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UNIVERSITY OF WITWATERSRAND, SCHOOL OF ARCHITECTURE AND PLANNING

COPING MECHANISMS OF LOW-INCOME URBAN HOUSEHOLDS TO ESCALATING ENERGY COSTS IN SOUTH AFRICA

Khetsiwe Thandeka Hazel Dlamini

A research report submitted to the Faculty of Engineering and the Built Environment at the University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Architecture (Sustainable Energy Efficient Cities)

Johannesburg, 2015

DECLARATION

I declare that this research report is my own unaided work. It is being submitted for the degree of Masters of Architecture in Sustainable Energy Efficient Cities to the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university.

……

Khetsiwe Thandeka Hazel Dlamini

21 September 2015

Abstract

Whereas the escalation of energy costs in South Africa over the past 5-years has been systematically reported, the extent to which low-income urban households are coping with the escalation has not been studied. Based on ethnographic data from Etwatwa in Ekurhuleni and secondary data from the Department of Energy and Statistics South Africa, the study evaluates the extent to which ongoing energy poverty mitigation programmes under FBE (Free Basic Electricity) and FBAE (Free Basic Alternative Energy) are facilitating how such households cope with the escalating costs. One of the key findings of the study is that FBE is not only inadequate for beneficiary household needs but also fails to accommodate large family sizes whose consumption goes beyond the set threshold of 450kWh/month. Since FBAE is only available for households not yet connected to the grid, the programme would not serve as a complementary intervention for households not benefiting from FBE due to consumption beyond the threshold.

Based on the key finding of inadequacy of existing mitigation interventions (declining affordability of electricity, unresponsiveness of FBE to large-family size and the barrier to accessing FBAE while connected to grid) the study finds that energy poverty among low-income households and communities is deepening. As coping strategies, households resort to switching to alternative combustible fuels like paraffin, wood, coal, and solid waste which leads to indoor and outdoor air-pollution with related respiratory illnesses and under severe situations they resort to suppressing demand through options such foregoing cooked meals, irregular bathing/cleaning and space-heating in winter.

The findings also allowed the study to critique the energy ladder model on its assumptions on linear energy carrier transitions in line with improved incomes of low-income households. In particular, the study finds that even as incomes of affected households improve, an ever increasing share of the income goes towards covering the escalating energy costs but still never managing to close the affordability gap for clean energy thus reinforcing a vicious cascade in energy poverty In order to systematically mitigate these escalating patterns of energy poverty, the study recommends the distribution of renewable technology through a more innovative FBAE policy which would allow municipalities,

national government and other stakeholders to commit to more equitable long-term investments in energy efficiency and renewable energy interventions for such households.

Key words: escalating energy costs, coping mechanism, energy poverty, Free Basic Electricity, Free Basic Alternative Energy

In memory of my brother
Prince ‘Mzi’ Dlamini

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List of abbreviations

ALRI	Acute Lower Respiratory Infections
BEE	Black Economic Empowerment
CESU	City Energy Support Unit
CO	Carbon Monoxide
DME	Department of Minerals and Energy
DoE	Department of Energy
DPLG	Department of Provincial and Local Government
EPA	Environmental Protection Agency
FBAE	Free Basic Alternative Energy
FBE	Free Basic Energy
GDP	Gross Domestic Product
IHCES	Integrated Household Clean Energy Strategy
INEP	Integrated National Electrification Programme
kWh	kilowatt hour
LGES	Local Government Equitable Share Grant
LPG	Liquefied Petroleum Gas
MYPD	Multi Year Price Determination
MW	Megawatts
NEF	National Electrification Fund
NEM	National Environmental Management
NER	National Energy Regulator
NERSA	National Energy Regulator of South Africa
NO_x	Nitrogen oxides
PBMR	Pebble Bed Modular Reactor

PM	Particulate Matter
RDP	Reconstruction and Development Programme
SABS	South African Bureau of Standards
SALGA	South African Local Government Association
SANS	South African National Standard
SAP	Structural Adjustment Policies
SAPA	South African Press Association
SHS	Solar Home Systems
SO_2	Sulphur Dioxide
STATS SA	Statistics South Africa
UNDP	United Nations Development Programme
VAT	Value Added Tax

Chapter 1
Introduction

1.1 Overview

South Africa is currently experiencing an electricity crisis that has led to country-wide interruptions of electricity supply (commonly termed as load shedding). Due to increased efforts to improve Eskom's financial position to effectively manage the supply through additional generational capacity the burden to the consumer has been the rapid escalation in electricity tariffs. The primary purpose of the increase has been to provide additional revenue for Eskom to use towards infrastructure development and maintenance. This study provides an insight on the coping mechanism of low income households as they confront the challenges of escalating energy prices such as described above. The focus will be on low income urban households and the energy behaviours of such households as they strive to cope with their energy poverty experiences.

In South Africa's urban environments poor communities are mainly located on the periphery of major cities mainly as a result of the legacies of apartheid. Informal urban developments are characterized by various challenges such as inadequate transport infrastructure development, lack of employment opportunities and lack of access to certain services for basic needs. The poor have to travel long distances to get to places of employment and to access the social services provided by government. The associated costs are part of the challenges they grapple with daily. Since 1994 the government has increased public services in these areas as part of the provisions enshrined in the constitution. Although this has improved the lives of millions of poor households, there are still many who do not access these public services because they live in unserviced informal settlements.

