208	49.6
	Mean:	5.7	5.1	0.6	230	181	50	19.5
	Median:	3.8	4.1	0	160	142	22	19.2

Source: Own calculations using Statistics South Africa (2011b) and Statistics South Africa (2006)

It is common for poorer households to use multiple energy sources and this will be considered here. It is therefore of interest to know whether on a national scale, decreases in one fuel were compensated by increases in another. Thus, the total energy has been separated into its constituent parts, viz. electricity, gas and liquid fuels (paraffin/diesel). Solid fuels were not considered, since it is not common amongst urban households.

5.4.1 Electricity

Over the five year period between 2005/06 to 2010/11 electricity has grown to be the dominant energy source for the majority of households in South Africa across all income bands. This is consistent with the Census 2011 results, which showed that over 90% of households, who have access to electricity, were using electricity as a main fuel for lighting and cooking (Statistics South Africa 2011a). Electricity has replaced inefficient fuels such as candles, paraffin and wood for many poor households who previously did not have access to electricity. This substitutionary effect is most apparent among low to low-middle income households. Table 19 shows that the proportion of their electricity expenditure compared to alternative fuels such as paraffin grew from roughly 50:50 in 2005/06 to 80:20 in 2010/11, whereas their total energy expenditure remained the same. In this instance, expenditure is interchangeable with consumption since the cost of paraffin for example, increased in real terms (linked to petrol price); so in order for households to maintain their consumption they would have had to pay more. Moreover, the study has found that the real cost of electricity for low-purchase customers (majority low income households) was kept relatively constant between 2006/07 and 2013/14 (City of Cape Town example); so in general an increase in expenditure would equate to an increase in consumption. It can therefore be said that a decrease in the consumption of one fuel (such as paraffin or wood), was compensated for by an increase in the consumption of another (electricity). Between 2005/06 and 2010/11, low to low-middle income households spent between R30 to R60 more on electricity, while keeping their overall energy expenditure constant.

Table 19: Comparison of the average monthly expenditure of South Africans on electricity between 2010/11 and 2005/06

Wealth categories	Income deciles	Electricity exp. as a proportion of total energy		Real growth in the proportion of electricity	Electricity expenditure		Increase in Rand terms	Real growth in exp.
		IES 10/11	IES 05/06		IES 10/11	IES 05/06		
	#	%	%	%	2013 Rands	2013 Rands	2013 Rands	%
Low 1	1	77.4	46.0	31.4	74	37	37	100
	2	74.9	43.8	31.3	76	47	29	61.7
Low 2	3	75.1	50.9	24.2	95	62	33	53.2
	4	79.3	50.6	28.7	104	68	36	52.9
Middle 1	5	82.3	61.5	20.8	122	86	36	41.9
	6	86.5	62.2	24.3	147	89	58	65.2
Middle 2	7	88.1	74.1	14.0	177	116	61	52.6
	8	92.9	85.6	7.3	261	175	86	49.1
High	9	94.9	91.3	3.6	402	278	124	44.6
	10	94.6	94.0	0.6	627	394	233	59.1
	Mean:	84.6	66.0	18.6	209	135	73	58.0
	Median:	84.4	61.9	22.5	135	88	48	53.1

Source: Own calculations using Statistics South Africa (2011b) and Statistics South Africa (2006)

5.4.2 Liquid fuels/Paraffin

In general in South Africa, the Integrated National Electrification Programme (INEP) has been successful in displacing paraffin as a main fuel for lighting and cooking for many poor urban households. This can be seen in the decline of paraffin expenditure between IES 2005/06 and IES 2010/11 (Table 20). However for winter space heating, paraffin remains the main fuel for many of the urban poor, especially black African households in informal settlements.

It is important to note that the data capturing (diary and recall) for households in IES 2010/11 and IES 2005/2006 spanned an entire year, thus the seasonal variations of paraffin consumption particularly for space heating, is assumed to be accounted for in annual terms. For this study the table was converted to a monthly average which is misleading in a sense, since in reality the paraffin expenditure should peak during winter and is therefore not an accurate reflection of the monthly consumption. It merely illustrates the decline in paraffin consumption and the growing

substitutionary effect of electricity despite the concern that households may revert back to paraffin in reaction to tariff increases. The period between 2008/09 and 2010/11 had some of the largest real increases in electricity on average (Figure 17), but this study of the tariffs has shown that the small to medium customers (mostly low to low-middle income households) were in fact shielded from the increases. Thus in general, the electricity tariff increases did not have a negative impact on the energy choices of the poor.

Table 20: Comparison of the average monthly expenditure of South Africans on paraffin between 2010/11 and 2005/06

Wealth categories	Income deciles	*Paraffin exp. as a proportion of total energy		Real growth in the proportion of paraffin	Paraffin expenditure		Increase in Rand terms	Real growth in expenditure
		IES 10/11	IES 05/06		IES 10/11	IES 05/06		
	#	%	%	%	2013 Rands	2013 Rands	2013 Rands	%
Low 1	1	15.5	30.5	-15.0	15	24	-9	-37.5
	2	13.4	26.5	-13.1	14	28	-14	-50.0
Low 2	3	14.8	22.3	-7.5	19	27	-8	-29.6
	4	10.5	23.5	-13	14	31	-17	-54.8
Middle 1	5	9.9	19.6	-9.7	15	27	-12	-44.4
	6	7.4	18.3	-10.9	13	26	-13	-50.0
Middle 2	7	5.2	13.6	-8.4	11	21	-10	-47.6
	8	4.0	8.0	-4	11	16	-5	-31.3
High	9	2.8	3.4	-0.6	12	10	2	20.0
	10	3.0	1.0	2.0	20	4	16	400
	Mean:	6.1	12.5	-6.4	14	19	-6	27.4
	Median:	5.2	13.6	-8.4	13	21	-10	-44.4

Source: Own calculations using Statistics South Africa (2011b) and Statistics South Africa (2006)

* The IES 10/11 and IES 05/06 do not specify which liquid fuel is used, but for lower income deciles it is assumed to be paraffin

5.4.3 Gas

Gas is not widely used for household energy in South Africa. For the five year period, gas expenditure declined on average by 25% (Table 21). Households in Middle 2 (income decile 7) however, had the largest increase in gas expenditure albeit small in comparison to electricity expenditure. This may be as a result of households either consuming more gas on average, an

increase in gas prices or an increase in the number of households using gas in that income category. Poor households did not have an increase in expenditure and remained constantly low over the five years. This trend may suggest that gas is unlikely to be a substitution fuel for electricity by poor households in a scenario where electricity price increases are excessive in the short to medium term future and gas prices remain stable.

Table 21: Comparison of the average monthly expenditure of South Africans on gas between 2010/11 and 2005/06

Wealth categories	Income deciles	Gas exp. as a proportion of total energy		Growth in percentage of total energy spent on gas	Gas expenditure		Increase in Rand terms	Real growth in expenditure
		IES 10/11	IES 05/06		IES 10/11	IES 05/06		
	#	%	%	%	2013 Rands	2013 Rands	2013 Rands	%
Low 1	1	1.3	1.7	-0.4	1	1	0	0
	2	1.6	1.5	0.1	2	2	0	0
Low 2	3	2.3	1.9	0.4	3	2	1	50
	4	1.5	2.3	-0.8	2	3	-1	-33.3
Middle 1	5	1.8	2.3	-0.5	3	3	0	0
	6	1.9	3.4	-1.5	3	5	-2	-40
Middle 2	7	3.9	2.1	1.8	8	3	5	166.7
	8	1.4	2.5	-1.1	4	5	-1	-20
High	9	1.1	3.5	-2.4	5	11	-6	-54.5
	10	1.4	2.8	-1.4	9	12	-3	-25
	Mean:	1.9	2.7	-0.8	4.9	6.0	-1.1	-0.9
	Median:	1.5	2.5	-1.1	4.0	5.0	-1	-25

Source: Own calculations using Statistics South Africa (2011b) and Statistics South Africa (2006)

6 The case study in Imizamo Yethu

The case study, which took the form of an in-depth household survey, is chiefly concerned with investigating whether households in Imizamo Yethu have been negatively affected by the tariff increases applicable to the City of Cape Town municipality. The impacts that were explored from the onset using a questionnaire include: i) changes to the household's main and secondary energy source, along with consumption levels; ii) cut backs on food expenditure to pay extra for electricity; iii) energy-related health burdens resulting from substituting electricity with paraffin; iv) an increase in energy-related fire hazards. During the fieldwork, more impacts were discovered that were initially not considered; these will be included in the forthcoming sections relating to households who share meters.

To limit the recall bias of respondents, the questionnaire reflected on the tariff increase closest to the time of the survey, which was on 1 July 2012 (almost twelve months prior to the time of the survey). Thus, households would have had an entire year to feel its effects and form an opinion. The actual consumption was history retrieved for households includes the twelve month period before the increase, i.e. 1 July 2011 to 30 June 2012 compared to the twelve month period after the increase, i.e. 1 July 2012 to 30 June 2013. This data is a record of the households' monthly electricity purchases in kWh or units. Together, the questionnaire and the consumption history are two complementary datasets with which to measure and analyse the impacts of rising electricity tariffs on poor urban households in South Africa.

6.1 Household income and expenditure

6.1.1 Monthly household income

In socio-economic research circles, 'household Income' is known to be a difficult entity to measure and is often considered a largely imperfect indication of wealth and resourcefulness (Du Toit 2005; Harris 2007; Sen 2010). Being cognisant of this layered and somewhat contentious subject, this study will limit income to being an indicator of a household's purchasing power or ability to acquire necessities such as electricity and food. The income measurement is guided by the approach used in Statistics South Africa (2011b); all household members who receive money in the form of a wage, salary, grant and remittance is accounted for and aggregated. In

addition, rent-free dwellings are assigned an imputed rental income and added to the household's total income.

Table 22 below, provides a breakdown of the entire sample which consists of forty households, 97.5% of which are black African headed households. The table shows each household's income with and without rental imputations. For formal brick dwelling, an imputed rental income of R3000 was estimated which includes water and rates subsidies. This average amount was extracted from the IES 2010/2011 survey for a similar dwelling type (2 bedrooms, a kitchen, a lounge, 1 bathroom and some yard space). The imputations for shacks was also guided by the IES 2010/2011, as well as input from residents in Imizamo Yethu who gave estimations of shack rentals in the area.

Table 22: Average monthly household income of participants in the Imizamo Yethu household survey

Subject	Dwelling type	Household size	Total household income (without imputations) (2013 Rands)	Imputed rental income (2013 Rands)	Total household income (with imputations) (2013 Rands)
zam01	Shack	1	4000	400	4400
zam02	Shack	1	3500	400	3900
zam03	Formal brick	4	2280	3000	5280
zam04	Formal brick	3	2790	3000	5790
zam05	Formal brick	5	3580	3000	6580
zam06	Formal brick	3	3790	3000	6790
zam07	Formal brick	5	4080	3000	7080
zam08	Formal brick	4	3500	3000	6500
zam09	Formal brick	3	7000	3000	10000
zam10	Shack	2	2000	400	2400
zam11	Shack	2	4490	400	4890
zam12	Shack	3	4290	400	4690
zam13	Shack	4	3590	400	3990
zam14	Shack	3	3580	400	3980
zam15	Shack	3	3080	400	3480
zam16	Shack	1	2000	400	2400
zam17	Shack	3	1490	400	1890
zam18	Shack	1	5000	400	5400
zam19	Shack	4	4080	400	4480
zam20	Shack	2	1290	400	1690
zam21	Shack	5	2580	400	2980
zam22	Formal brick	3	8500	3000	11500
zam23	Formal brick	2	4000	3000	7000
zam24	Shack	2	2000	400	2400
zam25	Formal brick	5	6580	3000	9580
zam26	Shack	1	3500	400	3900
zam27	Shack	2	4000	400	4400
zam28	Shack	3	3790	400	4190
zam29	Shack	1	2600	400	3000
zam30	Shack	2	2000	400	2400
zam31	Shack	1	3000	400	3400
zam32	Formal brick	3	3500	3000	6500
zam33	Shack	2	3200	400	3600
zam34	Shack	3	2580	400	2980
zam35	Shack	3	2780	400	3180
zam36	Shack	3	2400	400	2800
zam37	Shack in yard	5	1470	0	1470
zam38	Formal brick	4	1200	3000	4200
zam39	Shack	3	2690	400	3090
zam40	Formal brick	4	1856	3000	4856

There is a great benefit in matching the sample data with the income deciles for South Africa found in Statistics South Africa (2011b), since it allows for comparability with national datasets such as the IES 2010/11 and IES 2005/06 (Table 23) (the expanded table is included in ANNEXURE 3). The results show that just over half the sample in Imizamo Yethu have household incomes of less than R4000 per month, which is below the median household income of South Africa as per IES 2010/2011; the majority of households in the sample are of low to low-middle income and generally poor.

Table 23: A summary of the wealth categories of participants in the Imizamo Yethu household survey

Wealth categories	Income deciles	Average household monthly income	Frequency	Percentage of IY sample	Cumulative Percentage
	#	2013 Rands	#	%	%
Low 1	1		0	0	0
	2	1 470	1	2.5	2.5
Low 2	3	1 790	2	5.0	7.5
	4	2 717	9	22.5	30
Middle 1	5	3 782	10	25	55
	6	4 910	9	22.5	77.5
Middle 2	7	6 742	6	15	92.5
	8	10 360	3	7.5	100
High	9	-	0	0	-
	10	-	0	0	-
		Total	40		

Many low income households are sustained by government grants, particularly targeted at the elderly and children. Leibbrandt and Levinsohn (no date) argue that in South Africa, grants have been a significant source of income for poor households (post-apartheid). In the sample, the Josephs[13] (zam 38) and Mtuli (zam 36) households are sustained by the old age grant of R1200 and R2400 respectively. Their competing food and energy needs will be discussed in section 6.4, highlighting specifically the role adequate 'tariff and energy-use education and awareness' plays in reducing their electricity costs

[13] Not their real name. All names mentioned in the thesis are pseudo names to ensure anonymity.

thereby mitigating the negative impacts of rising tariffs they are presently experiencing.

6.1.2 Food expenditure

Food such as bread, samp, tin fish, meat and chicken are a significant part of the South African diet. Poor households have especially high proportions of maize products in the range of 30% of their total food expenditure, followed by meat (Statistics South Africa 2011b).

The food expenditure for households in the sample is in the same order of magnitude as that reported in Statistics South Africa (2011b) (Table 24). As income increases, the food expenditure increases from R800 to R1600 per month. Poor households spend a larger proportion of their income on food, which is consistent with the findings in Statistics South Africa (2011b).

Table 24: Average monthly food expenditure of participants in Imizamo Yethu compared to IES 2010/11

Wealth categories	Income deciles	Percentage of income spent on food		Food expenditure	
		IY Sample 12/13	IES 10/11	IY Sample 12/13	IES 10/11
	#	%	%	2013 Rands	2013 Rands
Low 1	1	-	143.9		643
	2	54.4	61.5	800	775
Low 2	3	36.0	45.8	650	875
	4	26.1	35.2	706	933
Middle 1	5	24.9	27.2	940	981
	6	21.3	21.7	1033	1080
Middle 2	7	20.6	15.7	1383	1147
	8	15.4	11.6	1600	1364
High	9	-	7.4	-	1585
	10	-	3.7	-	2075
	Mean:	28.4	31.2	1016	1022
	Median:	24.9	27.2	940	981

Source: Own calculations, Statistics South Africa (2011b)

The households in Low 1 who spend an average of 54% of their income on food alone, would have less than half left to meet other essential needs such

as energy, transport and communication. Protecting these income-deficient households against electricity price shocks is essential. There are many poor households In Imizamo Yethu; Census 2011 reports that 46% of households with access to electricity are in the poorest quintile (Figure 23). This suggests that nearly half of the households in Imizamo Yethu who use electricity will have competing food and energy needs with very little disposable income to cope well with significant real increases in tariffs.

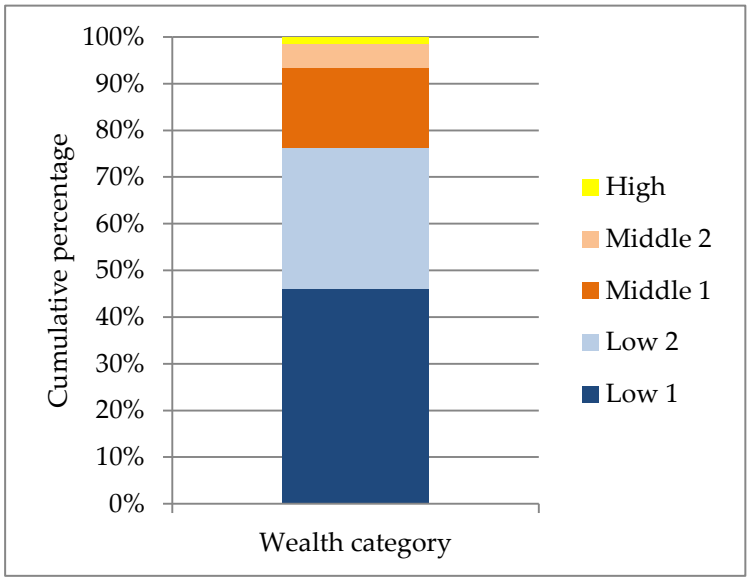


Figure 23: Wealth categories of households in Imizamo Yethu who have access to electricity based on Census 2011

Source: Own calculations using SuperCross (Statistics South Africa 2011a)

6.1.3 Energy expenditure

Multiple fuel use is common among poor households, especially those without access to electricity. When households become electrified (or have access via extension cords) a substitutionary effect takes place over time; electricity becomes the main fuel for lighting and cooking primarily (Heunis and Dekenah 2010; Statistics South Africa 2011a). In Imizamo Yethu, all households in the sample reported that they use electricity as the main fuel for lighting, cooking and water heating. Paraffin however is the main fuel used for space heating by 80% of households, bar those who have respiratory problems, who alternatively use wood, gas or make use of warm blankets instead of a fuel. It is preferred over gas from a safety perspective, and deemed more affordable for heating purposes than electricity. This is in spite of the devastation caused by paraffin-related shack fires common to informal settlements (Swart 2012). Furthermore, 60% of households use

paraffin as a secondary fuel for cooking samp, steamed bread or meat to conserve electricity units. Paraffin is perceived as a cheaper fuel for preparing meals that require longer cooking times (Cowan 2008b).

Table 25 is a computation of the total monthly energy expenditure for households in the sample. The reported expenditures for the sample are a cause for concern when comparing the energy expenditure to households with the same income in Statistics South Africa (2011b). Participants were asked to give the best estimate of their average monthly expenditure of fuels that included electricity, paraffin, wood and gas. Households in the sample have consistently quoted much larger energy expenditures compared to the more recent 2010/11 national survey. The median expenditure for the sample is R516 per month compared to R160 for the South African average in 2010/11. Based on the 10% poverty line, 68% of households in the sample are energy poor (refer to ANNEXURE 4 for the energy poverty indicator results).

Table 25: Average monthly energy expenditure of participants in Imizamo Yethu compared to IES 2010/11

Wealth categories	Income deciles	Percentage of income spent on total energy		Total energy expenditure	
		IY Sample 12/13	IES 10/11	IY Sample 12/13	IES 10/11
	#	%	%	2013 Rands	2013 Rands
Low 1	1	-	21.3	-	95
	2	36.7	8.0	540	101
Low 2	3	19.3	6.6	350	126
	4	16.8	4.9	447	131
Middle 1	5	11.3	4.1	425	149
	6	10.4	3.4	516	171
Middle 2	7	9.0	2.8	600	201
	8	5.8	2.4	600	281
High	9	-	2.0	-	424
	10	-	1.1	-	627
	Mean:	15.6	5.7	497	230
	Median:	11.3	3.8	516	160

Source: Own calculations, Statistics South Africa (2011b)

Electricity consumption calculator

NB: efficiency of appliance not considered

Lighting:

CFL: 11W x 5hrs/day x 30 days = 1.65kWh

Cooking:

Hotplate: 1275W x 1.5hrs/day x 30 days = 57.38kWh

Water heating:

Kettle: 1900W x 0.5hrs/day x 30 days =28.50kWh

Refrigeration:

Large fridge: 160W x 12hrs/day x 30 days =57.60kWh

Entertainment:

Colour TV: 60W x 6hrs/day x 30 days = 10.80kWh

Hi-fi: 15W x 4hrs/day x30 days = 1.80kWh

Communication:

Cellphone charging: 9W x2hrs/day x 30 days = 0.54kWh

Total monthly consumption if all the above were used conservatively = 158kWh

NB. The is the same consumption estimated using the Heunis and Dekanah (2010) model (

Table 8*)*

For low-purchase customers on a lifeline tariff (see Annexure 5 and 6), the cost is calculated as follows for 2012/13:

150kWh – 50kWh FBE = 100kWh.

100kWh x R0.74/kWh = R74.00

8kWh x R1.0254/kWh = R8.20

6.1.3.1 Electricity expenditure

In Imizamo Yethu, electricity is made available to residents formally by the City of Cape Town and informally by residents who have their own electricity meters; electricity theft through meter tampering is also common (City of Cape Town 2013a). Thus electricity is widely used in the settlement beyond what was planned for by the engineers who designed the network for a specific load. Households regard electricity as a basic necessity; those without access have largely made a way to connect and reconnect themselves despite it being informal and illegal; the City of Cape Town does not regard the extension cords as a safe or legal connection and at times send technical personnel in to cut and remove the wires.

The electricity expenditure for the sample is significantly larger than the corresponding national data, with the low to low-middle income households paying roughly between R250 to R350 on average per month compared to the national monthly averages as low as R70 to R150 per month (see Table 26 below).

Table 26: Average monthly electricity expenditure of participants in Imizamo Yethu compared to IES 2010/11

Wealth categories	Income deciles	Electricity exp. as a proportion of total energy		Electricity expenditure	
		IY Sample 12/13	IES 10/11	IY Sample 12/13	IES 10/11
	#	%	%	2013 Rands	2013 Rands
Low 1	1	-	77.4	-	74
	2	55.6	74.9	300	76
Low 2	3	73.3	75.1	250	95
	4	72.1	79.3	310	104
Middle 1	5	64.9	82.3	261	122
	6	75.8	86.5	361	147
Middle 2	7	64.4	88.1	375	177
	8	60.6	92.9	383	261
High	9	-	94.9	-	402
	10	-	94.6	-	627
	Mean:	66.7	84.6	320	209
	Median:	64.9	84.4	310	135

Source: Own calculations, Statistics South Africa (2011b)

Individual households in the small user category (typical of low income households) and medium user category (low-middle income households), should have paid between R80 (150kWh) to R250 (300kWh) (2013 Rands) a month on average in 2012/2013, to meet their basic lighting, cooking, water heating, refrigeration and entertainment needs comfortably (excludes electric space heating). If households are paying more than these averages, it may be that: i) they are using more energy than they can afford, ii) a problem with inefficient behaviour or iii) a case of households sharing meters with very little control of their energy management.

For sharing customers it is largely a case of high priced electricity tariffs designed for high-purchase customers and exploitation/overcharging by private sellers. Here follows an example of four households sharing a meter: 150kWh x 4 = 600kWh. For 2012/13 tariff rates, this costs of R846 (2013 Rands) which if shared equally is R212 per household. Thus households in shared meters (large tariff category) roughly pay R134 more than households with their own meters that also consume 150kWh per month (small or medium tariff category). In addition, private selling of electricity may lead to further inflation in electricity charges.

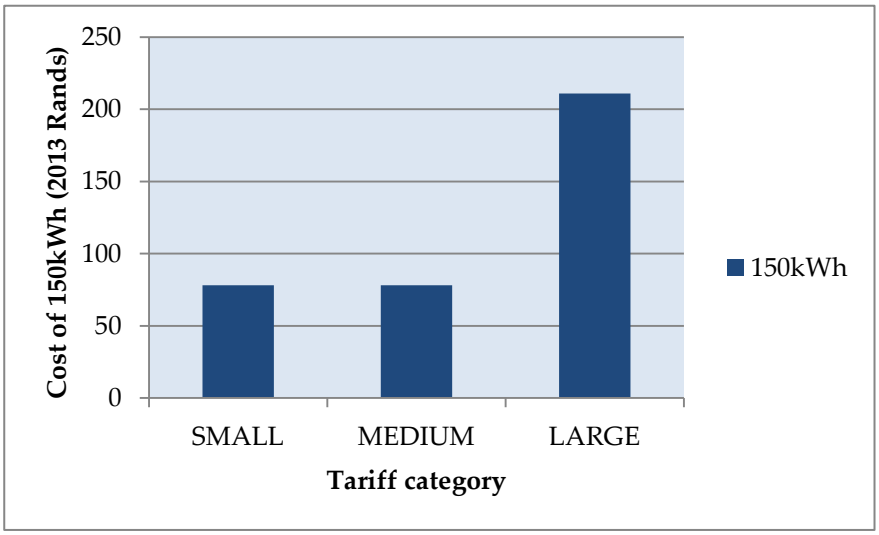


Figure 24: Comparing the cost of electricity for sharing customers versus individual metered customers with FBE for 2012/13 tariffs

Source: City of Cape Town (2012)

6.1.3.2 Gas expenditure

Gas is not widely used in Imizamo Yethu. Most households are afraid of the possibility of gas–related accidents. The fear of gas was the most frequent response as to why households do not use gas for cooking or heating. Although the question was not formally asked in the questionnaire, it was deemed necessary after observing the low use of gas in the area. This is consistent with the low gas expenditures on a national scale (Table 27).

In the sample, zero households used gas as a main fuel for cooking and only two households used gas for space heating; one had been given a gas cylinder by her employer and the other had a child with asthma and thus preferred gas over paraffin. To further exacerbate the fear, there was a fatal explosion during the survey period, which residents believe was caused by a gas cylinder exploding; it was yet to be confirmed by the investigating officers. This incident has further worked to taint the use of gas as a viable alternative to paraffin in the face of rising electricity costs.

Table 27: Average monthly gas expenditure of participants in Imizamo Yethu compared to IES 2010/11

Wealth categories	Income deciles	Gas exp. as a proportion of total energy		Gas expenditure	
		IY Sample 12/13	IES 10/11	IY Sample 12/13	IES 10/11
	#	%	%	2013 Rands	2013 Rands
Low 1	1 2	- 0	1.3 1.6	- 0	1 2
Low 2	3 4	0 0	2.3 1.5	0 0	3 2
Middle 1	5 6	2.0 0	1.8 1.9	13 0	3 3
Middle 2	7 8	0 7.7	3.9 1.4	0 50	8 4
High	9 10	- -	1.1 1.4	- -	5 9
	Mean: Median:	1.9 0	1.9 1.5	12.6 0	4.9 4.0

Source: Own calculations, Statistics South Africa (2011b)

The Nettie household (zam 39) – in the face of excessive electricity costs, the fear of gas makes paraffin a more acceptable alternative fuel

The interview with the Nettie household assisted in further exploring the fear of gas. The primary fear is that unsupervised children will tamper with the cylinder and thus cause the gas to leak undetected. There is an anticipation that it would lead to an explosion when striking a match to light the gas stove or when igniting the gas heater. Since gas cannot be seen it appears as an enigma, something not to be trusted, especially around children. This fear is a formidable force and would be the number one non-energy barrier to overcome if the uptake of gas is to become more acceptable than paraffin. Education in this regard is central, along with culturally relevant technology solutions. In this case, "seeing is believing."

6.1.3.3 Liquid fuels expenditure

The paraffin expenditure for the survey participants ranged between R100 and R240 per month (Table 28), which is mainly used for space heating in winter. A further 60% of households also use paraffin for secondary cooking such as preparing samp and beans which is a slow cooking meal. For the poorest wealth category, 44.4% of the total energy expenditure is for purchasing paraffin, compared to the sample average of 31.6%. Using a cost of R12/litre (the average retail price for paraffin at the time of survey) households consumed between 8 – 20L of paraffin per month.

The sample's average paraffin expenditure of R167 per month far exceeds the national average of R14 per month (2013 Rands). There could be a few reasons for the difference between the sample averages and the national averages. When segmenting the data, it is possible to identify the problem areas where paraffin consumption is more prevalent compared to other segments.

Table 28: Average monthly paraffin expenditure of participants in Imizamo Yethu compared to IES 2010/11

Wealth categories	Income deciles	Paraffin exp. as a proportion of total energy	Actual expenditure	
		IY Sample 12/13	IY Sample 12/13	IES 10/11
	#	%	2013 Rands	2013 Rands
Low 1	1	-	-	15
	2	44.4	240	14
Low 2	3	26.7	100	19
	4	27.9	137	14
Middle 1	5	33.4	151	15
	6	24.2	154	13
Middle 2	7	35.6	225	11
	8	37.1	167	11
High	9	-	-	-
	10	-	-	-
	Mean:	31.6	167	14
	Median:	33.4	154	13

Source: Own calculations, Statistics South Africa (2011b)

Firstly, Census 2011 data (Table 29) shows that paraffin is more commonly used by black African households compared to other population groups in

the same income category. This indicates a cultural influence on the energy choices of households in South Africa; 98% of the sample was black African.

Table 29: Fuels used for space heating by low income households from different population groups in South Africa

Population Group	Paraffin	Electricity	Gas	Wood	Total
Black African	10.8%	85.1%	1.5%	2.6%	100.0%
Coloured	1.5%	92.5%	1.0%	5.0%	100.0%
White	0.4%	91.6%	6.5%	1.4%	100.0%
Indian	0.5%	97.3%	1.8%	0.5%	100.0%

Source: Own calculations using data from Statistics South Africa (2011a)

NB: The data only includes households who have access to electricity and who use a fuel for heating; this is therefore different to the results in Table 4 .

Secondly, Supercross was used to further filter the Census 2011 data to select 'all provinces, low income black African households, within urban informal settlements, with access to electricity, who use paraffin for space heating', first for 'brick dwellings' and then 'shack' separately. The data show that the percentage of households in informal settlements using paraffin, is higher in the shack areas (21%), compared to other formal sections that have brick houses (7%) (Statistics South Africa 2011b). This trend needs to be further investigated on a national scale, with greater levels of segmentation to find specific locations, as there may be other dynamics at play, such as in Imizamo Yethu. Half of the sample lived in shacks and the other half lived in brick houses, yet all of the households used paraffin for space heating. This indicates that paraffin use is above average in Imizamo Yethu for households who live in brick houses and shacks; it may be indicative again of a prevailing culture where paraffin is acceptable. This is concerning, since paraffin is a health risk (e.g. ALRI) and fire hazard especially in shack areas.

Thirdly, although the questionnaire did not distinguish between summer and winter expenditure (in future this segmentation should be done), one of the participants suggested that households in Imizamo Yethu use less paraffin in summer; this makes intuitive sense since space heating needs are lower in the warmer months. The paraffin consumption is likely to decrease significantly for the warmer 8 months of the year thus giving a lower 12 month average; further research is however required to validate this. The results do however suggest that winter is a particularly difficult period for poor households in thermally inefficient homes such as shacks, who cannot do without a winter fuel.

Electricity for space heating

The cost of using one electric heater in winter for roughly 4 hours a day varies depends on the power rating of the heating element.

Based on the 2012/13 tariff structure for low-purchase customers the following average additional monthly costs would apply for using a heater for 4 hrs a day for 30 days in a month:

0.4 kW heater x 4 hrs/day x 30 days x R0.74/kWh = R36 ~ R0.30/hr

or

0.8kW heater = R71 ~R0.59/hr

or

1kWh heater = R120 ~ R1.00/hr

The additional costs are much less than the paraffin costs of households in the Imizamo Yethu sample.

In general, the respondents have major thermal inefficiency problems in their homes, which influence their space heating requirements (DME, 2012). Dwellings will be considered thermally inefficient if they are deprived in at least one of the following areas: i) The state of repair of the dwelling is considered poor ii) The dwelling either leaks, is damp or is considered too cold iii) The household reports a respiratory problem related to the dwellings poor condition (DME, 2012).

The application of this energy poverty indicator for the sample is included in ANNEXURE 4. It classifies each household in the sample as either thermal efficient or thermal inefficient based on the criteria listed above. At least 93% of dwellings are thermally inefficient, of which 80% of the households have problems with a damp interior (condensation) and at least 50% have expressed concern that their roofs leak when it rains and it is extremely cold inside during the winter months. This is extremely unpleasant and creates a need for additional heating. The state of repair of a dwelling can influence the state of health of an individual; 35% of respondents indicated a connection between their health burden and the condition of their dwellings.

Paraffin used by the Deda household (zam 40)

Ms. Deda lives in Imizamo Yethu with her two children and unemployed brother. Their combined disposable income (i.e. without rental imputations) is between R2000 to R3500 per month in a good month. Due to the seasonal nature of the fishing industry where she is employed, they at times live on much less.

The food expenditure for the Deda's is R1200 per month on average; electricity costs are R200 per month and in winter

paraffin costs are 240 per month. The household could benefit greatly from reduced energy costs.

Figure 26: Paraffin heater used for space heating and secondary cooking

The household uses paraffin as a main fuel for space heating in winter, and as a secondary fuel for cooking meals, such as samp, meat and steamed bread to conserve electricity units. A paraffin heater is used for the dual purpose of heating and secondary cooking as shown in Figure 26. They find this a safer way of cooking as opposed to using the paraffin flame stove which is prone to bursting under high temperatures.

Electricity for heating is deemed too expensive by the household. When considering the fuel costs only, electricity is shown to be less expensive (depending on the power rating of the heater) and can be used in combination with using blankets and hot water bottles for additional warmth. An 800W electric heater used for 4 hrs of the day could cost them between R71 per month (R0.59/hr) compared to the R240 (R2/hr) they spend on paraffin per month. Cowan (2008a) did a similar calculation to compare the cost of using a 1 600W two bar electric heater versus a common paraffin heater estimated to have a heat output of 2 000W. Based on prevailing fuel prices in 2008 they found that electric heating would cost R1.29/hr (2013 Rands) and paraffin heating R2.13/hr (2013 Rands) (Cowan 2008a). Considering only the fuel price is however insufficient to make a complete judgment about the true cost of using electricity for space heating compared to paraffin. A life-cycle cost analysis is necessary, that accounts for the cost of the appliances and fuel over the lifetime of the appliances. This is beyond the scope of this study and will be included in the recommendations for further investigation on paraffin use among poor households.

For secondary cooking that includes preparing slow-cooking meals such as samp and beans. Cowan (2008b) conducted a cooking demonstration in Imizamo Yethu to inform households of different cooking fuels and the comparative cost of each. The results showed that electricity is a cheaper cooking fuel than both paraffin and gas. Their cost estimates for cooking samp and beans (pre-soaked) with a paraffin Panda wick stove was R5.33

compared to R0.92 with a two hot plate electric stove and R6.10 single cylinder-top gas burner. Cowan (2008b) highlights that the community members in the audience was surprised that electric cooking was the cheapest cooking fuel compared to the non-electric options.

It is important to educate households on energy-use on an on-going basis, making them aware of cheaper and safer alternatives available for space heating and secondary cooking. Paraffin is unsafe; in addition to the fire hazard, inhalation of the fumes can cause lung damage (Acute Lower Respiratory Infections (ALRI)). There are many reported cases of paraffin ingestion where young children mistake the paraffin for water or cool-drink Figure 27. Increased awareness can greatly reduce paraffin consumption in townships along with these associated dangers (Lloyd and Truran 2008; Barnes, Mathee, Thomas and Bruce 2009; Swart 2012).

Figure 27: Paraffin sold in 2L Coke bottles at a local 'spaza' shop in Imizamo Yethu

6.2 The cost of not having an electricity connection

Meter sharing is rife in Imizamo Yethu. The sample has nearly equal proportions of households who own a prepayment meter and households that do not and thus informally connect themselves to a meter box via extension cords (Table 30). Metered households can connect up to three additional households using the three sockets on the meter box (Figure 6).

Not everyone who owns a meter is willing to connect other households. In an interview, one of the metered households, zam 01, said that he refused to share his meter with other households because it created too many problems that included electricity units being used up too quickly (energy management difficulties). There are however, metered households who share with their friends or family who move from the Eastern Cape or are unemployed and cannot afford to support themselves. Sharing a meter has many drawbacks as zam 01 reported. Table 30 shows the customer categories that exist in the

sample. Households with their own meters can either remain as an individual user (no sharing) or become a private seller (sharing their meter with others).

Table 30: Prepayment meter ownership in the Imizamo Yethu sample

Meter ownership	Frequency
Own prepayment meter	19
Shared (No) prepayment meter	21
Total	**40**
Household category	**Frequency**
Single (Own meter)	14
Sharing (Private seller with own meter)	5
Sharing (No meter)	21
Total	**40**

6.2.1 Loss of FBE and higher tariff rates

Sharing meters often results in a high combined monthly average that exceeds 450kWh, if there are three or four households sharing a meter. As a result the owner of the meter and those sharing do not qualify for FBE and the owner will be recognised as a high-purchase customer. In 2012/2013, households on Domestic Tariff 1 for low to medium customers paid 70.2c/kWh for the first 150kWh compared to 129.05.c/kWh on Domestic Tariff 2 for high-purchase customer, i.e. 84% more per unit purchased.

Shared networks with two households have averages of about 300kWh a month and thus still qualify for FBE, but in the City of Cape Town, the 50kWh will be reduced to 25kWh for medium users as of 1 July 2013/2014. The low-purchase customers will benefit from a FBE of 60kWh, but those in shared networks will unfortunately lose out on this improved subsidy. Eskom customers however will still benefit from the 50kWh if their purchases are less than 400kWh per month.

In many cases, sharing meters is one of the benevolent ways by which the community attempts to solve the problem of human settlement in the townships. There are cases however, where sharing has worked out more for the benefit of the private seller.