Municipalities have the responsibility of implementing government policies related to the mitigation of poverty and they have responded differently to informal settlements. Some municipalities have neglected informal settlements and do not provide services such as electricity, water, sanitation (and others) while others such as Cape Town, provide services to

varying levels. The purpose of the FBE (Free Basic Electricity) grant is to aid poor households in mitigating the effects of energy poverty which is becoming a widespread problem in South Africa especially among low income urban households. Consequently, the implementation of FBE policy varies across municipalities as some provide the grant according to the set minimum of 50 kWh (kilowatt hour) while others have extended the provision to 100kWh per month. The quantity-based conditions to qualify for the grant have excluded some deserving recipients from benefiting from the grant.

1.2 Background and context

In the aftermath of the 2007-8 global financial crises many countries in Africa such as South Africa have been affected by fossil fuels commodity prices particularly energy resource prices (Stephan & Bridgman, 2012). Hart (2010) and Wratten (1995) argue that the legacy of Structural Adjustment Policies (SAP) that advocated for the commodification of state functions, has been the deterioration of the human quality of life because of decreasing urban wages, employment security and employer benefits. The urban poor (mostly unskilled labour) are more vulnerable to such shocks in the economy than middle to high income households as they are more likely to be retrenched leading to loss of household income (Hart, 2010).

Wratten (1995: 12) argues that urban poverty refers to households generally concentrated in peripheral social housing estates and inner city areas living in deprivation of the basic needs that are crucial for human survival. Devas (2004) suggests that urban poverty varies in respect to deprivation and vulnerability to economic shocks, insecurity, inadequate access to essential services, social exclusion and helplessness – which are experienced differently by the different urban poor groups. Therefore government policies need to promote both employment creation through infrastructure investments while protecting the poor through providing compensatory schemes as well as strengthening their coping strategies (Amis, 1995).

In 2000 the South African government decided to respond to energy poverty by drawing up policy that would mitigate energy cost for poor urban and rural households in the form of Free Basic Electricity FBE policy of 2003 and Free Basic Alternative Energy FBAE of 2007 (DME, 2007).

FBE covers the initial 50 kWh per month per electrified household. The grant is offered by government as a basic service with the objective of improving the living standards of poor households through access to good quality modern energy service (DoME, 2003). FBAE aims to provide non-electrified poor households with alternative energy to help them meet their basic needs through access to good quality energy service (DME, 2007; CESU, 2011). According to Greenberg (2010) municipalities are the key sites and entities for implementing FBE and FBAE through availing the technology, reducing energy use (improved building design) and switching energy providers (alternative sources of energy for unelectrified households).

1.2.1 Deepening of energy poverty

Although the country had energy efficiency policies in place in 2008 it experienced a power crisis that led Eskom to initiate country-wide load shedding schedules (Sebitosi, 2008). Ashton (2014) argues that the state utility still struggles with meeting demand as load shedding practice occurred earlier in the year. However, the situation has continued to deteriorate as the country is experiencing schedule two (which allows for up to 2000 MW (Megawatts) to be shed nationally) and three (up to 4000 MW) of country-wide load shedding in December - which is expected to continue until March 2015 (Brock, 2014; SAPA, 2014). This is despite the interventions (roll out of compact fluorescent lights, solar water heaters and energy saving campaigns) (Sebitosi, 2008). In addition, the completion of the two power stations (Medupi and Kusile) intended to mitigate demand has been delayed for close to 2-years now (SAPA, 2014; Ashton, 2014).

The delays have worsened energy poverty in the country leaving both households and industries vulnerable to load shedding (Brock, 2014). Eskom is also faced with aging infrastructure in other power stations (Majuba) that has led to below capacity performance (SAPA, 2014). Minister Radebe as cited in Vecchiatto (2014) argues that government's response to the energy crisis has been to implement five strategies that will increase efficiency of Eskom from 72% to 80% and will be overseen by the Deputy President. The strategies consist of the following; Eskom to assume certain specific interventions within 30 days such as setting up a "technical team war room", extension of co-generation contracts with the private sector,

stepping up efforts to move towards gas fired plants, introducing other power producing programmes that are not dependent on coal and multiple level interventions to manage demand (Vecchiatto, 2014:1).

Despite government's best efforts to improve the lives of households by providing electricity to previously disadvantaged communities (CESU, 2011: 12-13), they have been unsuccessful in meeting deadlines for power stations infrastructure development and maintenance (Brock, 2014). Critical theory sheds light in the dilemma that government finds itself in: while it has been addressing historical energy imbalances (especially through electrification), there are other challenges such as population growth, urbanisation and aging infrastructure which frustrate levels of achievement (Duvall & Varadarajan, 2003: 79; SALGA, 2013: 2).