6.2.2 Being overcharged

The Bokwe's (zam 30) and Mdende's (zam 33) – the cost borne by a shared network and the benefits incurred by their private seller

The Bokwe's and Mdende's are two households that have been informally connected via extension cords to an electricity meter in another dwelling. In the interview, both households have reported that they pay the owner R250 (2013 Rands) per month on average for electricity. Both households believe that the owner is not charging them too much for electricity. The aim of this case study is to explore what costs are borne by the households in the shared network and what benefits the owner would derive from this arrangement.

There were a total of three households sharing the meter at the time of the interview. Considering only the consumption history for the three months closest to the time of the interview, i.e. May, June and July, the following cost and benefits have been calculated (Domestic 1 Tariff) in Table 31.

Table 31: Profits involved in private selling of electricity

Month	Units (kWh)	Total cost	Combined amount paid by Bokwe and Mdende	Benefits incurred to owner
May 2013	432.4	R390	R250 x 2 = R500	+R110 and ~150kWh of free units (or units that the owner used but did not need to pay for. The R500 contribution of the Bokwe's and Mdende's covered the cost of the owners units and leaves a profit of R110.)
June 2013	447.4	R410	R500	+R90 and ~150kWh of free units
July 2013	481.2	R456	R500	+R44 and ~150kWh of free units

It is clear from the table above that the combined contribution of the two households has more than covered the total consumption for the months in question, without any contribution by the owner. It appears that the private electricity connections were a profitable business for the owner of the meter. (There are other cases in this sample where the owner has tampered with the meter and thus does not pay for electricity at all, but still charges those in the shared network.)

Unbeknown to the Bokwe's and Mdende's, they are being overcharged for electricity compared to households with their own meters. Assuming that there is an equal sharing of the electricity purchased every month, the average per household in this shared network is 150kWh (In reality, the proportions are most likely skewed toward the owner, since numerous reports from the field have indicated that some owners disconnect households when electricity units are running low. For 150kWh, the Bokwe's and Mdende's could have paid R74 (2013 Rands) using the 2012/13 tariffs, if they had their own meters and had more control of their energy management. However, they are paying over three times more for electricity by being in a shared network.

6.3 How households responded to electricity tariff increases

6.3.1 Summary of hypotheses based on survey responses (Qualitative)

In response to past tariff increases on 1 July 2012 (12 months prior to survey) the Hypotheses can be summarise as follows:

Hypothesis 1: Households pay extra to maintain their electricity consumption.

73% of all participants stated that they continued to use the same amount of electricity, with no significant difference in response between single and sharing households. This is much larger that the percentage of households reported in the Human Science Research Council and Department of Energy (2012) study; 23% of participants from informal settlements and 15-25% from a low to medium living standard stated that pay extra to maintain their electricity consumption (Table 5). It is uncertain how much extra their participants were required to pay. Based on the analysis of the City of Cape

Town Tariffs, low and medium-purchasing customers saw a R10 cumulative real increase in tariffs between 2006/07 and 2013/14, with yearly increases of no more than R3. Therefore the high percentage in Imizamo Yethu is consistent with this low real increase in costs.

Hypothesis 2: Households reduce their electricity by saving.

26% of participants in Imizamo Yethu reported that the reduced their electricity through savings such as using CFL's for lighting, switching off the geyser, reducing the number of hot meals prepared with an electric stove and reducing the amount of hot water. The Human Science Research Council and Department of Energy (2012) reported that 46% of households from informal settlements 18 – 38% from a low to medium living standard reduced their electricity consumption through saving. The Imizamo results differ by 20% for informal settlements and roughly 8 – 12% for the living standards measure. This is indicative of some consistency between the two studies, showing that households are trying to save electricity; more energy efficiency awareness and technological innovation particularly for cooking and heating appliances is necessary to enhance energy savings for poor households.

Hypothesis 3 and 4: Household reduce their electricity consumption by switching to other fuels

None of the participants in Imizamo Yethu reported that they had reduced their electricity consumption through switching to other main fuels. However, secondary cooking with paraffin is a means of saving electricity through switching and 60% of households use this method of saving (on average 1 to 7 days at the end of the month). In addition households who use paraffin heaters for heating purposes did not regard this as a switch to other fuels but rather they perceive it to be an affordability hurdle that has always been present. The Human Science Research Council and Department of Energy (2012) reported that 23% of households in informal settlements and 32 – 45% of households from a low to medium living standard switched to other fuels. The study does not indicate which fuels were used to replace electricity and whether it is as main fuel or for secondary purposes. Thus no comparative comments can be made between the two findings.

Hypothesis 5: Households use electricity without paying for it by tampering with the meter (theft)

There is no conclusive finding that can link theft to tariff increases (see next section for examples of theft).

In response to future tariff increases, 13% of participants in Imizamo Yethu expect to maintain their electricity consumption (Hypothesis 1), 73% will attempt to reduce their consumption through saving and the remaining (Hypothesis 2), 7% would prefer switching to other fuels (Hypothesis 3 or 4) and the remaining 7% did not know.

6.3.2 Measuring the actual change in electricity purchases before and after tariff increases (Quantitative)

This study wishes to examine whether there is a difference between the average electricity consumption before and after the tariff increase on 1 July 2012, for the sample as a whole and for individual participants. Using the consumption data 12 months before and 12 months after the increase, the box plot for the entire sample was plotted by meter status, i.e. individual compared to sharing.

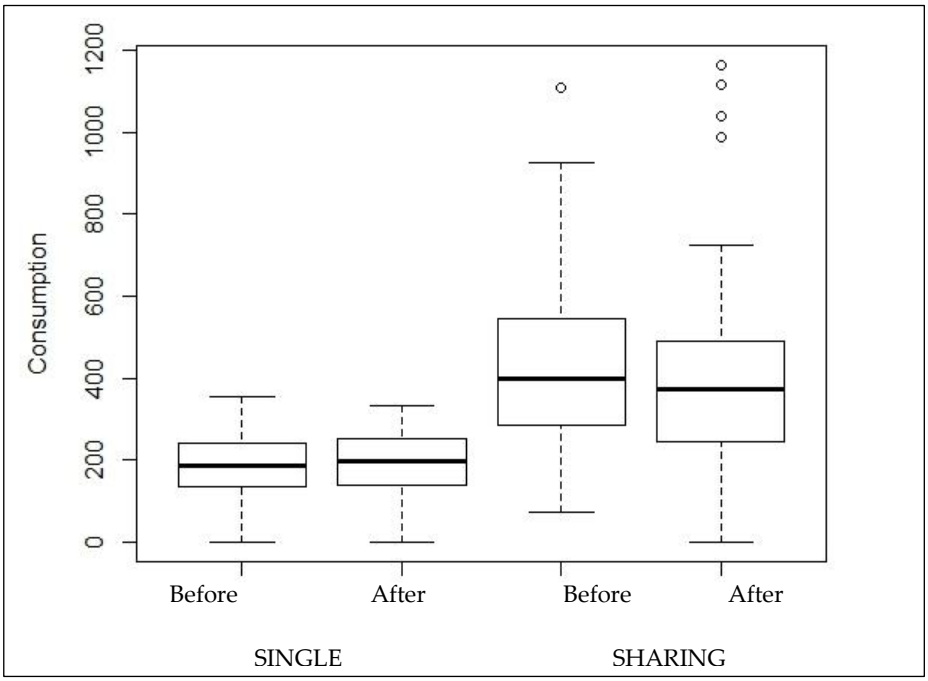


Figure 28: Boxplot of electricity purchases (kWh) before and after tariff increases by meter ownership

For metered households who do not share their boxes (Single household category), the average electricity purchases (most likely consumption) remained relatively constant before and after tariff increases. The box plots are a near mirror image of each other. This is to be expected in view of the outcome of the tariff analysis; these household saw very little increase to their tariffs and thus did not need to reduce their consumption to avoid paying extra.

Sharing households showed an overall reduction in consumption, which also confirms that they have been more strongly affected by tariff increases. It is important to note that there are some inactive meters (zero purchases) present in the sample; this may be due theft which is also one of the reactions to affordability constraints. Eberhard and PDG (2010) reports that approximately 1.3 million of Eskom's meters, installed in low-income households, were inactive which the study highlights as an informal subsidy amounting to R3 billion per annum (2013 Rands). In the Imizamo Yethu sample, the number of inactive meters increased from one to five households in 2011/12 (Table 32); this means that in that year 13% of the sample was stealing electricity through meter tampering. Furthermore, the 5 households who were stealing electricity in 2011/12 were depriving 7.5 other poor households who as yet do not receive their FBE subsidy. This is a rate of 1:1.5 which implies that for every household who steals, at least 1.5 other poor households are being 'robbed' of their formal subsidy (Table 32).

Table 32: Number of inactive meters in the Imizamo Yethu household sample

Participant with an inactive meter	Number inactive months			
	09/10	10/11	11/12	12/13
zam 01 (own meter)	6	12	5	0
zam 03 (own meter)	0	0	7	11
zam 05(own meter)	0	0	2	0
zam 06 (own meter)	0	0	12	4
zam 16 (shared)	0	0	4	12
Total number of inactive months	6	12	30	27
Number of households with inactive meters	1	1	5	3
Total number of free units per year @ a minimum rate of 150kWh per month	900	1 800	4 500	4 050
Number of indigent households robbed from receiving a 12 month supply of FBE	1.5	3	7.5	6.8

Source: A case by case discussion with revenue protection at the City of Cape Town (2013a) to determine whether there was strong evidence of theft.

Some of the meter tampering had been uncovered by the municipality and as a result households pay a penalty. Zam 05 was paying a penalty for tampering with the meter at a rate of 30% recovery, which means that with every electricity purchase 30% is deducted to recover the debt until is paid in full (City of Cape Town 2013a). People are motivated to steal for various reasons; and since low-purchase customers who do not share their electricity meters (single household category) have generally experienced very little increase in electricity costs, it cannot be strongly argued that tariffs are the main cause for the increase in theft in 2011/12. The profile in Figure 29 shows that unusually low purchases occurred just after the increase in July of every year (beyond the expected seasonal highs and lows). In this instance Hypothesis 5 that includes the influence of tariff increases on theft cannot be firmly validated, more data is required to test for a significant relationship. Dealing with theft is important and will allow for a more equitable distribution of electricity subsidies to the 3.5 million eligible households who still require them; this excludes the estimated 3.4 million households who have not yet been electrified (Eberhard and PDG 2010)

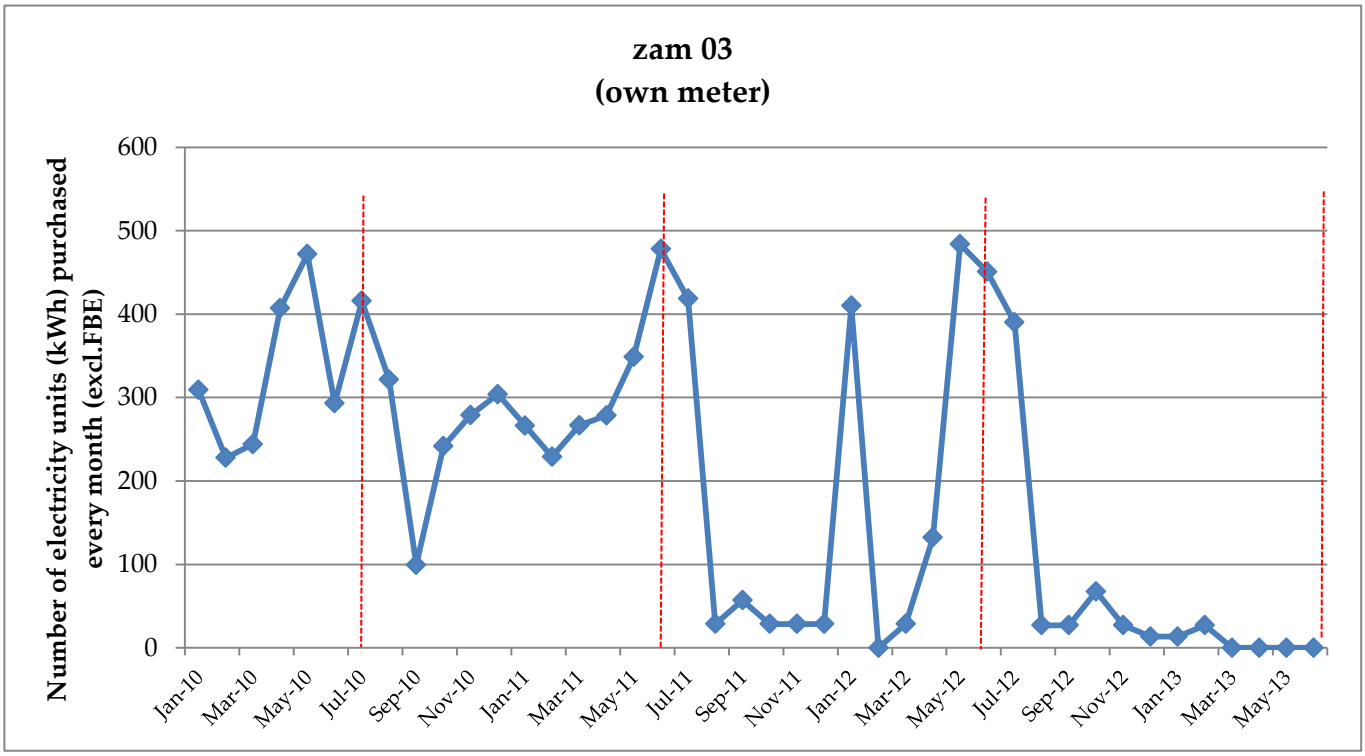


Figure 29: The purchasing history of a metered customer who appears to be tampering with the meter

Source: A print out of the purchasing history was issued by City of Cape Town (2013a)

Table 33 below includes the mean purchase for each subject in the sample for whom data was available or complete. It is highly unlikely that electricity purchases for any household are exactly the same each year. This study aims to identify changes that are linked to tariff increases. Change however can be income related and thus an allowable tolerance is set at +-50kWh that allows purchases to vary within these limits, to accommodate for households with irregular income. This tolerance is based in part on *Table 8: Electricity consumption for households in different wealth categories*. The average change in consumption between consecutive income groups in the model (i.e. an increment or decrement in annual income of R8 683 or monthly income of R724) is within 50kWh. This means that an increase or decrease of 50kWh per month could be linked to fluctuating income. Beyond that (whether up or down), it is assumed that other dynamics are at play such as consumption reductions in response to tariff increases, households joining or disconnecting from sharing network or even theft. The tolerance however has a degree of arbitrariness (why 50kWh and not 53.77 or 42.46kWh) but a rounded number was chosen for ease of use.

Table 33: An analysis of the actual changes in electricity purchases before and after tariff increases

Subject	Meter	Mean 11/12	Mean 12/13	Mean Diff.	Response based on purchasing history (tolerance set at +- 50kWh)	Response based on household interview	Reported response matched with their purchasing history
zam01	Own	213	208	-6	same	same	✓
zam02	Shared	330	166	-164	skewed by sharing	same	?
zam03	Own	175	49	-125	possible theft	same	?
zam04	Own (private seller)	786	1077	292	increased	same	×
Zam05	Own	406	571	165	increased	same	x
zam06	Own	3	211	207	possible theft	same	?
zam07	Own	268	210	-58	reduced	same	×
zam08	Own	254	269	15	same	same	✓
zam09	Own	220	263	44	same	same	✓
zam10	Shared	479	391	-88	reduced	same	×
zam11	Shared	725	317	-408	skewed by sharing	same	?
zam13	Shared	257	0	-257	possible theft	same	?
zam14	Shared	281	381	100	increased	reduced	×
zam15	Shared	775	321	-454	skewed by sharing	same	?
zam16	Shared	257	0	-257	possible theft	same	?
zam18	Shared	482	415	-67	reduced	same	×
zam19	Shared	519	294	-225	skewed by sharing	same	?
zam20	Own	136	130	-6	same	reduced	×
zam22	Own	272	274	1	same	same	✓
zam24	Shared	498	463	-35	same	same	✓
zam25	Own (private seller)	732	635	-97	reduced	same	×
zam26	Shared	248	240	-7	same	same	✓
zam28	Shared	262	514	252	skewed by sharing	same	?
zam29	Own	123	103	-20	same	reduced	×
zam30	Shared	188	411	223	skewed by sharing	reduced	?
zam31	Shared	289	553	264	skewed by sharing	same	?
zam32	Own	133	196	62	increased	reduced	×
zam33	Shared	188	411	223	skewed by sharing	reduced	?
zam34	Own	203	249	47	same	same	✓
zam35	Shared	382	356	-26	same	same	✓
zam36	Own	495	293	-202	reduced	reduced	✓
zam37	Shared	288	402	-288	increased	reduced	×
zam38	Own (private seller)	385	426	41	same	reduced	×
zam39	Own (private seller)	478	224	-254	skewed by sharing	reduced	?
zam40	Own (private seller)	288	402	114	increased	reduced	×
						✓	9
						×	13
						?	13

The purchasing history for only 33 of the participants could be obtained. In addition, it is difficult to assess the history of sharing households without knowing how many households are sharing at any given time (this may change multiple times and therefore affects consumption). In future, this should be considered when dealing with sharing customers.

The results from that table should be interpreted with care due to the high number of invalid data (a history that is affected by theft or skewed by sharing) and should not be a direct substitute for the survey responses but rather add to the discussion. Firstly, based on a tolerance of 50kWh, the data indicate that 11 households (32%) remained the same (Hypothesis 1); 5 households (15%) reduced their purchases (Hypothesis 2 or 3); 5 households (15%) increased their purchases (Hypothesis 4); and the data for 13 households (39%) showed abnormally large increases or decreases in purchases which could be caused by a few factors and therefore an Hypothesis can be assigned to them:

- For a sharing network, one or more households may have disconnected or joined a particular meter at some point in the year, which affects the purchase history by at least 150kWh (skewed by sharing)
- Theft (Hypothesis 5) is also major cause of changes in purchases where a meter becomes inactive, reflecting zero's (full bypass of meter), or even lower than usual purchase levels (partial bypass of meters). From the field research in Imizamo Yethu, some community members are aware of the meter tampering and report that these households purchase a few units in a month to conceal an inactive meter, hoping to remain inconspicuous while stealing electricity. This was confirmed by the City of Cape Town's revenue protection department who run periodic checks for low purchases, uncovering some of the theft (City of Cape Town 2013a).
- Cable faults can reflect zero on a purchasing history, this however is for a short period usually three months at most (City of Cape Town 2013a).

Secondly, the table indicates that for the valid data (data that are not affected by theft nor skewed by sharing), 50% of households had an accurate sense of their electricity purchases. This is an important observation that encourages the use of actual data to confirm the survey responses and also highlight the grey areas that would need

further investigation. Without it, the data may be inflated or skewed in the direction of a subjective response.

Thirdly, the data indicate the energy savings of 3 households (zam 4, 14 and 40) may have been compromised in the shared network, since they stated that they reduce their consumption but the data show either an increase or unchanged combined consumption. Energy expenditure is not easily managed without having one's own meter.

6.4 Electricity expenditure in the context of multidimensional poverty

The Josephs (zam 38) – the unemployed, a frail pensioner and competing food and energy needs

Among the circle of women casually sitting on the front porch, was Mrs Josephs. She is a frail elderly lady and recently became head of the household when her husband passed away. Now her pension of R1200 per month is the disposable income they have available to provide for a household of four, she is the soul breadwinner. Tanya, her daughter was 25 year old daughter, has a baby and a six year old son, and is presently unemployed (she has not completed high school which lowers her income earning potential).

The Josephs household finds it impossible to meet all their household needs with such a meagre income per capita. As a result they suffer multiple deprivations in order to meet their food and energy needs. For one, their house, although brick, is in a poor state of repair admits Mrs Josephs and is thermally inefficient; it is too cold, the roof leaks when it rains and the walls are damp from condensation despite having a ceiling. There is just not enough money to fix things around the house. Instead, the monthly pension is spent largely on food, R600 (50% of pension), of which bread is a large component of the diet.

Mrs Josephs shares her meter with her neighbour. Both households pay on average between R150 to R200 a month to maintain their monthly

combined average of 400kWh (over a 12 month period. Figure 31 below is a plot of their purchasing history. The two years follow a similar profile with high winter peaks (Q1- July, Aug and Sep) and lower spring (Q2- Oct, Nov and Dec) and summer (Q3 - Jan, Feb and Mar) peaks. On average their electricity purchases remained the same, although they felt they started using less, see zam 38 in Table 33.

Figure 30: Purchase history (kWh) for zam38 for 2011/2012 and 2012/2013

In 2012/13, the Josephs and the neighbour each needed to pay R173 (nominal cost according to tariffs in Annexure 5) to maintain a combined consumption of approximately 400kWh (**Error! Reference source not found.**). In 2013/14, if consumption remains at 400kWh, the individual contribution would need to be R200. Now if Mrs Josephs was not sharing and maintained an average of 200kWh, she would be paying less. In 2012/13, she would have paid R125, which is a saving of R48. In 2013/14, it would be even less, costing R127 (2013 Rands) to maintain 200kWh, which is a saving of R73. The energy savings could be used to meet additional food requirements. The problem is not with the tariff, the fundamental problem is that of sharing a meter.

Table 34: A case study of the Josephs household, showing the cost of sharing a meter

Year	Meter	Monthly purchases	Total nominal cost (incl.. FBE)	Each pay
2012/13	Sharing	400kWh	R346	R173
2013/14	Sharing	400kWh	R400	R200
2012/13	If no sharing	200kWh	R125	-
2013/14	If no sharing	200kWh	R127	-

Source: City of Cape Town (2012) and City of Cape Town (2013c)

The Mtulis (zam 36) – the elderly, their poverty and how energy literacy could make a difference

The Mtulis are a family of three living in a two-roomed shack in Imizamo Yethu. They benefit from two old age pensions providing an income of R2400 per month. While spending time with Mrs Mtuli in her home, it was evident that this family did not have all their basic needs met. According to IES 2010/2011, households in a similar income bracket, have a yearly deficit of roughly R8221 in 2013 Rands (Statistics South Africa 2011b).

As a result of limited resources, this household lacks the necessary funds to improve their dwelling, which they regard as being in a 'poor' state of repair. It is cold inside; the window panes and structure itself are broken in places allowing an unpleasant draft to enter the bedroom/kitchen. The dwelling stands dilapidated and leaks during the winter months, which Mrs Mtuli believes has worsened her asthmatic condition.

For energy, the household uses electricity as a main fuel for lighting and cooking because they consider it a safer fuel compared to candles or paraffin. However, Mrs. Mtuli thinks electricity is too expensive for space heating and instead collects wood, where the fire is made outside first and only the coals are brought in as a means of reducing smoke inhalation. However, carbon

monoxide and particulate matter is emitted from the burning coals, which may worsen her asthmatic condition (Barnes, Mathee et al. 2009).

Over time, the family has acquired quite a few essential appliances that include an electric stove with oven, a large fridge, a toaster, an electric iron, a colour TV set, cell phone charger and multiple kettles which don't last long. On average the household spends R80 a week on electricity. In view of the future, Mrs Mtuli is worried that electricity is becoming too expensive for her household to keep using the same amount as before.

Mrs Mtuli has noticed tariff increases since 1 July 2012 and in response has already started changing what and how she cooks and heats. She now only cooks once a day on average; and does not roast or bake as much anymore, to her grandson's dismay. In addition, the family eats less samp because it needs to be cooked for longer. They boil about 2 pots of water for bathing at least twice a day and to save on water heating, one pot is shared between Mrs Mtuli and her grandson. This attempt to reduce consumption through saving is evident in the household's purchasing history graphed in Figure 32, showing a significant reduction in the last 12 months (2012/2013), which confirms her report in the interview, see zam36 in Table 33 .

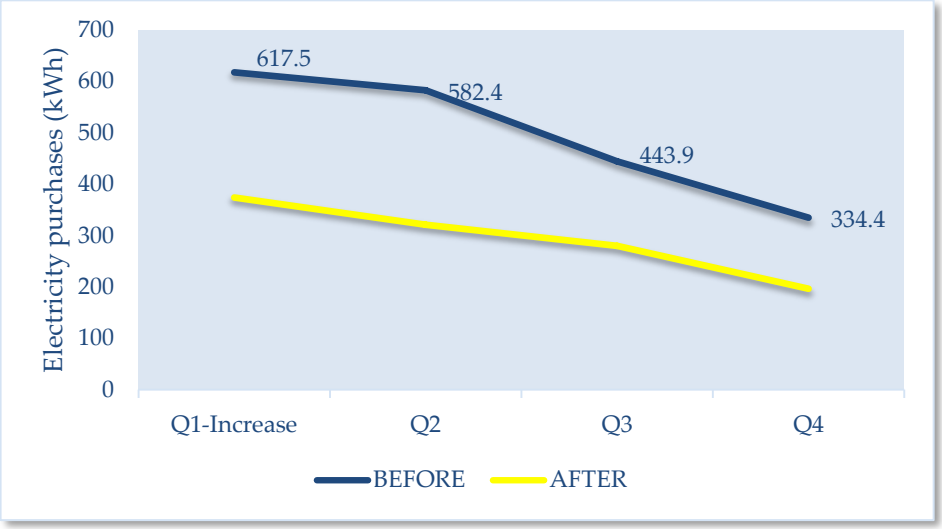


Figure 32: Purchase history (kWh) for zam36 for 2011/2012 and 2012/2013

The graph shows a clear difference between the two years, and within each year, beyond normal seasonal fluctuations; Q4 is lower than expected relative to normal seasonal peaks. The average difference between 2011/12 and 2012/13 is 202kWh that is a decrease of 40.8%.

During the interview, Mrs Mtuli indicated that she no longer received FBE but did not know why. In 2009/10, the household received an average of 464.9 kWh according to the City of Cape Town's records. This means that the household purchased 414.9 kWh and received 50kWh free. As a result of their monthly purchases exceeding 400kWh on average in 2009/2010, the household was transferred to a higher tariff in 2010/2011, the Domestic 2 tariff; hence they no longer qualified for the usual 50kWh's of free units.

Table 35: The purchasing history of the Mtuli household for 2009/10 to 2012/13

Subject	Meter	TARIFF 09/10	AVG. 09/10	TARIFF 10/11	AVG. 10/11	TARIFF 11/12	AVG. 11/12	TARIFF 10/11	AVG. 12/13
zam36	Own	Domestic 1	464.9	Domestic 2	438	Domestic 2	495	Domestic 2	293

NB. The print out included the FBE of 50kWh for 2009/10

As of the 1 July 2013 however, they will be transferred to a new tariff once again, the Lifeline 2 tariff for medium-purchase customers based this time on the previous year's 12 month average of 293kWh. In the new billing year, the Mtuli's will receive an FBE of 25kWh a month. It will be interesting to follow-up on their purchasing trend in the coming year (2013/14) to see if a rebound effect would occur since historically the household is a relatively high consumer and may use the energy savings to purchase more electricity (Davis, Cohen, Hughes, Durbach and Nyatsanza 2010).

Without a rebound effect, assuming that the Mtuli's maintain their average of roughly 300kWh, the following forecast about future electricity expenditure may be made in the box below

Without a rebound effect, assuming that the Mtuli's maintain their average of roughly 300kWh, the following forecast about future electricity expenditure may be made in the box below:

In 2012/2013, the Mtulis paid R407 (2012 Rands) for 300kWh of electricity. In 2013/2014, the Mtulis will pay R235 (2012 Rands) to maintain the same consumption. The Mtulis could potentially experience a decrease in the cost of electricity of 42%. The lowered cost is made possible through the FBE subsidy and lower cost per kWh for customers on the Lifeline tariff. This is good news for the Mtulis as long as they deem their present consumption as sufficient for their basic needs and do not increase their average monthly purchases above 400kWh, otherwise it is back to a higher tariff rate with no FBE.

6.4.1 Causal diagrams that summarise the drivers and barriers to affordability of electricity for the poor

This study has shown that low-purchase and medium purchase customers, have had minimal real increases to their electricity tariffs, mainly due to the lifeline tariffs that have an FBE and lower cost per unit of electricity. This has contributed to the sustained affordability of electricity for the poor. For 2012/13 they were required to pay under R10 more in electricity in real terms. However, sharing households by virtue of their combined consumption have had to pay more for electricity than is necessary based on tariffs for high-purchase customers. The tariffs themselves have not been the reason for their affordability constraints. The causal diagrams in Figure 33 and Figure 34 show a number of factors, both financial and non-financial, that affect the affordability margin (the maximum affordable expenditure beyond which one extra unit purchased will be unaffordable) of electricity for poor households.

Some of the financial factors that negatively affect the affordability margin of electricity for the poor:

- Above inflation increases to electricity tariffs.
- The increase in the cost of other essential goods and services such the food and travelling costs beyond the annual increases in a household income.
- A reduction of household income or inadequate household income resulting from unemployment or a low-income earning potential (education and skills-deficit).

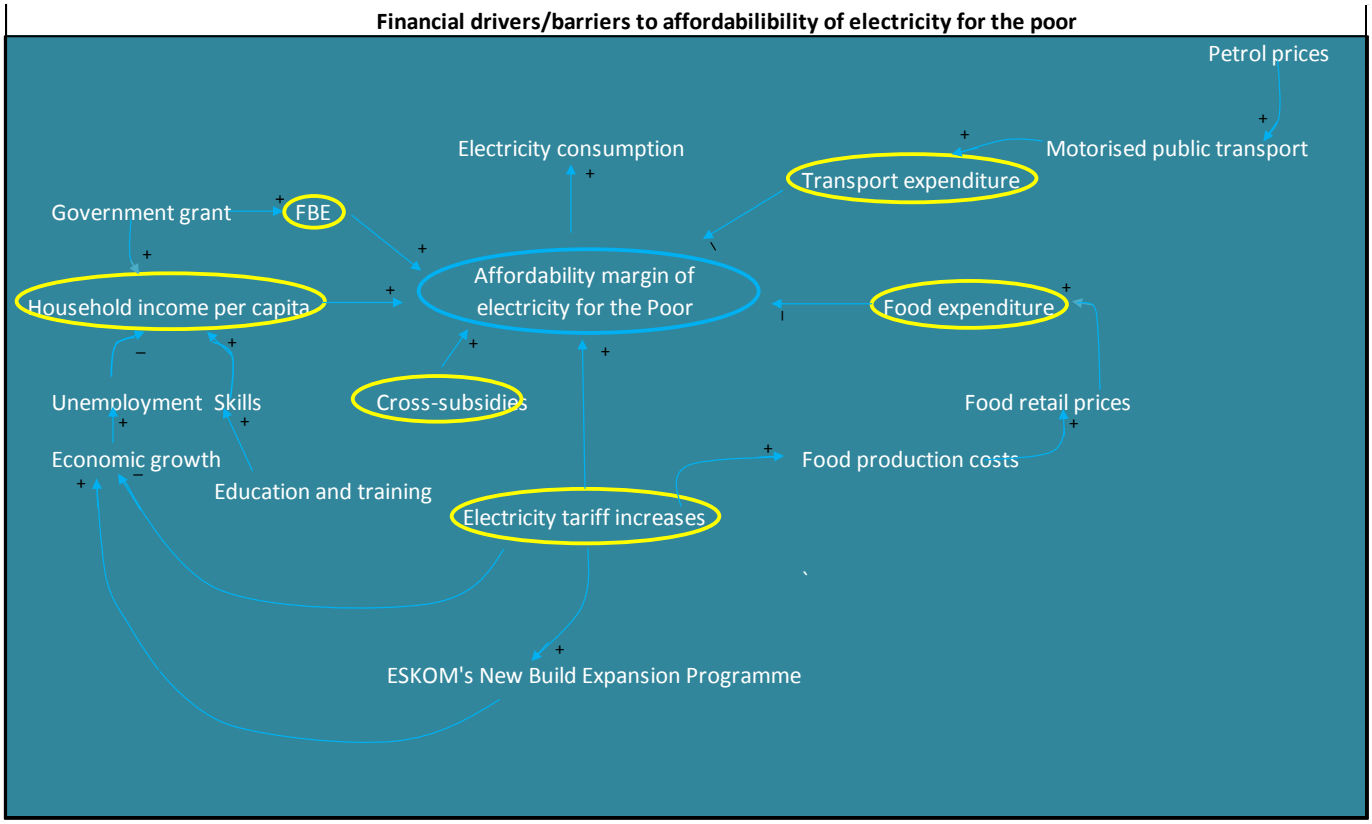


Figure 33: Financial drivers and barriers to affordability of electricity for the poor

Some of the non-financial factors that negatively affect the affordability margin of electricity for the poor:

- Sharing a prepayment meter in cases where the demand for subsidised urban housing (with services), exceeds the rate of service delivery. As a result of human settlement problem:
    - Sharing households have combined consumption that leads to a higher tariff bracket or cost per unit of electricity.
    - Dependence on private sellers who in some instances overcharge their customers.
    - Loss of the monthly free basic electricity subsidy (policy does not make provision for this yet).
- A lack of understanding of how the tariff structures and costs work.
- A lack of awareness or commitment to energy efficiency.
- Institutional failure in reaching qualified indigent households with the free basic electricity subsidy.

- Inadequate targeting, where free basic electricity is allocated to non-indigent households e.g. Prior to 2013/14, the City of Cape Town FBE policy included all households who purchased up to 400kWh per month.

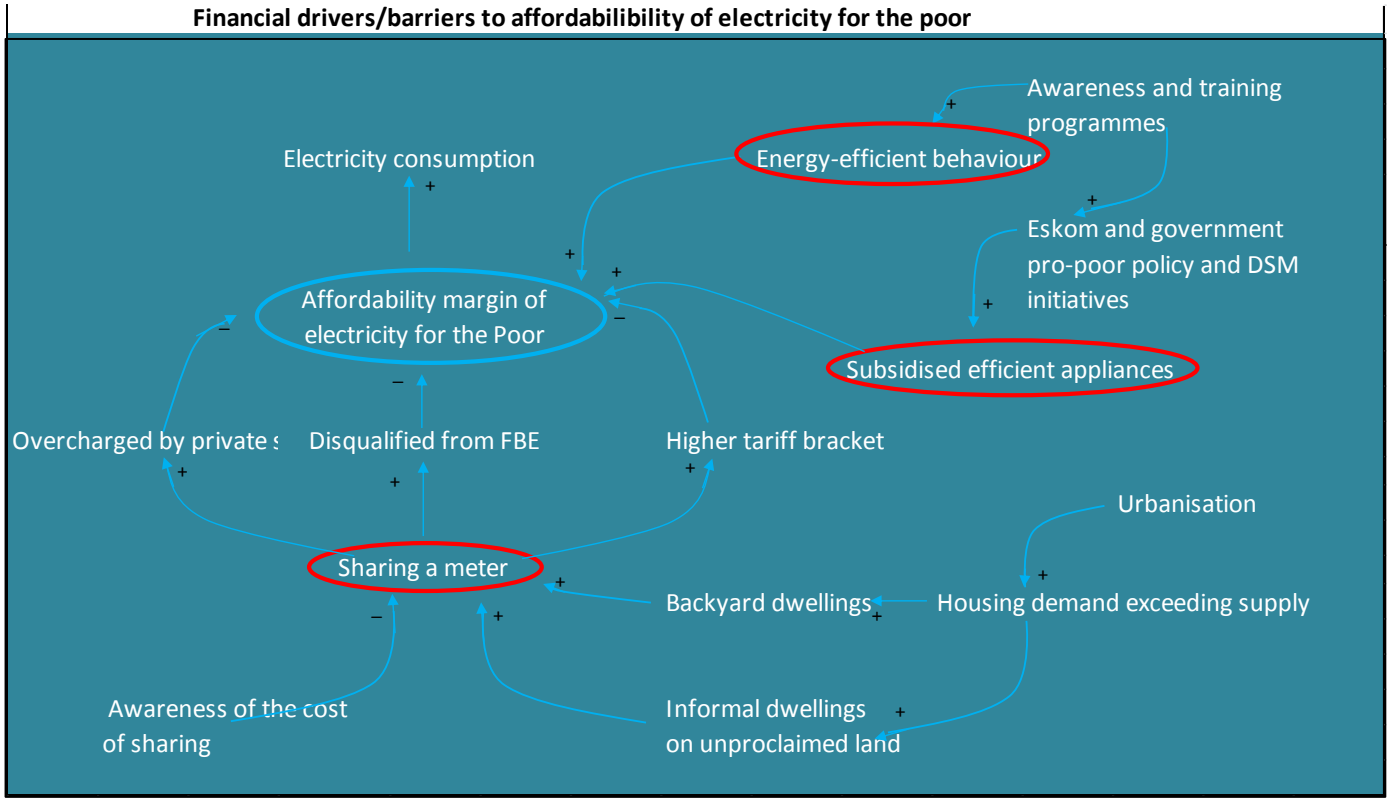


Figure 34: Non-financial drivers or drivers to affordability of electricity for the poor

An energy-use communication strategy is a key driver of affordability

As early as the 1990's, it was apparent that an energy-use communication strategy was vital for ensuring the success of the electrification programme in South Africa (Leitner and van der Byl 1997). Such a strategy needed to be on-going, and required the financial commitment of utilities to reach customers easily through television, radio and various printed media etc.(Leitner and van der Byl 1997). This was deemed necessary to assist newly electrified households to make the transition away from traditional fuels toward using electricity as a modern, safer and more economical source of energy. Leitner and van der Byl (1997) argue that without effective and on-going communication, a complete transition which yields the well-intended benefits of the new energy source is not possible.

7 Conclusion

This study sought to measure the impact of rising electricity tariffs on the urban poor in South Africa by means of a mixed methods research methodology. This method included a qualitative approach to assess household perception of past and future tariff increases, as well as capture the changes to their energy choices in light of these increases. This was accompanied by a range of quantitative research techniques to analyse three main datasets, viz. electricity tariffs between 2006/07 and 2013/14 (City of Cape Town example); the IES 2010/11 and IES 2005/06 (comparative study) and then the purchasing history of households in Imizamo Yethu (case study).

This study as defined has defined three customer groups as follows:

- low-purchase customers (up to 200kWh per month on average)
- medium-purchase customers (201kWh – 400kWh)
- high-purchase customers (>400kWh)

Based on studies by Borchers, Qasa et al. (2000) and Heunis and Dekenah (2010), poor households use an average of 150kWh of electricity per month, which places them within the low-purchase customer category.