For Eskom to meet its financial requirements towards improving the aging infrastructure and adding new generation capacity, the National Energy Regulator of South Africa (Nersa) has granted Eskom yet another tariff increase of 13% for the year 2015, which will have additional negative impact on the disposable income of households (Fin24, 2014). According to DoE (2012:63), 73% of urban informal households perceived the price of electricity to be high. Further increases in the price of electricity will lead to energy switching by low income households who are the most vulnerable to energy poverty (DoE, 2012: 67) and economic shocks as they struggle to secure employment due to a lack of skills (Wratten, 1995: 11; Devas, 2004: 19).

1.2.1 Illegal connections

In South Africa electricity theft has increased to an annual loss of approximately R4.4 billion. This has become a concern for both Eskom and municipalities as their revenue is affected by the losses. The methods used to steal electricity are illegal connections such as connecting to the street light, meter tampering as well as illegal vending of prepaid electricity. Both residential and commercial sector are responsible for illegal electricity connections. Contrary to popular perceptions that informal settlements are mostly likely to be perpetrators of this crime, corporates are the biggest perpetrators of illegal theft of electricity (Slabbert, 2015). In informal settlements and low-income households non-payment has been a tool for protest against rising

electricity tariffs. This was the same method (protest strategy) that struggle movements and civil society used against the apartheid government. Within low income urban households energy poverty can be viewed as a potential driver for becoming trapped into illegal connections and electricity theft in general as one of the coping mechanism.

1.3 Problem Statement

Most recent studies on energy poverty in South Africa highlight that low-income households use multiple energy sources to cope with the rising energy costs (DoE, 2012: 2; STATS SA, 2013: ii). The most common alternative energy sources among the poor are combustible solid fuels which include cow dung, wood and crop residues. When burned indoors, these fuels cause indoor and outdoor air-pollution. In urban settings the poor do not have access to cow dung and crop residues and therefore rely mostly on commercially available fuels. Alternative fuels available in urban areas are paraffin, LPG (liquified petroleum gas), natural gas, wood and coal.

These alternative energy sources are used to meet some of the basic domestic energy needs such as cooking and space heating. The demand for space heating increases during winter months in areas such as Gauteng and Bloemfontein (Isover, 2012). Informal homes whose structures are made of corrugated iron as well as RDP (Reconstruction and Development Programme) houses (most of which have no ceilings or insulation) need more energy for thermal comfort (CESU, 2011). Barnes et al. (2009) notes that there are health risks associated with polluting fuels which compromise the health of low income households living in such inadequate shelter.

The broader coping mechanisms of low income households in South Africa as they mitigate high energy costs have not been systematically studied. The effectiveness of alternative energy sources in meeting basic needs has also not been systematically appraised. FBE and FBAE have been criticized in most studies for being inadequate and making an insignificant difference in the living standards of poor households especially those living in informal settlements (DoE, 2012; CESU, 2011; Wolpe and Reddy, 2010; SALGA, 2013).

1.4 Rationale of the study

This study provides an assessment of the coping mechanisms of low-income urban households in mitigating the challenges experienced as a result of escalating energy costs and thus highlights the need for South Africa to balance its economic ambitions with the responsibility to mitigate the impacts of escalating energy costs on low-income households (Tacoli, 2003). The study is also expected to unify policy formulation at both national and local government level with regard to improving the quality of life for the majority of the affected households.

As argued by Andreasson (2011), South Africa is still grappling with socioeconomic transformation barriers which often contribute to frequent social crises such as service delivery protests and xenophobic violence. Andreasson (2011) posits that although the government has tried to implement Black Economic Empowerment (BEE) policy, only a few black elite have benefited. As a result the expected socio-economic transformation to date is limited. Within this context of stagnating transformation, stubborn high unemployment and deepening poverty, this study focuses specifically on energy poverty in order to create a better understanding of the coping mechanisms engaged by the affected households.

1.5 Research question

What are the impacts of rising energy costs on the quality of life of South African low-income urban households and what have been their coping mechanisms?

1.5.1 Sub-questions

How are low income households in South African urban areas coping with rising energy costs and the deepening of energy poverty?

What has been the effectiveness of FBE and FBAE as interventions to mitigate energy poverty?

What does this tell us about the “energy ladder model” of understanding energy transformations especially within communities in developing countries?

1.6 Research approach

The research applied secondary data from two recently completed surveys documenting energy related behaviours in low-income households. The surveys concluded that low income households use multiple energy sources to cope with energy poverty (DoE, 2012; STATS SA, 2013). The policy documents of FBE and FBAE were also consulted in order to gain an understanding of the current interventions by government to mitigate energy poverty for poor households nation-wide. The study draws from existing literature on the link between poverty, informality and energy poverty with the theory of energy poverty as the primary theoretical framework.

Primary data were collected by ethnographic method during my role as a participant observer within an urban low-income household over a period of one week. An analysis was conducted between the secondary and primary data with the aim of drawing comparisons on the coping mechanisms of low income households (Maxwell, 1998: 89). In view of the understanding sought in this study a qualitative research approach was prioritised as it allows one to capture in-depth meaning of the experiences of the phenomena studied. Ethnographic approach was used as it allowed the researcher to be part of the experience through a short stay with a host family. Atkinson and Hammersley (1994: 248) posit that ethnographic research allows an in-depth study of a social phenomenon with the researcher engaged as a participant observer in order to understand the verbal and nuanced meaning of related behaviours and choices (Robson, 2002: 310).