The following wealth categories are defined in accordance with the annual income grouping in Statistics South Africa (2011a).

- Low 1: R0 – R21 800
- Low 2: R21 801 – R42 500
- Middle 1: R42 501 – R85 100
- Middle 2: R85 101 – R171 300
- High: > R171 300

These income wealth categories further include the following descriptions which are linked to terms used in the IES 2005/06 and IES 2010/11 (Statistics South Africa 2006; Statistics South Africa 2011b); and LSM groupings used by SAARF (2011):

- Low 1: Income deciles 1 – 2, LSM 1
- Low 2: Income deciles 3 – 4, LSM 2 – 4
- Middle 1: Income deciles 5 – 6, LSM 5 – 6
- Middle 2: Income deciles 7, LSM 7 – 8
- High: Income deciles 8 – 10, LSM 9 – 10

In terms of access to adequate housing, services and purchasing power (income), the poor in this study are generally described by Low 1 and Low 2, but may also include Middle 1 as can be seen from the households in Imizamo Yethu.

Here follows the main findings:

1. A systems thinking approach has added great value to the study of energy poverty. Households make decisions about the way their income is spent within a system of needs such as the need for adequate food, energy and transport.
   Food is the largest expenditure share for poor households (Statistics South Africa 2011b). Between IES 2005/06 and IES 2010/11, the proportion of income spent on food increased for the poorest 30% of South African households (income deciles 1 – 3) - their income growth (-R122, R4 and R155) was too small to offset the increase in their food expenditure (R150, R163 and R190 respectively). The average household in income decile 1 had a decrement in income but on average spent more on food. With more income dedicated to food, these poor households had less income available to offset major increases in other expenditures between 2005 and 2011.

   Transport is the third largest expenditure group for the average low income household in South Africa (Statistics South Africa 2011b). Between IES 2005/06 and IES 2010/11, there was a dramatic increase in the monthly expenditure of South Africans on transport. This can be largely attributed to the increase in petrol prices that affect public transport such as taxis and buses frequented mainly by low and middle income households. Unlike private vehicle transport, once the price of public transport increases it does not come down again, even if petrol price drops. The combined increase of food and transport is thus in the range of R227 to R283 per month for Low 1 to Middle 1 households. These increases are two strong competitors for energy expenditure and will serve to limit surplus funds available to pay extra for electricity if need be. Protecting the poor against price hikes is thus crucial in inhibiting or completely preventing the triple effect of increases in food, transport and electricity costs.

   In the absence of adequate regulation of informal electricity connections, some enterprising households in informal settlements protect themselves at

the expense of others, by passing the cost on to those connected to their meter– this is business of informal electricity re-selling; a welcome source of extra income to the selling household in a poor community.

Analysing the impact of rising electricity tariffs on the poor should therefore not be done in isolation, a systems thinking approach is needed.

2. Poor urban households who have their own electricity connections and receive a free basic electricity subsidy have largely been shielded from tariff increases, experiencing a minimal annual real increase of no more than R3 in real terms (2013 Rands). The cost of 150kWh of electricity increased from R71 to R81 in real terms (2013 Rands) between 2006/07 and 2013/14. This was mainly achieved through a lifeline tariff applicable to both small and medium-purchase customers, where customers receive a FBE subsidy and are charged a lower unit cost for electricity. Between 2006/07 and 2013/14, the cumulative tariff increases remained below inflation.

3. In contrast, poor urban households who share electricity prepayment meters have been negatively affected by tariff increases, having to cut back on food to pay more for electricity. The tariff is not the problem however sharing a meter is which results from the complexities of human settlement in the townships. In cases where the demand for subsidised urban housing (with services), exceeds the rate of service delivery, some of the households without meters connect themselves informally to metered households via extension cords. Sharing households have combined a consumption that places them within the high-purchase customer category. Between 2006/07 and 2013/14 the cost of electricity for these customers nearly doubled; the cost of 450kWh of electricity rose from R328 to R641 in real terms (2013 Rands). This tariff soared above inflation since 2007, showing a cumulative real increase much large than tariffs applicable to low and medium-purchase customers.

   In addition sharing households who depend on private sellers are in some instances overcharged and do not receive their free basic electricity subsidy. The Bokwe and Mdende households are an example of two households who are unknowingly being exploited by a private seller. They each pay the owner R250 a month on average for electricity. The owner only purchased R390 worth of units in May 2013. Thus the owner pocketed R110 and in addition received units for ‘free’ at the expense of the Bokwe and Mdende households.

Furthermore, the owner controls the meter box and can unplug the households if the units are running low.

4. Educating poor households on how the inclining block tariff works will assist them to better manage their energy consumption and retain their free basic electricity subsidy, thus avoiding paying more for electricity than is necessary. In general, households in Imizamo Yethu lack knowledge and an understanding of how the inclining block tariff works and therefore cannot manage spending. It was clear after every interview that households did not firstly know what tariff structure they were on and therefore were unaware that they will begin to pay more per unit after a certain consumption level. As a result some wondered why they no longer received free units and others wondered why they paid more for units towards the end of the month. Households need to be informed that they will lose their subsidy if their 12 month purchasing average exceeds 400kWh per month. Unfortunately the electricity meters do not keep a running count of kWh used in a month. Households may need to use an energy diary to keep track of their spending in order to pay the minimum rate. For the City of Cape Town's lifeline tariff in 2013/14, Block 1 allows for 350kWh which is at 90.86c/kWh. Beyond that it increases steeply to 210.90c/kWh. However poor households with limited appliances generally use 150kWh per month on average and thus will remain shielded, if they have their own meters. Understanding how the tariff works is very important.

   The example of Mrs Josephs, an elderly lady who supports a household of four with her pension and shares her meter with the neighbour, illustrates the cost of sharing and the need to understand how electricity is charged. She could be paying R127 for 200kWh compared to her monthly R200 – R250 every month. With her meagre income, such savings could make a difference to her well-being.

5. In response to tariff increases, 73% of households in the Imizamo Yethu sample have reported that they pay extra to maintain their electricity consumption, some at the sacrifice of food. Again, the tariff however is not the fundamental problem, sharing a meter is, in addition to high paraffin expenditure during winter. Of the 29 households (73% of sample) that maintained their electricity consumption, 60% of households, had said that they had cut back on food such as dairy products, fish and mielie meal.

26% of households reported that they reduced their consumption mainly through the continued use of CFL's, reducing the number of hot meals, reducing the amount of hot water used for bathing, soaking samp and switching off the geyser. Of these households, 27% eat more bread reduce cooking with electricity; this contributes to unbalanced diet.

In response to future tariff increases, 13% of participants in Imizamo Yethu expect to maintain their electricity consumption, 73% will attempt to reduce their consumption through saving, 7% would prefer switching to other fuels and the remaining 7% did not know..

6. Households in Imizamo Yethu perceive paraffin to be cheaper for cooking samp and for space heating. The sample spent Cowan (2008b) conducted a cooking demonstration in Imizamo Yethu to show households that electricity is a cheaper cooking fuel than both paraffin and gas. Their cost estimates for cooking samp and beans (pre-soaked) with a paraffin Panda wick stove was R5.33 compared to R0.92 with a two hot plate electric stove and R6.10 single cylinder-top gas burner.

   Furthermore, for space heating this study estimates that an 800W electric heater used for 4 hrs of the day could cost households between R71 per month (R0.59/hr) compared to the R240 (R2/hr) they spend on paraffin per month. Cowan (2008a) did a similar calculation to compare the cost of using a 1 600W two bar electric heater versus a common paraffin heater estimated to have a heat output of 2 000W. They found that electric heating would cost R1.29/hr (2013 Rands) and paraffin heating R2.13/hr (2013 Rands) (Cowan 2008a).

   Considering only the fuel price is however insufficient to make a complete judgment about the true cost of using electricity for space heating or cooking compared to paraffin. A life-cycle cost analysis is necessary, that accounts for the cost of the appliances and fuel over the lifetime of the appliances. This is beyond the scope of this study.

   Furthermore, paraffin use was found to be more prevalent among black African households compared to other population groups of the same income group.

7. Nationally, real increases in income allowed households to buffer the effect of rising electricity tariffs (where applicable) and maintain a constant energy

expenditure ratio between 2005 and 2011. In South Africa for the average household, the proportion of income spent on food and energy remained relatively constant between IES 2005/2006 and IES 2010/2011 (Statistics South Africa 2006; Statistics South Africa 2011b). This is due mainly to the overall real growth in income for the majority of households in South Africa and a decline in multi-dimensional poverty (Finn, Leibbrandt et al. 2013). The poorest households in income decile 1 however, experienced a decrement in income largely due to unemployment. Thus, they would have been less resourced to pay extra for electricity if required. Shielding the poorest of the poor against tariff increases is essential in a country like South Africa where structural poverty inhibits a growth in income for many poor and unskilled households.

8. Nationally, an estimated 3.5 million eligible households do not receive their free basic electricity subsidy largely due to an institutional failure on the side of both Eskom and Municipal distributors. The implementation of FBE subsidies differ across municipalities, with KwaZulu-Natal and the North West province servicing only 16% and 17% of their indigent households respectively, compared to 46% in the Western Cape. Without a free basic electricity subsidy, poor households face affordability constraints and may lack of vital electricity services.

9. This study suggests that if poor households in informal settlements face high tariff increases in the future, paraffin use will rise. Thus far in Imizamo Yethu, paraffin has been used as a secondary fuel for cooking when households run out of electricity units (one to three days in a month) and as a main fuel for winter space heating because they think it is cheaper than electricity. Secondary cooking is likely to grow in prominence. Thus, greater government intervention is needed through both energy awareness and special winter subsidies, to assist poor households in moving away from using paraffin and reduce the risk of fires and paraffin-related respiratory problems.

10. It is unlikely that the use of LPG will rise as an alternative fuel among black African households in informal settlements, without dispelling the fear factor through awareness campaigns. Gas for space heating is no competitor, both nationally and locally in Imizamo Yethu. Only 2 households in the sample used gas for space heating; fear of gas deters the majority of households. Yet, whether gas or paraffin is used, the extra cost of heating fuels in winter leads

to compromises in food. To solve this, the thermal efficiencies need to be improved to reduce damp and leaking, and if this is not sufficient, poor households need larger subsidies in winter to meet the extra energy needs with a modern fuel such as gas or electricity.

11. Existing energy poverty indicators applied in South Africa, such as the energy expenditure ratio, are inadequate for effectively measuring and tracking energy poverty over time. Adequate energy poverty indicators are especially important in the context of rising electricity tariffs. Studies have found that for poor households the elasticity of demand for electricity is lower than that of high income households, since they have less room to adjust their consumption in the short term compared to the long term.

    As such, over time, poor households may adjust their consumption. Fuel switching is one of the responses to tariff increases which include reverting back to unsafe fuels such as paraffin. The energy expenditure ratio is insensitive to fuel switching and does not change even if the deprivation of the poor worsens, for example and increase from 20% to 30% on energy are both above the 10% limit and thus the headcount will remain unchanged.

8 Recommendations

1. The complex relationship between human settlement and energy needs to be further explored, with the aim of ensuring that poor households who have little choice but to share meters, are not excluded from energy subsidies and in addition can be safely connected to a modern energy source, while the human settlement problems are resolved. Access to renewable energy may be the best interim solution to this.

2. A comprehensive energy-use communication strategy should be implemented to address the lack of knowledge households have pertaining to how the tariff works, in addition to their energy choices, affordability constraints and sharing of meters should be discussed. In so doing it will assist poor households to retain their free units and improve their energy management. These workshops will also resolve some of the common negative perception about tariff increases, placing the blame where it belongs.

3. A paraffin study needs to be conducted that determines firstly the extent of paraffin use in South Africa and investigates the prevalence among black African households compared to other population groups. Second, a lifecycle cost analysis of electric heaters versus paraffin heaters needs to be done to determine the cost over the lifetime of the appliances. Third, the dangers of using paraffin need to be reinforced in informal settlements, providing alternative safe solutions to space heating needs such as electric heaters, hot water bottles, blankets, and gas.

4. The analytical techniques used to assess the tariff history in the City of Cape Town municipality should be applied to municipalities in other regions of South Africa, since municipalities have the right to implement different surcharges resulting in heterogeneous tariff structures across South Africa.

5. Further research is required to determine the extent and cost of sharing an electricity meter in South Africa in all the major provinces such as Gauteng, Kwa-Zulu Natal and Western Cape, where 80% of the 1 million households from informal settlements live.

6. A multidimensional energy poverty indicator (MEPI) should be developed for South Africa, similar to what has been initiated by the Oxford Poverty and Human Development Initiative (OPHI), to more adequately track energy poverty over time.

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ANNEXURE 1: National Income and Expenditure Survey data

Table 36: The percentage shares of household expenditure by income deciles for IES 2010/11

Wealth Categories as per study	Low 1		Low 2		Middle 1		Middle 2		High	
Main expenditure groups / Income deciles	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Food and non-alcoholic beverages	30.7	32.1	30.0	27.9	25.1	22.7	17.6	13.9	9.7	5.6
Alcoholic beverages and tobacco	2.5	2.1	1.8	1.7	1.8	1.8	1.6	1.3	1.0	0.6
Clothing and footwear	6.7	7.0	8.4	7.4	7.5	7.4	6.1	5.5	4.1	2.6
Housing (includes furnishings, services and maintenance)	23.6	23.1	24.1	26.4	28.0	29.1	30.7	32.9	35.4	39.6
Electricity, gas and other fuels	4.5	4.2	4.3	3.9	3.8	3.6	3.1	2.9	2.6	1.8
Health	1.6	1.5	1.3	1.4	1.4	1.5	1.5	1.6	1.5	1.4
Transport	11.8	11.4	11.8	12.2	13.4	13.3	16.8	17.1	17.3	19.6
Communication	3.2	3.0	2.9	2.9	3.1	3.1	3.0	3.0	2.9	2.6
Recreation (includes culture, restaurants and hotels)	5.0	4.6	4.6	4.4	4.3	5.2	5.3	5.0	5.5	6.1
Education	1.5	1.8	1.4	1.5	1.9	1.7	2.3	2.3	2.8	3.3
Insurance (includes misc. other goods and services)	8.9	9.1	9.3	10.2	9.8	10.5	11.8	14.4	17.0	16.8
Other unclassified expenses	0.2	0.2	0.3	0.2	0.1	0.2	0.1	0.1	0.1	0.1
Total (rounding off errors do exist)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Ranking Key
1st
2nd
3rd

Source: Own calculations, Statistics South Africa (2011b)

ANNEXURE 2: Electricity purchasing history participants in Imizamo Yethu household survey

Quarter 1 (Q1) = a 3month average of July, August and September
Quarter 2 (Q2) = a 3 month average of October, November and December
Quarter 3 (Q3) = a 3 month average of January, February and March
Quarter 4 (Q4) = a 3 month average of April, May and June

Table 37: Summary table with quarterly purchasing data for 1 July 2009 to 30 June 2011

Subject	Meter	TARIFF'09/10	Sep-09	Dec-09	Mar-10	Jun-10	AVG. 09/10	TARIFF'10/11	Sep-10	Dec-10	Mar-11	Jun-11	AVG. 10/11
zam02	Shared	Domestic 1	597.8	521.9	375.5	434.4	482.4	Domestic 2	446.3	395.0	320.4	449.3	403
zam10	Shared	Domestic 1	197.4	158.4	164.8	457.3	244.5	Domestic 1	544.6	461.6	490.7	449.2	487
zam13	Shared	Domestic 1	522.0	142.2	147.5	543.7	338.9	Domestic 1	444.4	730.7	610.8	698.1	621
zam16	Shared	Domestic 1	522.0	142.2	147.5	543.7	338.9	Domestic 1	444.4	730.7	610.8	698.1	621
zam17	Shared	Domestic 1	597.8	521.9	375.5	434.4	482.4	Domestic 2	446.3	395.0	320.4	449.3	403
zam18	Shared	Domestic 1	245.1	255.2	266.8	272.0	259.8	Domestic 1	232.7	353.3	386.9	478.2	363
zam19	Shared	Domestic 1	525.6	207.3	223.6	473.0	357.4	Domestic 1	584.2	679.6	816.4	1163.5	811
zam20	Own	Domestic 1	189.7	163.8	190.9	233.3	194.4	Domestic 1	176.9	162.5	130.5	187.9	164
zam21	Shared	Domestic 1	207.3	163.8	169.2	271.6	203.0	Domestic 1	332.0	304.1	391.9	409.4	359
zam22	Own	Domestic 1	560.3	386.0	370.0	369.9	421.6	Domestic 1	283.3	291.6	225.2	233.6	258
zam23	Own	Domestic 1	597.8	521.9	375.5	434.0	482.3	Domestic 2	446.3	395.0	320.4	449.3	403
zam24	Shared	Domestic 1	657.8	548.2	434.8	665.3	576.5	Domestic 2	596.8	600.0	397.8	510.3	526
zam25	Own	Domestic 1	682.3	559.6	601.0	748.4	647.8	Domestic 2	557.7	593.3	620.2	779.2	638
zam26	Shared	Domestic 1	180.1	180.0	201.7	163.8	181.4	Domestic 1	262.6	196.2	208.6	254.2	230
zam28	Shared	Domestic 1	768.4	471.2	421.9	456.7	529.6	Domestic 2	294.2	216.2	178.6	162.9	213
zam29	Own	Domestic 1	125.8	136.8	345.3	120.5	182.1	Domestic 1	90.3	26.7	63.5	110.4	73
zam36	Own	Domestic 1	413.4	494.7	413.4	538.1	464.9	Domestic 2	347.6	387.0	561.2	457.6	438
zam38	Own	Domestic 1	519.2	483.8	478.6	482.5	491.0	Domestic 2	482.5	383.8	351.2	316.0	383

Table 38: Summary table with quarterly purchasing data for 1 July 2011 to 30 June 2013

Subject	Meter	TARIFF'11/12	Sep-11	Dec-11	Mar-12	Jun-12	AVG. 11/12	TARIFF'12/13	Sep-12	Dec-12	Mar-13	Jun-13	AVG. 12/13	TARIFF'13/14
zam01	Own	Domestic 1	0.0	203.1	295.3	354.5	213	Domestic 1	253.1	174.0	226.1	177.3	208	Lifeline 1
zam02	Shared	Domestic 1	584.8	361.8	207.4	166.2	330	Domestic 1	188.9	108	175.3	193.1	166	Lifeline 1
zam03	Own	Domestic 1	168.0	28.5	146.2	355.6	175	Domestic 1	148.0	36.0	13.5	0.0	49	Lifeline 1
zam04	Own	Domestic 1	429.9	682.1	923.8	1107	786	Domestic 2	1117	988.5	1163.6	1040.7	1077	Domestic
Zam05	Own	Domestic 1	-	-	93.2	738.2	406	Domestic 1	741.1	800.7	351.7	339.5	571	Domestic
zam06	Own	Domestic 1	0.0	0.0	0.0	13.6	3	Domestic 1	0.0	180.9	328.3	334.0	211	Lifeline 1
zam07	Own	Domestic 1	231.2	265.7	334.9	242.1	268	Domestic 1	238.2	245.6	204.0	152.8	210	Lifeline 1
zam08	Own	Domestic 1	262.0	246.8	246.8	262.0	254	Domestic 1	248.8	260.8	252.1	314.3	269	Lifeline 1
zam09	Own	Domestic 1	236.9	202.1	202.1	236.9	220	Domestic 1	292.1	255.5	221.3	284.7	263	Lifeline 2
zam10	Shared	Domestic 1	544.1	439.6	433.0	499.3	479	Domestic 2	223.7	408.6	446.9	485.3	391	Lifeline 2
zam11	Shared	Domestic 1	663.1	697.9	821.7	716.8	725	Domestic 2	58.0	280.8	335.4	593.4	317	Lifeline 2
zam13	Shared	Domestic 1	445	375.5	133.3	73.5	257	Domestic 1	0	0	0	0	0	Lifeline 1
zam14	Shared	Domestic 1	510.7	307.4	166.1	138.7	281	Domestic 1	350.7	318.6	477.0	378.0	381	Lifeline 2
zam15	Shared	Domestic 1	713.1	747.9	871.7	766.8	775	Domestic 2	74.7	280.8	335.4	593.4	321	Lifeline 2
zam16	Shared	Domestic 1	445.0	375.5	133.3	73.5	257	Domestic 1	0.0	0.0	0.0	0.0	0	Lifeline 1
zam17	Shared	Domestic 1	584.8	361.8	207.4	166.2	330	Domestic 1	0.0	108.0	175.3	193.1	119	Lifeline 1
zam18	Shared	Domestic 1	560.9	506.5	377.2	483	482	Domestic 2	480.4	293.6	370.4	515.2	415	Domestic
zam19	Shared	Domestic 1	705.3	474.8	486.1	408.1	519	Domestic 2	194.3	231.5	372.7	377.5	294	Lifeline 2
zam20	Own	Domestic 1	155.8	111.7	140.2	135.4	136	Domestic 1	128.7	116.8	134.8	140	130	Lifeline 1
zam21	Shared	Domestic 1	382.7	321.7	370.4	454.7	382	Domestic 1	348	302.6	294	480.6	356	Lifeline 2
zam22	Own	Domestic 1	325.4	203.9	236.3	324.3	272	Domestic 1	266.4	194.8	298.9	333.9	274	Lifeline 2
zam23	Own	Domestic 2	584.8	361.8	207.4	166.2	330	Domestic 1	0.0	108.0	175.3	193.1	119	Lifeline 1
zam24	Shared	Domestic 2	419.1	465.4	470.7	637.5	498	Domestic 2	593.5	419.5	382.6	456.8	463	Domestic
zam25	Own	Domestic 2	812.0	783.5	622.2	710.3	732	Domestic 2	722.7	618.1	545.4	653.7	635	Domestic

Subject	Meter	TARIFF'11/12	Sep-11	Dec-11	Mar-12	Jun-12	AVG. 11/12	TARIFF'12/13	Sep-12	Dec-12	Mar-13	Jun-13	AVG. 12/13	TARIFF'13/14
zam30	Shared	Domestic 1	39.7	277.2	204.1	231.4	188	Domestic 1	304.2	312.0	567.7	459.7	411	Lifeline 2
zam31	Shared	Domestic 1	279.5	314.4	236.3	326.6	289	Domestic 1	510.2	551.4	498.0	653.0	553	Domestic
zam32	Own	Domestic 1	87.1	136	167.3	143.2	133	Domestic 1	198.5	198.1	201.3	184.7	196	Lifeline 1
zam33	Shared	Domestic 1	39.7	277.2	204.1	231.4	188	Domestic 1	304.2	312	567.7	459.7	411	Lifeline 2
zam34	Own	Domestic 1	214.6	203.9	155.8	236.3	203	Domestic 1	330.6	204.6	198.1	264.7	249	Lifeline 1
zam35	Shared	Domestic 1	382.7	321.7	370.4	454.7	382	Domestic 1	348	302.6	294	480.6	356	Lifeline 2
zam36	Own	Domestic 1	617.5	582.4	443.9	334.4	495	Domestic 2	373.8	320.9	279.8	196.1	293	Lifeline 2
zam37	Shared	Domestic 2	350.8	369.9	315.5	114.9	288	Domestic 1	405.7	327.5	360.8	514.2	402	Lifeline 2
zam38	Own	Domestic 1	456.9	390.5	286.6	405.8	385	Domestic 1	390.5	424.7	419.9	469.5	426	Lifeline 2
zam39	Own	Domestic 1	628.1	623.9	336.8	324.1	478	Domestic 2	249.6	201.3	220.3	226.2	224	Lifeline 1
zam40	Own	Domestic 2	350.8	369.9	315.5	114.9	288	Domestic 1	405.7	327.5	360.8	514.2	402	Lifeline 2

ANNEXURE 3: Household income of participants in Imizamo Yethu household survey

Table 39: South Africa's average monthly income as per IES 2010/2011 by income decile

Income decile	Average monthly household income in South Africa (2013 Rands)
1	0 - 855
2	856 - 1586
3	1587 - 2285
4	2286 - 3131
5	3132 - 4285
6	4286 - 6127
7	6128 - 9528
8	9529 - 16666
9	16667 - 39181
10	>39182

Source: Own calculations, IES 2010/2011

Table 40: Household income of survey participants classified according to South Africa's national income deciles

Total household income (with rental imputations)	Income decile	Freq.	Cum. Percent
1470	2	1	2.5
1690	3	1	5
1890	3	1	7.5
2400	4	4	17.5
2800	4	1	20
2980	4	2	25
3000	4	1	27.5
3090	4	1	30
3180	5	1	32.5
3400	5	1	35
3480	5	1	37.5
3600	5	1	40
3900	5	2	45
3980	5	1	47.5
3990	5	1	50
4190	5	1	52.5
4200	5	1	55
4400	6	2	60
4480	6	1	62.5
4690	6	1	65
4856	6	1	67.5
4890	6	1	70
5280	6	1	72.5
5400	6	1	75
5790	6	1	77.5
6500	7	2	82.5
6580	7	1	85
6790	7	1	87.5
7000	7	1	90
7080	7	1	92.5
9580	8	1	95
10000	8	1	97.5
11500	8	1	100
	Total	40	

ANNEXURE 4: Energy poverty indicators applied to Imizamo Yethu sample

Table 41: Energy poverty indicator 1: Energy Expenditure Ratio

Subject	Dwelling type	Prepayment electricity meter	Household income (with imputations)	Reported monthly avg. electricity exp.	Reported monthly avg. paraffin exp.	Reported monthly avg. gas exp.	Total energy exp.	Energy exp. ratio (with income imp.)	Energy Poverty Measure >10%
zam01	Shack	Own	4400	200	0	0	200	4.5	Non-energy poor
zam02	Shack	Shared	3900	110	0	0	110	2.8	Non-energy poor
zam03	Formal brick	Own	5280	150	0	0	150	2.8	Non-energy poor
zam04	Formal brick	Own	5790	600	300	0	900	15.5	Energy poor
zam05	Formal brick	Own	6580	400	300	0	700	10.6	Energy poor
zam06	Formal brick	Own	6790	500	400	0	900	13.3	Energy poor
zam07	Formal brick	Own	7080	200	100	0	300	4.2	Non-energy poor
zam08	Formal brick	Own	6500	400	300	0	700	10.8	Energy poor
zam09	Formal brick	Own	10000	150	300	0	450	4.5	Non-energy poor
zam10	Shack	Shared	2400	450	150	0	600	25.0	Energy poor
zam11	Shack	Shared	4890	600	150	0	750	15.3	Energy poor
zam12	Shack	Shared	4690	450	300	0	750	16.0	Energy poor
zam13	Shack	Shared	3990	300	200	0	500	12.5	Energy poor
zam14	Shack	Shared	3980	300	200	128	628	15.8	Energy poor
zam15	Shack	Shared	3480	400	100	0	500	14.4	Energy poor
zam16	Shack	Shared	2400	500	300	0	800	33.3	Energy poor
zam17	Shack	Shared	1890	300	150	0	450	23.8	Energy poor
zam18	Shack	Shared	5400	400	200	0	600	11.1	Energy poor
zam19	Shack	Shared	4480	350	200	0	550	12.3	Energy poor
zam20	Shack	Shared	1690	200	50	0	250	14.8	Energy poor

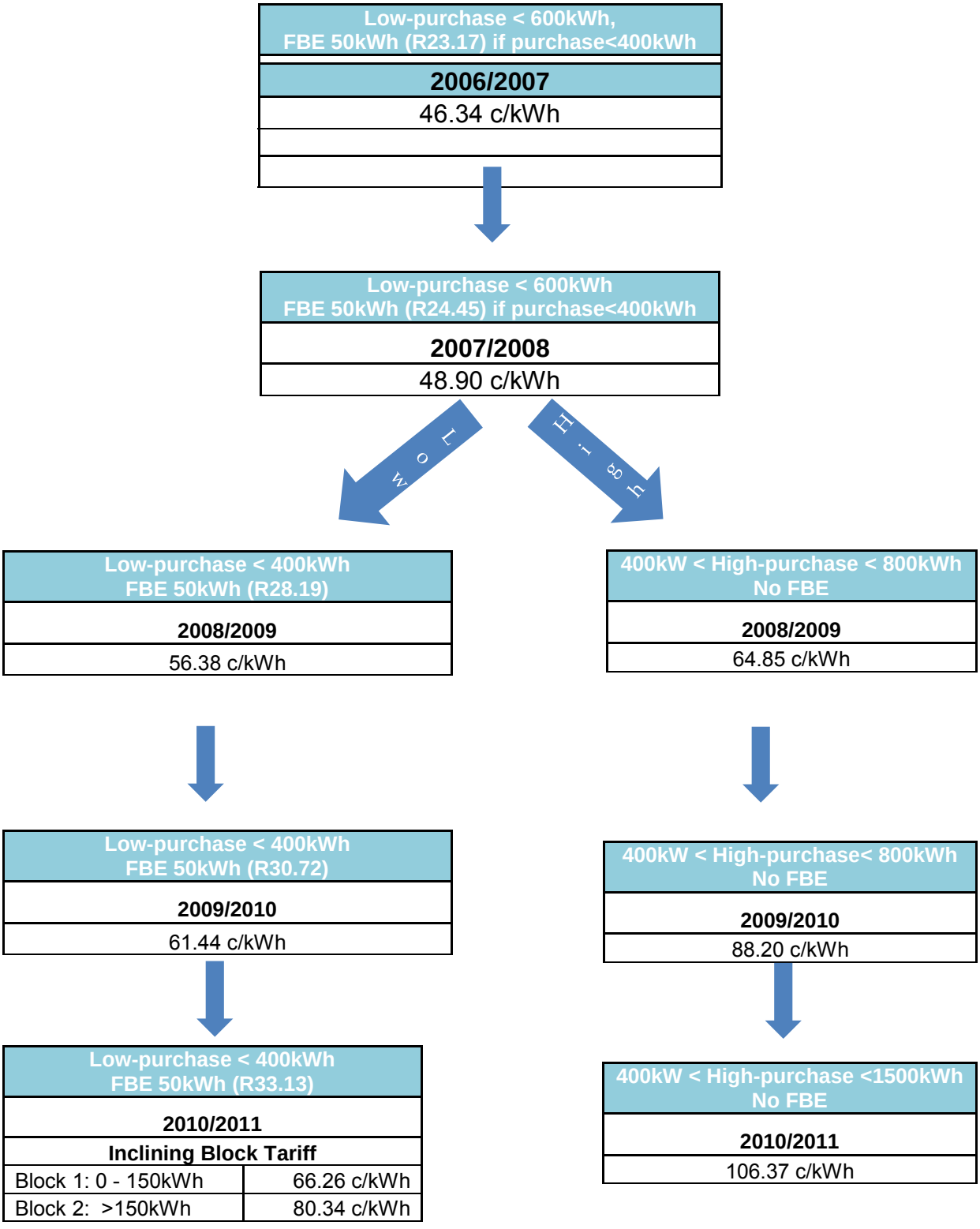
Subject	Dwelling type	Prepayment electricity meter	Household income (with imputations)	Reported monthly avg. electricity exp.	Reported monthly avg. paraffin exp.	Reported monthly avg. gas exp.	Total energy exp.	Energy exp. ratio (with income imp.)	Energy Poverty Measure >10%
zam21	Shack	Shared	2980	450	180	0	630	21.1	Energy poor
zam22	Formal brick	Own	11500	500	200	0	700	6.1	Non-energy poor
zam23	Formal brick	Own	7000	400	100	0	500	7.1	Non-energy poor
zam24	Shack	Shared	2400	400	0	0	400	16.7	Energy poor
zam25	Formal brick	Own	9580	500	0	150	650	6.8	Non-energy poor
zam26	Shack	Shared	3900	350	100	0	450	11.5	Energy poor
zam27	Shack	Shared	4400	300	0	0	300	6.8	Non-energy poor
zam28	Shack	Shared	4190	300	240	0	540	12.9	Energy poor
zam29	Shack	Own	3000	100	240	0	340	11.3	Energy poor
zam30	Shack	Shared	2400	250	0	0	250	10.4	Energy poor
zam31	Shack	Shared	3400	200	200	0	400	11.8	Energy poor
zam32	Formal brick	Own	6500	350	150	0	500	7.7	Non-energy poor
zam33	Shack	Shared	3600	250	120	0	370	10.3	Energy poor
zam34	Shack	Own	2980	200	100	0	300	10.1	Energy poor
zam35	Shack	Shared	3180	200	200	0	400	12.6	Energy poor
zam36	Shack	Own	2800	240	0	0	240	8.6	Non-energy poor
zam37	Shack in yard	Shared	1470	300	240	0	540	36.7	Energy poor
zam38	Formal brick	Own	4200	200	150	0	350	8.3	Non-energy poor
zam39	Shack	Own	3090	200	260	0	460	14.9	Energy poor
zam40	Formal brick	Own	4856	200	240	0	440	9.1	Non-energy poor
									68% energy poor

Table 42: Energy poverty indicator 2: Thermal Inefficiency

Subject	Dwelling type	State of repair of dwelling as reported by household	Thermal problems with dwelling	Respiratory problems related to dwelling	Thermal inefficiency measure
zam01	Shack	Adequate	-	Tuberculosis	Inefficient
zam02	Shack	Adequate	Leaking	-	Inefficient
zam03	Formal brick	Adequate	Leaking, damp	-	Inefficient
zam04	Formal brick	Adequate	-	-	Efficient
zam05	Formal brick	Adequate	Damp	Tuberculosis	Inefficient
zam06	Formal brick	Adequate	Damp	Tuberculosis	Inefficient
zam07	Formal brick	Adequate	-	-	Efficient
zam08	Formal brick	Adequate	Leaking, damp	-	Inefficient
zam09	Formal brick	Adequate	Damp	-	Inefficient
zam10	Shack	Poor	Too cold leaking, damp	-	Inefficient
zam11	Shack	Poor	Too cold, damp	-	Inefficient
zam12	Shack	Adequate	Leaking	Tuberculosis	Inefficient
zam13	Shack	Poor	Too cold, leaking, damp	-	Inefficient
zam14	Shack	Poor	Too cold, leaking, damp	-	Inefficient
zam15	Shack	Poor	Too cold, damp	-	Inefficient
zam16	Shack	Poor	Too cold, leaking,	-	Inefficient
zam17	Shack	Poor	Too cold. leaking,	Asthma	Inefficient
zam18	Shack	Adequate	Too cold, damp	Asthma	Inefficient
zam19	Shack	Poor	Too cold, damp	Tuberculosis	Inefficient
zam20	Shack	Poor	Leaking, damp	-	Inefficient
zam21	Shack	Poor	Damp,	-	Inefficient
zam22	Formal brick	Adequate	Too cold, damp	-	Inefficient
zam23	Formal brick	Adequate	Too cold, damp	-	Inefficient
zam24	Shack	Poor	Leaking, damp	-	Inefficient

Subject	Dwelling type	State of repair of dwelling as reported by household	Thermal problems with dwelling	Respiratory problems related to dwelling	Thermal inefficiency measure
zam25	Formal brick	Adequate	Damp	Tuberculosis	Inefficient
zam26	Shack	Adequate	Too cold, damp	-	Inefficient
zam27	Shack	Poor	Too cold, leaking, damp	-	Inefficient
zam28	Shack	Poor	Leaking, damp	-	Inefficient
zam29	Shack	Poor	Leaking, damp	Tuberculosis	Inefficient
zam30	Shack	Poor	Too cold, leaking, damp	Tuberculosis	Inefficient
zam31	Shack	Adequate	Too cold, leaking, damp	-	Inefficient
zam32	Formal brick	Adequate	Leaking, damp	-	Inefficient
zam33	Shack	Poor	Too cold, leaking, damp	-	Inefficient
zam34	Shack	Poor	Too cold, damp	-	Inefficient
zam35	Shack	Adequate	Too cold, damp	-	Inefficient
zam36	Shack	Poor	Too cold, damp	Asthma	Inefficient
zam37	Shack in yard	Poor	Too cold, leaking, damp	Bronchitis	Inefficient
zam38	Formal brick	Poor	Too cold, leaking, damp	-	Inefficient
zam39	Shack	Poor	Too cold, leaking, damp	Bronchitis	Inefficient
zam40	Formal brick	Good	-	-	Efficient

ANNEXURE 5: City of Cape Town tariff history



Low to Medium-purchase < 400kWh FBE 50kWh (R37.01)	
2011/2012	
Inclining Block Tariff	
Block 1: 0-150 kWh	70.22 c/kWh
Block 2: 151-350 kWh	92.39 c/kWh
Block 3: 351-600 kWh	122.47 c/kWh
Block 4: >600 kWh	134.59 c/kWh

High-purchase > 400kWh No FBE	
2011/2012	
Inclining Block Tariff	
Block 1: 0 - 600kWh	122.47 c/kWh
Block 2: >600kWh	134.59 c/kWh

Low to Medium-purchase < 400kWh FBE 50kWh (R37.01)	
2012/2013	
Inclining Block Tariff	
Block 1: 0-150 kWh	74.02 c/kWh
Block 2: 151-350 kWh	102.54 c/kWh
Block 3: 351-600 kWh	134.65 c/kWh
Block 4: >600 kWh	159.81 c/kWh

High-purchase > 400kWh No FBE	
2012/2013	
Inclining Block Tariff	
Block 1: 0-150 kWh	129.05 c/kWh
Block 2: 151-350 kWh	134.64 c/kWh
Block 3: 351-600 kWh	134.64 c/kWh
Block 4: >600 kWh	159.81 c/kWh

Lifeline 2: 200 kWh < Medium-purchase <400kWh FBE 25 kWh (R22.72)	
Lifeline 1: Low-purchase <200kWh FBE 60 kWh (R54.52)	
2013/2014	
Inclining Block Tariff	
Block 1: 0-350kWh	90.86 c/kWh
Block 2: >350kWh	210.90 c/kWh

High-purchase > 400kWh No FBE	
2013/2014	
Inclining Block Tariff	
Block 1: 0-600kWh	142.50 c/kWh
Block 2: >600kWh	173.28 c/kWh

ANNEXURE 6: Nominal and real cost of electricity tables

These costs are based on the City of Cape Town tariffs listed in Annexure 5.