1.7 Delimitation of the study

For the overall objective of this study, it was important that the researcher gains an in-depth ethnographic view of one family's coping mechanisms which would then be referenced to general understanding based on secondary data from nationwide surveys on energy related behaviours in low-income households. A key limitation of the study is that the findings cannot be generalized because they are based on the experiences of one household over a period of a week. However, when linked to secondary data at a nationwide scale, the ethnographic findings can add a richer level of nuance beyond the general understanding supported by national data.

The government policies prioritized in this study are FBE, FBAE and IHCES (Integrated Household Clean Energy Strategy). The policies have been rolled-out by national and municipal governments to mitigate the effects of energy poverty on poor urban households. In view of the constant doubt raised in various studies over the inadequacy of these policies relative to the need warranted by poverty in general (and energy poverty specifically) this study has explored how the affected households are coping with the shortfall.

1.8 Definition of key concepts

The key concepts used in the study will be defined as follows:

Coping mechanism is defined as a conscious or subconscious systematic or adhoc adjustment of choices and behavior in one's life in response to perceived and persistent threat on well-being and survival at an individual or collective level with regard to energy poverty. The inability to afford clean, safe and secure energy services renders a household vulnerable to the negative consequences of alternative combustible biomass or liquid fuels such as paraffin. When viewed as a short-term measure, coping mechanism allows for a temporary adjustment in lifestyle until the threat or risk recedes and one regains normal behaviour. Where coping mechanisms are engaged over an extended period to the point of becoming the 'new normal' they cease to confer benefits or value and thus lead, to 'failure-to-cope'. In context of energy poverty, this is taken to mean the descent into indigency.

Effectiveness refers to the ability of energy poverty mitigation policies to successfully reduce the prevalence of energy poverty among low-income households in South Africa. The study will assess the policies implemented by government (Integrated National Electrification Programme, Free Basic Electricity and Free Basic Alternative Energy).

Energy ladder model refers to the assumed transitions of households from "traditional" fuels such as biomass to "modern" fuels such as gas and electricity as their incomes improve. According to Barnes et al. (2009: 5), the fuels are classified into three categories traditional, transition and modern. The term is adopted into the study for critique and reassessment of its explanatory value in the study of energy poverty.

Escalating energy costs refer to price increases that are not in line with normal inflation and can therefore be considered as unexpected. When prices rise at 2 to 3 times normal inflation it can be termed as escalation – as has been experienced in energy prices in South Africa since 2008 to date.

Backyarding refers to small-scale rental units (each property occupied by separate households) that are built around formal structures which are developed in privately owned or state controlled land that is developed mostly for residential tenancy (SALGA, 2013). These rental units often share an electricity meter or prepaid meter with the formal structure leading to the increased consumption of electricity, which disqualifies such households from the category of energy poverty alleviation intervention recipients.

Indigent household refers to low-income urban households that are not coping with energy poverty as a result of escalating energy costs. These households often experience abnormally long periods of their basic energy needs not being met with no hope of regaining or reverting to their 'normal' consumption or behaviour.

Low-income urban household refers to a combined household income of below 3500 per month (City of Cape Town, 2015: 1). The income can be generated through various means such as self-employment (business) or wages.

Poverty is the socio-economic condition associated with a substantial deficiency of that which an individual, household or community needs for well-being and survival (Wratten, 1995). Urban poverty varies with respect to levels of deprivation and vulnerability to economic shocks, insecurity, inadequate access to essential services, social exclusion and helplessness – which are experienced differently by the different individuals, households or communities (Devas, 2004).

Energy poverty in the South African context will be defined in this study on the basis of three approaches.

- *Expenditure*-based which considers households that spend more than 10% of their income on energy to be energy poor (DoE, 2012: viii).

- *Subjective* approach which classifies energy poor households based on the following criteria: energy used insufficient to meet needs and inadequate energy used for lighting, cooking and heating up rooms (DoE, 2012: viii).
- *Thermal efficiency* of households which refers to levels of thermal comfort derived from the place of residence (DoE, 2012: viii).

Suppressed energy demand refers to systematic under consumption of energy by low-income households as a result of constraints to higher levels of consumption due to either unaffordable costs or an inability to access alternative services due to technological or alternative fuel availability barriers (Ruiters, 2009). In most cases, suppressed energy demand arises from low-income affordability constraints.

1.9 Structure of the study

This chapter has provided an introduction to the study and its aim of appraising the coping mechanisms of low income households in view of escalating energy costs. The chapter also highlights contextual issues in relation to access to energy service and energy poverty in South Africa. The limitations and scope of the study are acknowledged, followed with an outline of the structure of the rest of the study as guided by the research question and method of the study. The rest of the study report is structured as follows: Chapter two extends on the literature appraisal based on themes in order to motivate for the theoretical framework. Chapter three motivates for the research approach and tools or techniques used in the study. Chapter four appraises the adequacy of formal energy poverty mitigation interventions based on secondary data. Chapter five appraises coping mechanism based on findings from ethnographic data. Chapter six consolidates the findings from sub-questions and concludes with the overall findings of the study.