6.1 ELECTRICITY COSTS APPLICABLE TO LOW-PURCHASE CUSTOMERS

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Table 43: Nominal cost of electricity for low-purchase customers in the City of Cape Town

BILLING YEAR	150kWh	300kWh	450kWh	600kWh
2006/2007	R 46.34	R 115.85	R 185.36	R 278.04
2007/2008	R 48.90	R 122.25	R 195.60	R 293.40
2008/2009	R 56.38	R 140.95	R 225.52	R 389.10
2009/2010	R 61.44	R 153.60	R 245.76	R 529.20
2010/2011	R 66.26	R 186.77	R 226.94	R 638.22
2011/2012	R 70.22	R 208.81	R 377.47	R 734.82
2012/2013	R 74.02	R 227.83	R 413.75	R 799.48
2013/2014	R 81.77	R 218.06	R 474.39	R 855.00

Table 44: Real cost of electricity for low-purchase customers in the City of Cape Town in 2013 Rands

BILLING YEAR	Month of increase	CPI Month of increase	150kWh	300kWh	450kWh	600kWh
2006/2007	July	66.9	R 71.28	R 178.19	R 285.11	R 392.02
2007/2008	July	71.6	R 70.28	R 175.69	R 281.11	R 386.52
2008/2009	July	81.2	R 71.45	R 178.62	R 285.79	R 392.96
2009/2010	July	85.4	R 74.03	R 185.08	R 296.12	R 407.17
2010/2011	July	88.6	R 76.95	R 216.91	R 263.57	R 263.57
2011/2012	July	93.2	R 77.53	R 230.54	R 416.76	R 619.58
2012/2013	July	97.8	R 77.88	R 239.71	R 435.33	R 647.83
2013/2014	July	104	R 80.91	R 215.76	R 469.38	R 782.38

NB: All values converted to June 2013 Rands using CPI of 102.9

Table 45: Cumulative real cost increase of electricity for high-purchase customers between 2006/07 and 2013/14 in 2013 Rands

BILLING YEAR	150kWh	300kWh	450kWh	600kWh
2006/2007	0	0	0	0
2007/2008	-R 1.00	-R 2.50	-R 4.00	-R 5.50
2008/2009	R 0.17	R 0.43	R 0.68	R 0.94
2009/2010	R 2.75	R 6.88	R 11.02	R 15.15
2010/2011	R 5.68	R 38.72	-R 21.54	-R 128.45
2011/2012	R 6.25	R 52.35	R 131.65	R 227.56
2012/2013	R 6.60	R 61.52	R 150.22	R 255.81
2013/2014	R 9.63	R 37.57	R 184.27	R 390.36

6.2 ELECTRICITY COSTS APPLICABLE TO MEDIUM-PURCHASE CUSTOMERS

Table 46: Nominal cost of electricity for medium-purchase customers in the City of Cape Town

BILLING YEAR	150kWh	300kWh	450kWh	600kWh
2006/2007	R 46.34	R 115.85	R 185.36	R 254.87
2007/2008	R 48.90	R 122.25	R 195.60	R 268.95
2008/2009	R 56.38	R 140.95	R 225.52	R 310.09
2009/2010	R 61.44	R 153.60	R 245.76	R 337.92
2010/2011	R 66.26	R 186.77	R 226.94	R 226.94
2011/2012	R 70.22	R 208.81	R 377.47	R 561.18
2012/2013	R 74.02	R 227.83	R 413.75	R 615.73
2013/2014	R 113.58	R 249.87	R 506.20	R 822.55

Table 47: Real cost of electricity for medium-purchase customers in the City of Cape Town in 2013 Rands

BILLING YEAR	Month of increase	CPI Month of increase	150kWh	300kWh	450kWh	600kWh
2006/2007	July	66.9	R 71.28	R 178.19	R 285.11	R 392.02
2007/2008	July	71.6	R 70.28	R 175.69	R 281.11	R 386.52
2008/2009	July	81.2	R 71.45	R 178.62	R 285.79	R 392.96
2009/2010	July	85.4	R 74.03	R 185.08	R 296.12	R 407.17
2010/2011	July	88.6	R 76.95	R 216.91	R 263.57	R 263.57
2011/2012	July	93.2	R 77.53	R 230.54	R 416.76	R 619.58

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

2012/2013	July	97.8	R 77.88	R 239.71	R 435.33	R 647.83
2013/2014	July	104	R 112.37	R 247.22	R 500.84	R 813.85

NB: All values converted to June 2013 Rands using CPI of 102.9

Table 48: Cumulative real cost increase of electricity for medium-purchase customers between 2006/07 and 2013/14 in 2013 Rands

BILLING YEAR	150kWh	300kWh	450kWh	600kWh
2006/2007	0	0	0	0
2007/2008	-R 1.00	-R 2.50	-R 4.00	-R 5.50
2008/2009	R 0.17	R 0.43	R 0.68	R 0.94
2009/2010	R 2.75	R 6.88	R 11.02	R 15.15
2010/2011	R 5.68	R 38.72	-R 21.54	-R 128.45
2011/2012	R 6.25	R 52.35	R 131.65	R 227.56
2012/2013	R 6.60	R 61.52	R 150.22	R 255.81
2013/2014	R 41.10	R 69.03	R 215.74	R 421.83

6.3 ELECTRICITY COSTS APPLICABLE TO HIGH-PURCHASE CUSTOMERS

Table 49: Nominal cost of electricity for high-purchase customers in the City of Cape Town

BILLING YEAR	150kWh	300kWh	450kWh	600kWh
2006/2007	R 69.51	R 139.02	R 208.53	R 278.04
2007/2008	R 73.35	R 146.70	R 220.05	R 293.40
2008/2009	R 97.28	R 194.55	R 291.83	R 389.10
2009/2010	R 132.30	R 264.60	R 396.90	R 529.20
2010/2011	R 159.56	R 319.11	R 478.67	R 638.22
2011/2012	R 183.71	R 367.41	R 551.12	R 734.82
2012/2013	R 193.58	R 395.54	R 597.51	R 799.48
2013/2014	R 213.75	R 427.50	R 641.25	R 855.00

Table 50: Real cost of electricity for high-purchase customers in the City of Cape Town in 2013 Rands

BILLING YEAR	Month of increase	CPI Month of increase	150kWh	300kWh	450kWh	600kWh
2006/2007	July	66.9	R 106.91	R 213.83	R 320.74	R 427.66
2007/2008	July	71.6	R 105.42	R 210.83	R 316.25	R 421.66
2008/2009	July	81.2	R 123.27	R 246.54	R 369.81	R 493.08
2009/2010	July	85.4	R 159.41	R 318.82	R 478.23	R 637.64
2010/2011	July	88.6	R 185.31	R 370.61	R 555.92	R 741.23
2011/2012	July	93.2	R 202.82	R 405.65	R 608.47	R 811.30
2012/2013	July	97.8	R 203.67	R 416.16	R 628.66	R 841.17
2013/2014	July	104	R 211.49	R 422.98	R 634.47	R 845.96

NB: All values converted to June 2013 Rands using CPI of 102.9

Table 51: Cumulative real cost increase of electricity for high-purchase customers between 2006/07 and 2013/14 in 2013 Rands

BILLING YEAR	150kWh	300kWh	450kWh	600kWh
2006/2007	0	0	0	0
2007/2008	-R 1.50	-R 3.00	-R 4.50	-R 6.00
2008/2009	R 16.36	R 32.71	R 49.07	R 65.43
2009/2010	R 52.50	R 104.99	R 157.49	R 209.98
2010/2011	R 78.39	R 156.79	R 235.18	R 313.57
2011/2012	R 95.91	R 191.82	R 287.73	R 383.64
2012/2013	R 96.75	R 202.33	R 307.92	R 413.51
2013/2014	R 104.57	R 209.15	R 313.72	R 418.30

ANNEXURE 7: CPI table

Table B1 - CPI headline index numbers[1] (Dec 2012 = 100)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1960	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
1961	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
1962	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
1963	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
1964	1,5	1,5	1,5	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6
1965	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6
1966	1,6	1,6	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7
1967	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7
1968	1,7	1,7	1,7	1,7	1,7	1,7	1,8	1,8	1,8	1,8	1,8	1,8	1,8
1969	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,9	1,9	1,9	1,8
1970	1,9	1,9	1,9	1,9	1,9	1,9	1,9	2,0	2,0	2,0	2,0	2,0	1,9
1971	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,1	2,1	2,1	2,1	2,1	2,0
1972	2,1	2,1	2,1	2,1	2,1	2,1	2,2	2,2	2,2	2,3	2,3	2,3	2,2
1973	2,3	2,3	2,3	2,4	2,4	2,4	2,4	2,4	2,4	2,5	2,5	2,5	2,4
1974	2,5	2,5	2,6	2,6	2,6	2,7	2,7	2,7	2,8	2,8	2,8	2,8	2,7
1975	2,9	2,9	2,9	3,0	3,0	3,0	3,1	3,1	3,1	3,1	3,2	3,2	3,0
1976	3,2	3,2	3,3	3,3	3,3	3,4	3,4	3,5	3,5	3,5	3,5	3,5	3,4
1977	3,6	3,6	3,6	3,7	3,7	3,7	3,7	3,8	3,8	3,8	3,8	3,9	3,7
1978	3,9	3,9	3,9	4,0	4,0	4,0	4,2	4,2	4,3	4,3	4,3	4,3	4,1
1979	4,4	4,4	4,5	4,5	4,5	4,6	4,8	4,8	4,9	4,9	4,9	5,0	4,7
1980	5,0	5,1	5,1	5,1	5,2	5,3	5,4	5,4	5,5	5,7	5,7	5,8	5,4
1981	5,8	5,9	5,9	5,9	6,0	6,1	6,2	6,3	6,5	6,5	6,6	6,6	6,2
1982	6,6	6,7	6,9	6,9	7,0	7,0	7,1	7,2	7,3	7,4	7,5	7,5	7,1
1983	7,5	7,7	7,7	7,8	7,9	7,9	8,0	8,1	8,1	8,2	8,3	8,3	8,0
1984	8,4	8,4	8,5	8,7	8,8	8,8	8,9	9,0	9,1	9,2	9,3	9,4	8,9
1985	9,5	9,8	9,8	10,1	10,2	10,3	10,3	10,5	10,6	10,7	10,9	11,1	10,3
1986	11,4	11,5	11,7	11,9	11,9	12,1	12,3	12,5	12,7	12,9	13,0	13,1	12,3
1987	13,3	13,5	13,7	13,9	14,0	14,1	14,2	14,4	14,7	14,8	15,0	15,1	14,2
1988	15,2	15,2	15,5	15,6	15,8	15,9	16,1	16,3	16,5	16,7	16,8	17,0	16,1
1989	17,2	17,4	17,7	17,9	18,2	18,3	18,5	18,8	18,9	19,1	19,3	19,6	18,4
1990	19,8	20,0	20,3	20,4	20,7	20,8	21,0	21,3	21,6	21,8	22,3	22,4	21,0
1991	22,7	23,0	23,1	23,5	23,8	24,0	24,3	24,6	25,0	25,4	25,7	26,0	24,3
1992	26,4	26,6	26,8	27,2	27,3	27,6	27,9	28,2	28,3	28,4	28,6	28,6	27,7
1993	28,9	29,0	29,4	30,1	30,2	30,4	30,6	30,8	30,9	31,1	31,2	31,3	30,3
1994	31,7	31,8	32,0	32,2	32,4	32,6	33,1	33,6	34,0	34,2	34,3	34,3	33,0
1995	34,8	35,0	35,4	35,8	35,9	35,9	36,1	36,2	36,2	36,3	36,5	36,7	35,9
1996	37,2	37,3	37,5	37,8	38,0	38,4	38,7	38,8	39,2	39,6	39,8	40,2	38,5
1997	40,6	40,9	41,1	41,5	41,7	41,8	42,2	42,2	42,5	42,6	42,5	42,6	41,9
1998	43,0	43,1	43,4	43,6	43,8	44,0	45,0	45,5	46,3	46,5	46,5	46,5	44,8
1999	46,8	46,8	46,8	46,9	46,9	47,1	47,1	47,0	47,1	47,3	47,4	47,5	47,1
2000	48,1	47,9	48,4	49,0	49,3	49,6	50,0	50,2	50,4	50,6	50,7	50,8	49,6
2001	51,5	51,6	51,9	52,2	52,4	52,6	52,6	52,5	52,6	52,6	52,9	53,1	52,4
2002	54,1	54,6	55,2	56,0	56,4	56,8	57,7	57,9	58,6	59,4	59,7	59,7	57,2
2003	60,3	60,2	60,9	61,0	60,9	60,7	60,7	60,9	60,7	60,3	59,9	59,9	60,5
2004	60,4	60,7	61,1	61,2	61,2	61,4	61,6	61,6	61,6	61,8	62,1	62,0	61,4
2005	62,2	62,3	62,9	63,2	63,2	63,1	63,7	63,9	64,2	64,2	64,2	64,2	63,4
2006	64,6	64,7	65,0	65,4	65,7	66,2	66,9	67,4	67,6	67,7	67,6	68,0	66,4
2007	68,5	68,4	69,0	69,9	70,3	70,9	71,6	71,9	72,5	73,1	73,4	74,0	71,1
2008	74,8	75,1	76,3	77,7	78,5	79,6	81,2	81,8	81,9	81,9	82,0	81,1	79,3
2009[2]	81,4	82,3	83,4	83,8	84,1	84,5	85,4	85,6	86,0	86,0	86,0	86,2	84,6
2010	86,4	87,0	87,7	87,8	88,0	88,0	88,6	88,6	88,7	88,9	89,0	89,2	88,2
2011	89,6	90,2	91,3	91,6	92,0	92,4	93,2	93,4	93,8	94,2	94,5	94,6	92,6
2012	95,2	95,7	96,8	97,2	97,2	97,5	97,8	98,0	98,9	99,5	99,8	100,0	97,8
2013	100,3	101,3	102,5	102,9	102,6	102,9	104,0						

[1] Primary urban areas up to and including December 2008. All urban areas from January 2009. The series were linked so as to provide a continuous index.

Source: Statistics South Africa (2012)

Example of method for converting nominal Rands into real Rands:

Converting income in IES 2005/06 and IES 2010/11 to 2013 Rands to allow for comparability in real terms:

Income deciles	1	2	3	4	5
IES 2010/2011 (March 2011 Rands)	4 757	13 436	20 324	28 324	38 345
IES 2005/2006 (March 2006 Rands)	4 312	9 587	13 297	17 626	22 974

Source: Statistics South Africa (2011b) and Statistics South Africa (2006)

Deflated by CPI

Jun 2013	102.9
Mar 2006	65
Mar 2011	91.3

Income deciles	1 (Example)	2	3	4	5
IES 2010/2011 (June 2013 Rands)	4 757 x 102.9/91.3 = 5 361	15 143	22 906	31 923	43 217
IES 2005/2006 (June 2013 Rands)	4 312 x 102.9/65 = 6 826	15 177	21 050	27 903	36 370
Increase in Rand terms	5 361 – 6 826 = -1 465	-34	1 856	4 019	6 847
Real % increase	-1 465/6 826 *100 = -21%	0%	9%	14%	19%

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

ANNEXURE 8: Household questionnaire

HOUSEHOLD ENERGY CHOICE QUESTIONNAIRE 2013

This is a detailed questionnaire which aims to explore how household energy choices are influenced by increasing electricity prices.

Interview details

Name of interviewer	
Date of interview	
Starting time	
Ending time	
Questionnaire number	
Locality of interview	

Instructions to interviewer

Interview a member of the household who knows most about the fuels used by the household for different purposes and has knowledge of household income from all sources and the expenses of the household.

Introduce yourself and explain what this study is about.

"Good (morning/afternoon/evening), my name is _____. As part of a university research project I am doing a survey to understand how increasing electricity prices are affecting households. A study like this helps to inform decision makers about what the real energy needs of people are and find ways to improve service delivery to them.

Does your household have access to electricity? (Only interview households who have access). Your opinion is important in helping us do this research. I would like to ask you a few questions about how your household uses different fuels and how you are coping with rising electricity prices with your current income and other expenses? The identities of you and your household members will not be identified by name or address in the written report and will not be disclosed to anyone outside the research team. I would also like you to answer the questions for your household as a whole not just for yourself. Would you like to participate in this survey?

If at any time you feel uncomfortable and want to opt out, you are free to do so."

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

A. Information on household

Surname of household								
Population group of head of household	Black African	1	Coloured	2	Asian	3	White	4
Street address								
Contact Number								
Area name								
Electricity payment method	Own prepayment meter	1	Shared prepayment meter	2	Own credit meter	3	Shared creadit meter	4
Electricity meter number								
Electricity provider	Eskom	1			Municipality			2

A01 Type of area / settlement

Urban formal	1
Urban informal planned	2
Urban informal unplanned	3
Peri- urban informal planned	4
Peri-urban informal unplanned	5
Other (specify)	

A02 Type of dwelling

Formal brick structure	1
Informal dwelling – shack in backyard	2
Informal dwelling – shack not in backyard	3

I will now ask you about your household and household members. I would like to ask about all the sources of income for your household:

A03 How many members live in your household (for more than 15 days of the month)? ☐

A04 Give us your ***best estimate*** of the total **INCOME** of your household**:**

Amount in Rands……

A05 First name	**A06** Sex	**A07** How old is	**A08** What is the highest level of education she/he	**A09** What is her/his employment

Write name of respondent in row a. Write the rest of household from oldest to youngest.	Male [1] Female [2]	[name] in completed years?	has completed? Choose from the list below: No schooling……..[0] Some primary school……..[1] Completed primary school..[2] Some secondary school…...[3] ABED……...[4] Grade 12……...[5] Higher ……..[6]	circumstances? Choose from the list below: Full-time employment…...[1] Part-time employment …..[2] Casual employment..…….[3] Self-employed……[4] Pensioner/retired…….[5] Disabled…….....[6] Student/scholar……...[7] Housewife/home maker….[8] Unemployed ……[9] Unemployed, in training….[10] Unemployed, looking for work ..[11] Preschool child…….[12] Other (specify)…….[13]
Example: Priscilla	*2*	*35*	*2*	*4*
a.				
b.				
c.				
d.				
e.				
f.				
g				
i				
j				

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

A05 First name Write name of respondent in row a. Write the rest of household from oldest to youngest.	**A10** What type of work do they do? Include part-time, informal selling of any kind and piece jobs. Officials/Administrators ……[1] Professionals …….[2] Technicians ……...[3] Sales workers ……[4] Office & clerical …[5] Craft (trade) workers [6] Operatives ……[7] Labourers ……..[8] Domestic workers….[9] Gardener……..[10] Handyman……. [11] Other (specify)…..[12]	**A11** If household member/s have own business (self-employed), what type of business do they have? Store/shop…….[1] Neighbourhood store selling from home ……[2] Hawker in nearby town ……[3] Sewing …….[4] Baking …… [5] Brewing beer/alcohol … [6] Carpentry …….[7] Cell phone service (pay phones) …[8] Collecting water or firewood for other people ……..[9] Other (specify)[10]	**A12** How much do they earn per month net from wages or salaries? (*net income is income after deductions)*	**A13** If household member/s receive a pension/grant, what type of pensions / grants does the person receive? Not applicable……..[0] Govt old age ……...[1] Private employer/work pension ……...[2] Govt. disability grant..[3] Govt. unemployment benefit……..[4] Retrenchment payment[5] Child support grant ….[6] Foster child grant ……[7] Pension received by Dependants from deceased person's employer …..[8] Other (specify)…….[9
Example: Priscilla				
a.				
b.				
c.				
d.				
e.				
f.				
g				
i				
j				

A05 First name Write name of respondent in row a. Write the rest of household from oldest to youngest.	**A14** What is the value of the grant?	**A15** How often do they contribute money to this household? Every day…….[1] Every week……...[2] Every two weeks ……..[3] Every month ……[4] Every 2-3 months ……..[5] every six months ……..[6] once a year……[7] infrequently…....[8] never…….[9]	**A16** How much do they contribute to this household each time? (*Amount in local money*.)	**A17** Did the household member lose a job in the 12 months, which reduced their contribution to household income? Yes [1] No [2]
Example: Priscilla				
a.				
b.				
c.				
d.				
e.				
f.				
g				
i				
j				

I will now ask you about what your household spends on food and energy.