Chapter 2
Literature Appraisal

2.1 Introduction

Based on rising energy costs and the expected increase in energy poverty it has become critical that the coping mechanisms of low income households are systematically monitored and evaluated. The literature appraisal reviews pertinent studies on poverty and informality according to themes emerging from the research question. The chapter also appraises studies on the health implications arising from the use of combustible fuels indoors. The chapter then appraises studies on current energy poverty alleviation interventions as well as alternative energy measures. Finally the chapter reviews studies on the impact of illegal connections on municipalities and then concludes with a contextual illustration of the theoretical framework of the study.

2.2 Poverty and informality

2.2.1 Urban poverty

According to Wratten (1995: 11) the quality of life for poor households has deteriorated since the Structural Adjustment Policies (SAP) of the 1970s and the recent economic crisis has resulted in uneven impact on the poor in the urban environments of the global South. South Africa is the second most unequal country in the world (based on income inequality) due to apartheid legacies and uneven economic development since 1994. The gap between the rich and the poor continues to widen (Bond, 2000: 46). Some of the experiences that have led to an increase in urban poverty are a decrease in urban wages, employment security and employer benefits as well as reduced public expenditure by government on basic services and infrastructure, and rising food prices (ibid: 11).

Wratten (1995: 12) acknowledges the lack of consensus on what constitutes basic needs, while arguing that poverty should be understood using both conventional economic definitions (quantitative) as well as participatory definitions (qualitative). Conventional economic definitions classify poor groups within society according to a general index of material welfare

by using criteria such as social indicators, levels of consumption and income, social differentiation and perceptions of non-material deprivation (excluded from participation in decision making) (ibid: 12-13). Participatory definitions posit that standardized definitions, while providing for generalizations that enables decision-making by government, they fail to take into account the variations between different urban sub-criteria such as location, male versus female headed households as well as child or old-age headed households (ibid: 16-17). Participatory definitions put emphasis on the concepts of vulnerability and entitlement (ibid: 16). As mentioned in the study, people who are severely exposed to socio-economic risks, shocks and stress are regarded as vulnerable. Vulnerability is associated with assets such as human capital (education and health), productive assets, access to community infrastructure and claims on resources in stages of need (from international community, government, influential people or organizations and other households) (ibid: 17). Entitlement refers to the varied and complex ways that individuals as well as households access and control resources in response to shocks in the long-term (ibid: 17). Control over resources could include sale of assets, own production, public provision of goods and services, reduced consumption and wage labour (ibid: 17).

However the study posits that there are four characteristics of poverty primarily linked to urbanization (ibid: 21). Firstly, there are environmental and health risks as a result of exposure to industrial and domestic pollutants which is worse in densely populated urban areas. Secondly, there is vulnerability linked to commercial exchange as a result of a lack of job security which could lead to a loss of income. Thirdly, cities attract different social groups which lead to social diversity, fragmentation and individualism along class lines, and vulnerability to crime. Finally, vulnerability also arises from state and police intervention – the urban poor are more likely to experience negative state interventions as the state attempts to regulate their activities without empathizing with their circumstances (ibid: 21-26).

The study contrasts poverty as viewed by others (as a personal failure of the individual household) versus the conflicting view that structured political and economic systems are responsible for perpetuating poverty by discriminating against disadvantaged groups (ibid: 26).

Most of the low-income settlements were created by the apartheid state through its segregation policies (ibid: 74). Bond (2000: 46) posits that the democratic government policy must be aligned with the constitution by ensuring equal access and provision of efficient basic services in a manner that is redistributive by allowing cross subsidization in order to improve the living conditions of low-income households especially in urban areas. According to the constitution, municipalities are tasked with ensuring equitable access to basic services (water, healthcare, electricity and others) as well as promoting social and economic development in low-income communities (ibid: 47).

The provision of improved basic services to such communities would enable a social mix that will lead to communities with mixed-income households (ibid: 75-76). A mixed community creates an environment where the youth can hope for a better future as they are not just exposed to the hopeless conditions of poverty (ibid: 76 -77). The study further argues that for anti-poverty policies to be effective they need to deal with the structured causes of poverty at both national and international levels which discriminate against the poor (Wratten, 1995: 32). In order for government to tackle poverty there needs to be an integrated and coordinated strategy that addresses economic, social, political and environmental poverty drivers (ibid: 33). The study argues against treating urban poverty as a separate category because urban and rural poverty are linked by the experiences of poverty (deprivation). The study is relevant to the research not only because it provides a working definition of urban poverty but also provides a deepened understanding of the challenges experienced specifically by poor households in cities.

2.2.2 Informality

According to City Energy Support Unit, 10% of South Africa's population live in approximately 2,700 urban informal settlements which make up 1.2 million households (CESU, 2011: 12). Poverty is prevalent among the majority of informal settlements and backyard dwellers in South African cities (Wolpe & Reddy, 2010: 2). Communities who are severely impacted by energy poverty live in urban informal settlements often found on unauthorized land or in land that is not zoned for residential development. They are densely settled communities with high

concentration of poor households (CESU, 2011: 12; Wolpe & Reddy, 2010: 2). These settlements are unlikely to have access to basic infrastructure or services (Wolpe & Reddy, 2010: 3-4). In the long-term many households continue to live on un-serviced or inadequately serviced areas as a result of informal housing growing at a faster rate than affordable formal housing supply (CESU, 2011: 12). The working definition of backyarding as applied in the report is small-scale rental units (per property and occupied by separate households) that are found in privately owned or state owned land that is developed mostly for residential tenancy or commercial spaces (that is managed by private individuals) (SALGA, 2013: 5).

Approximately 43% of backyard structures are classified as "formal" with access to basic services such as water, sanitation and energy supply (SALGA, 2013: 4). The average backyard household is characterized as middle income and small in family size (ibid: 4). Backyard informal structures are built alongside formal properties thus creating over-crowded housing conditions with energy poverty as a key characteristic (Wolpe & Reddy, 2010: 4; CESU, 2011: 12). The two main reasons that propel the landlords to supply backyard accommodation are monetary gain (rental income) and social cohesion (family and friends) (SALGA, 2013: 5). The key problems that arise from backyard dwellers are that they contribute to increased density (property and community) that could result in health and safety concerns as well as contribute to increased usage of existing infrastructure that provides services to the properties (ibid: 7-8). However the report highlights that the assumption that the addition of backyard households will cause an overload on existing infrastructure is not always the case because in certain instances the service infrastructure can handle the additional loading (ibid: 7) due to designed redundancy factors. The negative effects that are associated with backyarders can be mitigated through municipal control or social support (ibid: 8).

Wolpe and Reddy (2010: 2) argue that many informal settlements have no access to electricity and that local government faces challenges with regard to the delivery of alternative energy that would meet the basic energy needs (cooking, heating of water and space and lighting) of the affected households (ibid: 2). According to the study energy poverty occurs when

individuals are unable to exercise choice in accessing clean, reliable and safe energy sources in order to improve their living and economic conditions (ibid: 3). Although the government has classified energy as a basic need, the majority of the poor continue to experience energy poverty and rely on energy sources that are unaffordable, unhealthy, and unsafe (such as paraffin, coal and biomass) (ibid: 3). The draft policy is relevant to this research because it highlights the challenge of inadequate access to basic services such as energy supply to backyard dwellers (SALGA, 2013) among other informal settlements. As mentioned above, multiple households often share a single meter which leads to some poor households who qualify for FBE to not receive this benefit because their overall consumption levels exceed the 450kWh per month which is the qualifying benchmark (CESU, 2011).

2.3 Health risks

The main argument in Barnes et al. (2009: 4) is that there is an association between household energy, indoor air pollution and child acute lower respiratory infections (ALRI). The authors review existing scientific evidence on the association in the key variables of household energy, indoor air pollution and child ALRI in South Africa (ibid: 5). The study uses an 'energy ladder' model to depict a household's energy consumption patterns (ibid: 5). The model adopts a hierarchy of energy sources based on the criteria of costs, ease of use, technological advancement and concentration of air pollution they emit. At the bottom of the ladder are solid biomass fuels such as cow dung, wood and crop residues. The next step is transition fuels such as coal, charcoal and paraffin while liquid petroleum gases are a step further above (ibid: 5). The second highest step consists of natural gas and the top step is electricity which is considered the modern energy source. The authors argue that, the top three energy sources (electricity, natural gas and liquid petroleum gas) are considered to be modern sources of energy which are characterized as safer with less indoor air pollution impacts. According to the authors, there is an increase in both direct (usage) and indirect (appliances) costs for households using the more advanced energy sources (ibid: 5).

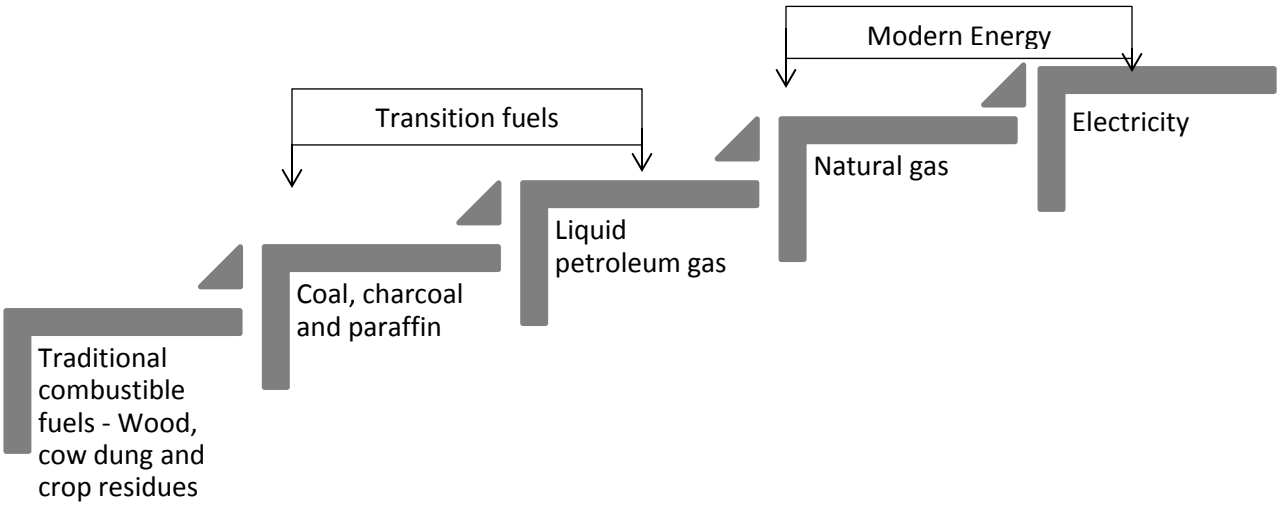


Figure 1: Energy ladder model (Source: Adapted for the study from Barnes et al. 2009: 5)