A18 On average what does the household spend on food every month?

Amount in Rands……

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

A19 On average what does the household spend on the following fuels every week/month/year?

Fuel →	**Weekly fuel cost**	**Quantity**		**Monthly fuel cost**	**Quantity**		**Yearly fuel cost**	**Quantity**
1. Electricity								
2. Paraffin								
3. Gas								
4. Candle								
5. Wood								

A20 What is the maximum amount the household is willing to pay for electricity with the current income?

Amount in Rands ……

A21 How often did your household receive free basic electricity in the last 12 months?

Every month	1
Most months	2
A few months	3
Not at all	4
Don't know	8

A22 Why does your household not receive the free basic electricity every month?

Electricity consumption is too high	1
Not available in area	2
Don't know	3
Other (specify)	4

A23 Has the household ever stayed without any electricity in the house? (excluding power failures)

Yes	1
No	2

→ GOTO A25

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

A24 How long does the household stay without any electricity before buying more?

A few hours	1	1 to 2 weeks	4
1 to 3 days	2	3 to 4 weeks	5
4 to 7 days	3	Longer than 4 weeks	6

A25 Excluding power failures, what are the reasons for staying without electricity? (*One reason only*)

Insufficient money to buy units or pay bill	1	Forgot to buy units or pay the bill	4
We had lost the bill/card or receipt	2	Other (specify)	5
Faulty meter	3		

A26 Have you noticed that electricity prices have increased?

Yes	1	→ GOTO A26
No	2	→ GOTO A27

A27 Since when did you notice this increase?

This year (2013)	1	Three years ago (2010)	4
Last year (2012)	2	More than three years (>2009)	5
Two years ago (2011)	3	Don't know	8

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

A28 In your opinion, do you think electricity is becoming too expensive for your household to keep using the same amount as before?

Yes	1
No	2
Don't know	8

A29 If your household buys electricity from a private seller, do you think they charge too much for electricity compared to those who have their own meters?

Yes	1
No	2
Don't know	8

A30 In the past 12 months when electricity prices increased how did the household respond?

Continued to use the same amount of electricity	1	→GOTO A31
Started to use less electricity by saving	2	→GOTO A30
Replaced electricity with other fuels	3	→GOTO B01
Don't know	8	

A31 Indicate all the ways used by the household to save electricity in the past 12 months:

	Yes	No
A. Lighting:		
a. Use energy saving CFL bulbs	1	2
b. When energy saving CFL bulbs fuse, replace with another energy saving CFL bulb even if it's more expensive	1	2
c. Use energy saving LED bulbs	1	2
d. Switch off lights in unoccupied rooms	1	2
e. Other (specify):		
B. Cooking:		
a. Reduce the number of hot meals that are cooked	1	2
b. Use a wonder bag	1	2
c. Soak samp and beans first to reduce cooking time	1	2
d. Freeze cooked meals and defrost when needed	1	2
e. Prepare faster cooking meals	1	2
f. Other (specify):		
C. Water Heating:		
a. Use less hot water in the basin or bath	1	2
b. Turn off geyser	1	2
c. Use a geyser blanket	1	2
d. Insulate the hot water piping	1	2
e. Share bath water	1	2
f. Use flask for coffee/tea	1	2
g. Other (specify):		
D. Space Heating:		
a. Wear warm clothes and use blankets on cold nights	1	2
b. Insulate roof and/or walls of dwelling	1	2
c. Other (specify):		

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

A32 If your household paid extra for electricity to keep using the same amount, did you cut back on anything else?

	Yes	No	Don't know
Nothing, could afford it.	1	2	8
Food	1	2	8
Eating and drinking outside the home	1	2	8
Clothes	1	2	8
Transport	1	2	8
Entertainment such as DSTV, TV, radio etc.	1	2	8
Cellphone airtime	1	2	8
Savings	1	2	8

A33 If households cut back on food, which items were affected most?

Grocery Item	Same	Less	More	Don't know
a. Mielie meal, samp	1	2	3	8
b. Bread	1	2	3	8
c. Meat and Chicken	1	2	3	8
d. Fish	1	2	3	8
e. Fruit and Vegetables	1	2	3	8
f. Dairy products	1	2	3	8
g. Coffee/tea	1	2	3	8
h. Other (specify):				
	1	2	3	8
	1	2	3	8

SECTION B: INFORMATION ABOUT YOUR HOUSE / DWELLING

B01 What material was used to construct your house/dwelling?

Material	A. Walls	B. Roof
Bricks	1	1
Wood	2	2
Corrugated Iron	3	3
Cement Block/Concrete	4	4
Plastic	5	5
Cardboard	6	6
Mixture of mud and cement	7	7

B02 Would you describe the state of repair of your home as good, adequate or poor?

Good	1
Adequate	2
Poor	3
(Do not know)	8

B03 Do you have any of the following problems with your accommodation?

Overcrowding, with too little space	1
Insufficient light	2
Cold, not enough heating	3
Leaking roof	4
Damp walls, floors, foundations, etc.	5
Damaged or broken windows or doors	6
No ceiling	7
None of these problems	9
Other (specify)	10

B04 Do you think anyone in your household has suffered from the following health burdens because of your housing condition?

Asthma	1
Bronchitis	2
Pneumonia	3
Burns	4
Tuberculosis	5
Eye problems	6

SECTION C
FUELS USED FOR LIGHTING, COOKING AND HEATING IN THIS HOUSEHOLD

Lighting:

C01

A. What is the main fuel used for lighting?		B. How often is it used?		C. What are the main reasons it is used?		D. Does the household use a second fuel for lighting?		E. How often is it used?	
No fuel	0	Every day	1	Affordable/ cheap	1	No fuel	0	Once a week	1
Electricity	1	A few times a week	2	Easily available	2	Electricity	1	Last week of the month	2
Paraffin	2	Once a week	3	Bright light	3	Paraffin	2	Less often/irregularly	3
Gas	3	Three times a month	4	Easy to use	4	Gas	3	Special occasions, during holidays and celebrations	4
Candles	4	Once per month	5	Safe	5	Candles	4	During power failures	5
Solar	5	Less often/irregularly	6	Other (specify)		Other (specify)		No electricity units	6
Other (specify)		Other (specify)						Other (specify)	

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

Cooking:

C02

A. What is the main fuel used for cooking?		**B. How often is it used?**		**C. What are the main reasons it is used?**		**D. Does the household use a second fuel for cooking?**		**E. How often is it used?**		**F. What is the second fuel used for?** Indicate all that are applicable	
No fuel	0	Every day	1	Affordable/ cheap	1	No fuel	0	Once a week	1	Cooking samp	1
Electricity	1	A few times a week	2	Easily available	2	Electricity	1	Last week of the month	2	Cooking beans	2
Paraffin	2	Once a week	3	Faster cooking	3	Paraffin	2	Less often/irregularly	3	Cooking meat	3
Gas	3	Three times a month	4	Easy to use	4	Gas	3	Special occasions, during holidays and celebrations	4	Brewing beer	4
Wood	4	Once per month	5	Safe	5	Wood	4	During power failures	5	Other (specify)	
Dung/crop residue	5	Less often	6	Other (specify)		Dung/crop residue	5	No electricity units	6		
Charcoal	6	Other (specify)				Charcoal	6	Other (specify)			
Coal	7					Coal	7				
Other (specify)						Other (specify)	8				

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

For those who use electricity for cooking:

C03 On average how often are hot meals prepared in the household using an electrical appliance (stove or oven)?

Three times a day	1	A few times a week	4
Two times a day	2	Once a week	5
Once a day	3	Less than once a week	6

C04 In the last 12months has the household continued to use same, less or more electricity for cooking?

Same	1
Less	2
More	3

For those who use other fuels for cooking:

C05 Has your household ever used electricity as a main fuel in the past five years or since you've been electrified?

Yes	1
No	2

C06

When did the household stop using electricity as a main fuel for cooking?

This year (2013)	0
Last year (2012)	1
Two years ago (2011)	2
Three years ago (2010)	3
Four years ago (2009)	4
Five years ago (2008)	5
Other (specify)	6

C07 What are the reasons the household has never used electricity as a main fuel for cooking?

	Yes	No
Too expensive	1	2
Don't have appliances	1	2
Don't receive FBE	1	2
Other (specify)	1	2

C08 On average, how often are hot meals prepared in the household?

Three times a day	1	A few times a week	4
Two times a day	2	Once a week	5
Once a day	3	Less than once a week	6

Water Heating

C09

A. What is the main fuel used for water heating?		**B. How often is it used?**		**C. What is the main reason it is used?**		**D. Does the household use a second fuel for water heating?**		**E. How often is it used?**	
No fuel	0	Every day	1	Affordable/ cheap	1	No fuel	0	Once a week	1
Electricity	1	A few times a week	2	Easily available	2	Electricity	1	Last week of the month	2
Paraffin	2	Once a week	3	Heats quicker	3	Paraffin	2	Less often/irregularly	3
Gas	3	Three times a month	4	Easy to use	4	Gas	3	Special occasions, during holidays and celebrations	4
Wood	4	Once per month	5	Safe	5	Wood	4	During power failures	5
Dung/crop residue	5	Less often/irregularly	6	Other (specify)		Dung/crop residue	5	No electricity units	6
Charcoal	6	Other (specify)				Charcoal	6	Other (specify)	
Coal	7					Coal	7		
Other (specify)						Other (specify)			

For those who use electricity for water heating:

C10 What main appliance do you use for boiling water?

Kettle	1
Pot on stove	2

C11 How many times a day is this appliance used to boil water for:

	A. Coffee/tea	B. Bathing	C. Washing dishes
Never	1	1	1
Three or more times a day	2	2	2
Two times a day	3	3	3
Once a day	4	4	4
A few times a week	5	5	5
Only special occasions	6	6	6
Other (specify)	7	7	7

C12 Does the household use an electric geyser, solar geyser or both?

Electric geyser	1
Solar geyser	2
Both	3
None	4

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

C13 What does household use to wash in for more than 15 days of the month?

Bath	1
Basin	2
Shower	3

C14 How many times a day does the household use this for washing purposes (include all members and give average)?

None	1	Three times a day	4
Once a day	2	Four times a day	5
Twice a day	3	Other (specify)	

C15 In the last 12months has the household used the same, less or more electricity for water heating?

Same	1
Less	2
More	3

For those who use other fuels for water heating:

C16 Has your household ever used electricity as a main fuel in the past five years or since you've been electrified?

Yes	1
No	2

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

C17 When did the household stop using electricity as a main fuel for cooking?

This year (2013)	0
Last year (2012)	1
Two years ago (2011)	2
Three years ago (2010)	3
Four years ago (2009)	4
Five years ago (2008)	5
Other (specify)	6

C18 What are the reasons the household has never used electricity as a main fuel for cooking?

	Yes	No
Too expensive – uses too many units	1	2
Don't have appliances	1	2
Don't receive FBE	1	2
Other (specify)	1	2

Space Heating

C19 Applicable for winter months June – August

A. What is the main fuel (heaters) used for space heating?		**B. How often is it used?**		**C. What is the main reason it is used?**		**D. Does the household use a second fuel for space heating?**		**E. How often is it used?**	
No fuel, warm clothes and thick blankets, hot water bottle	0	Every day	1	Affordable/ cheap	1	No fuel, warm clothes and thick blankets, hot water bottle	0	Once a week	1
Electricity	1	A few times a week	2	Easily available	2	Electricity	1	Last week of the month	2
Paraffin	2	Once a week	3	Heats quicker	3	Paraffin	2	Less often/irregularly	3
Gas	3	Three times a month	4	Easy to use	4	Gas	3	Special occasions, during holidays and celebrations	4
Wood	4	Once per month	5	Safe	5	Wood	4	During power failures	5
Dung/crop residue	5	Less often/irregularly	6	Other (specify)	6	Dung/crop residue	5	No electricity units	6
Charcoal	6	Other (specify)	7			Charcoal	6	Other (specify)	7
Coal	7					Coal	7		
Other (specify)	8					Other (specify)	8		

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

For those who use electricity for space heating:

C20 What main appliances are used for heating?

Electric heater (one bar)	1
Electric heater (two bar)	2
Small to medium Electric fan	3 →
Large electric fan	4
Wall electric heater	5
Other (specify)	6

C21 On average, for how many hours of the day is an electric heater used for heating the household during winter?

	Morning	Afternoon	Evening
0 hours	0	0	0
1 hour	1	1	1
2 hours	2	2	2
3 hours	3	3	3
4 hours	4	4	4
shorter	5	5	5
longer	6	6	6

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

C22 In the last 12months has the household used the same, less or more electricity for space heating?

Same	1
Less	2
More	3

For those who use other fuels for space heating:

C23 Has your household ever used electricity as a main fuel in the past five years or since you've been electrified?

Yes	1
No	2

C24 When did the household stop using electricity as a main fuel for cooking?

This year (2013)	0
Last year (2012)	1
Two years ago (2011)	2
Three years ago (2010)	3
Four years ago (2009)	4
Five years ago (2008)	5
Other (specify)	6

C25 What are the reasons the household has never used electricity as a main fuel for space heating?

	Yes	No
Too expensive – uses too many units	1	2
Don't have appliances	1	2
Don't receive FBE	1	2
Other (specify)	1	2

10 SECTION D
HOUSEHOLD RESPONSE TO FUTURE TARIFF INCREASES

D01 If electricity prices were to increase again tomorrow, how will the household respond?

Continued to use the same amount of electricity	1	→GOTO D02
Use less electricity by saving	2	→GOTO D04
Replace electricity with other fuels	3	→GOTO D05
Don't know	8	

D02 What is the maximum your household would be willing to pay to continue using the same amount of electricity?

R1 - 20	1
R21 - 50	2
R51 - 100	3
Other (specify):	

D03 What will your household have to cut back on to pay that extra electricity?

	Yes	No	Don't know
Nothing, could afford it.	1	2	8
Food	1	2	8
Eating and drinking outside the home	1	2	8
Clothes	1	2	8
Transport	1	2	8
Entertainment such as DSTV, TV, radio etc.	1	2	8
Cellphone airtime	1	2	8
Savings	1	2	8

D04 What would you be willing to save on first before switching from electricity to another fuel (this should now be extra to what you are already doing)?

	Yes	No
A. Lighting:		
a. Use energy saving CFL bulbs	1	2
b. When energy saving CFL bulbs fuse, replace with another energy saving CFL bulb even if it's more expensive	1	2
c. Use energy saving LED bulbs	1	2
d. Switch off lights in unoccupied rooms	1	2
B. Cooking:		
a. Reduce the number of hot meals that are cooked	1	2
b. Use a wonder bag	1	2
c. Soak samp and beans first to reduce cooking time	1	2
d. Freeze cooked meals and defrost when needed	1	2
e. Prepare faster cooking meals	1	2
f. Other (specify):		
C. Water Heating:		
a. Use less hot water in the basin or bath	1	2
b. Turn off geyser	1	2
c. Use a geyser blanket	1	2
d. Insulate the hot water piping	1	2
e. Share bath water	1	2
f. Use flask for coffee/tea	1	2
g. Other (specify):		
D. Space Heating:		
a. Wear warm clothes and use blankets on cold nights	1	2
b. Insulate roof and/or walls of dwelling	1	2
c. Other (specify):		

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

D05 If your household is forced to stop using electricity because it is too expensive what fuel are you most likely to use?

	Cooking	Water Heating	Space Heating
No fuel	0	0	0
Gas	1	1	1
Paraffin	2	2	2
Coal	3	3	3
Charcoal	4	4	4
Wood	5	5	5
Solar	6	6	6
Other	7	7	7

D06 In your opinion, what can government to make electricity more affordable for your household?

_____

_____

_____

_____

D07 Is there anything else your household can do to make electricity more affordable for yourselves?

_____

_____

_____

_____

Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town

SECTION E APPLIANCE OWNERSHIP AND USE

Households who use electricity

E01 What electrical appliances do the household use and what is the power rating?		**E02** What is the power rating? Eg. 1000 W	**E03** Was it purchased in the last 12 months?	
			Yes	No
Radio/cassette with electric plug	1		1	2
Music centre / hi-fi system	2		1	2
Colour TV	3		1	2
Black and white TV	4		1	2
Cell phone charger	5		1	2
Kettle	6		1	2
Hotplate – Two-plate	8		1	2
Two plate stove with oven	9		1	2
Electric stove with oven	10		1	2
Small Electric fridge / freezer	12		1	2
Large Electric fridge	13		1	2
Electric toaster	15		1	2
Electric iron	16		1	2
Electric heater	17		1	2
Grooming equipment (Electric hairdryer / Electric hair	19		1	2
Other (specify)…….	20		1	2

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Households who use Paraffin

E04 What paraffin appliances do the household use?		**E05** Was it purchased in the last 12 months?	
		Yes	No
Paraffin wick lamps	1	1	2
Paraffin flame stove	2	1	2
Paraffin heater	3	1	2
Paraffin lanterns	4	1	2
Paraffin primus stove	5	1	2
Paraffin fridge	6	1	2
Other (specify)	7	1	2

Households who use LPG

E06 What LPG appliances do the household use?		**E07** Was it purchased in the last 12 months?	
		Yes	No
Gas lamps	1		
Gas stove with oven	2		
Gas bottle with burner	3		
Gas heater	4		
Gas stove without oven	5		
Gas fridge	6		
Other (specify)	7		

General comments

Under general comments you might include how the respondents received you and tell us about any difficulties/problems experienced by that particular community.

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Adapted from questionnaire developed by ENERGY AND DEVELOPMENT RESEARCH CENTRE, University of Cape Town