According to the study (ibid: 5,6), democracy in South Africa has led to more previously disadvantaged groups moving up the energy ladder as a result of initiatives such as the Integrated National Electrification Programme (INEP) of 2001, which sought to connect non-electrified households to the national grid. The study argues that access and the increase in electricity use rose as a result of INEP and improved income especially among wealthier households (ibid: 6). On energy-related issues, the study suggests that there are environmental costs and benefits that are associated with electrification (Bond, 2000: 59). Eskom, the national electricity provider, uses coal to generate electricity. As the government increases its national electrification programme it leads to increase in coal usage which causes pollution of the environment (especially for communities living near power stations) (ibid: 67). However, for previously disadvantaged low-income communities that are not located near power stations, the expansion of INEP provides an opportunity to reduce outdoor air pollution (ibid: 67). Other health benefits include reduction of accidental paraffin poisoning of children, fires and scalds or burns (ibid: 72-73). The author affirms the common understanding that most of the low-income communities use coal and wood for space heating especially during winter which increases the risk of indoor air pollution that causes respiratory tract infections (ibid: 70). The study (ibid: 11) posits that for poorer households the choice of fuels is primarily influenced by affordability (direct or indirect costs) and availability.

The study argues that solid biomass fuels and transition fuels contribute to indoor air pollution when burned indoors through open fires or rudimentary appliances (ibid: 4). As a result of incomplete burning they tend to release high concentrations of toxic pollutants (particulate matter PM, carbon monoxide CO, nitrogen oxides NO_x, sulphur dioxide SO_2 and volatile organic compounds) into the indoor and outdoor spaces (ibid: 4). In high density human settlements, coal not only contributes to indoor air pollution but also to outdoor air pollution within the settlement (ibid: 7). The study notes that (ibid: 7) in low-income urban settlements the usage of paraffin continues even after connection to electricity grid due to affordability constraints. When paraffin is burnt in open flame, it has high levels of gaseous pollutants whose health effects still have to be determined.

The continued dependence on biomass and transition fuels leads to various health problems such as cancer, tuberculosis, nasopharyngeal cancer as well as eye disease in adults because of indoor air pollution (ibid: 4). Children's exposure to indoor air pollution results to detrimental health conditions such as low birth weight and ALRI which is one of the leading causes of death among the age group of under 5 years globally. Acute lower respiratory infections are the fourth leading cause of death in South Africa for the same age group (ibid: 4-5). This age-group is susceptible as a result of the epithelial lining of their lungs not being fully developed and a weak immune system (ibid: 5). Other factors contributing to indoor air pollution include human behavior, type of appliance, inadequate ventilation and the house design (ibid: 5). Other secondary factors which influence child susceptibility to ALRI are poor nutrition, overcrowding, poor vaccination history, family history of infection and exposure to tobacco smoke (ibid: 5).

The study (ibid: 8) posit that there are four global interventions that have proved effective in mitigating the incidence of ALRI in children. These are cleaner burning fuels, behavioural change, improved cook stoves and house design. South African government interventions to address indoor air pollution has been through INEP, Integrated Household Clean Energy Strategy (IHCES) by the Department of Minerals and Energy (DME) in 2004 and the National Environmental Management: Clean Air Act number 39 of 2004 (NEM) (ibid: 10). The failure of

RDP housing to optimise design for thermal comfort and energy efficiency could be a significant lost opportunity to address ALRI over the past 20 years of housing delivery (CESU, 2011: 15).

On an annual basis in South Africa, about 2,489 deaths (of which 1,428 are children under the age of 5 years) are as a result of ALRI which is linked to indoor air pollution (ibid: 8). However the authors caution against the assumption that reduction in indoor air pollution will amount to statistically significant reduction in ALRI in children (ibid: 10). The key findings of the research was that interventions do not completely eradicate air pollution in the indoor living environment because of the multiple fuel usage which generally increases during the winter months when polluting fuels are used for space heating (ibid: 10). The poor are the most affected by ALRI as a result of constraint of affordability when it comes to cleaner fuels (ibid: 10 - 11). The resultant health costs are huge to both the individuals who lose income due to sick days taken off work and the state in terms of incidences that lead to increase in clinic or hospital treatments of infections, poisoning and fires (Bond, 2000: 70).

Barnes et al. (2009: 11) argue that there are many factors that influence the choice of energy fuel and some of them become barriers to the uptake of interventions to reduce ARLI at the household level. The key factors are ease of availability and financial constraints which hinder the uptake and maintenance of an intervention (ibid: 11). The study suggests that a behavior change is a suitable complementary intervention for low-income households (ibid: 11). The study expresses opinion that as more people progress up the 'energy ladder,' indoor air pollution will decrease (ibid: 5). They recognize the delay in achieving the set targets of INEP (DoE, 2012) and propose context-specific interventions in low-income households who use a mix of fuels for domestic energy needs (Barnes et al., 2009: 5). However at the time of the study the authors were of the opinion that electricity would remain affordable for the connected low-income households, while in reality electricity tariffs have escalated over the past 5 years because of multiple factors such as the 2007/8 financial crisis, the 2008 electricity crisis and international demand for South African commodities, especially coal. Electricity tariffs will continue to escalate in future as Eskom struggles to deliver new power stations which remain incomplete and maintenance to existing infrastructure has been mostly reactive leading

to an increase in the practice of load shedding (SAPA, 2014). Therefore, the incidence of ALRI is more likely to have increased over the proceeding years and will continue to rise as more electrified low-income households attempt to mitigate escalating electricity tariffs. The study is relevant to this study because it assisted in the understanding of how the coping mechanisms could also be affecting the health of low-income households who still rely on multiple energy sources most of which would be considered to be 'polluting sources'.

2.4 Energy poverty mitigation interventions

2.4.1 Free Basic Electricity

In response to the government's statement of intent in 2000 to provide free basic services with focus on free basic energy, the Department of Minerals and Energy (DME) - proposed to Cabinet a zero rating of Value Added Tax (VAT) policy on paraffin which came into effect April 2001 and Free Basic Electricity (FBE) policy which came into effect in 2003 (DME, 2003: 5). The policy recommendations were a result of the DME realization that although INEP was addressing the historical backlog in electrification of low-income households, there were affordability constraints that affected the use of electricity by electrified low-income households (ibid: 5). The objective of the policy is to ensure that low-income households are able to maximise on the socio-economic benefits associated with electrification by providing relief (ibid: 5). The level of FBE allocation identified as sufficient to meet the basic domestic needs of poor households (such as lighting, media access, limited water heating and basic ironing and cooking) connected to the national electricity grid was 50kWh per month per household which would be subject to certain principles (ibid: 11). The motivating factors for the 50kWh per month allocation were Eskom's statistics showing that 56% of poor households connected to the national grid on average consumed less than 50kWh of electricity per month (ibid: 11). This approach is definitely flawed given what we now understand about suppressed demand especially in low-income households. The low energy consumption patterns that were characteristic of low income households were linked to affordability constraints (Ruiters, 2009).

Municipalities were delegated to provide these services within their boundaries with funding from the following sources; cross subsidization from other consumer categories, internal

municipal sources and through the inter-governmental transfer allocation from national government (ibid: 13). The policy states that for funding received through the inter-governmental transfers, the qualifying criteria to receive FBE would be on the basis of the low-income household's self-registration with the municipality (ibid: 25). For the benefit of non-grid electrification in rural areas, the DME commenced with the provision of Solar Home Systems (SHS) which were funded through the National Electrification Fund (NEF) (ibid: 14). The costs for FBE policy to municipalities covered the 50kWh, administration capacity at the municipal level (for back-office support operations) as well as the service provider and related infrastructure (ibid: 18-19). Since FBE is a national policy, the responsibility for its funding and implementation is on the national government which allows for a uniform approach country-wide (ibid: 20). Municipalities with adequate resources would be able to cross subsidize FBE with revenues from other services and sectors whilst municipalities that do not have adequate resources would rely solely on the funding from national government as administered through the Department of Provincial and Local Government (DPLG) (ibid: 21-22).

In response to the challenge of identifying beneficiary households, DME proposed a 'Self Targeting Model' which would be less costly to fund and implement. The model could be implemented using a two methods approach (DME, 2003: 15-16). Firstly, consumers could apply for current-limited electricity supply which would be useful in households with low electricity demand (mainly poor households) (ibid: 16). The second approach, would be to apply for "non-current limiting" whereby the electricity service provider uses a pre-determined ceiling level of consumption in kWh units and households that comply would receive FBE (ibid: 17). The later method is the most suitable for municipal electricity distributors as it can be applied to both prepaid and credit meter (post-paid) service customers (ibid: 17). The service providers reserve the right to choose the self-targeting method for their municipality (ibid 18). Although the policy does acknowledge that most poor households in urban areas live in extended families, it fails to clarify how this aspect was taken into consideration when determining the allocated FBE 50kWh per month (ibid: 17). The recommended implementation strategy (by DME to municipalities) is through existing service delivery networks. The extent of funding for FBE through inter-governmental transfers would be determined by the DME in

consultation with DPLG and National Treasury (ibid: 25). The number of electrified poor households registered with a particular service provider (municipality) would determine the respective funding allocation. The budget allocation by DPLG would be inclusive of municipal costs of providing FBE and in cases where service authorities have received grants to provide for operating costs of free basic services the expectation would be for the benefit to be passed on to qualifying targeted households (ibid: 25).

According to the DME policy, there are principles and restrictions for providing FBE that need to guide the implementation phase by service providers (ibid: 23):

1. All qualifying households meeting the requirements of self-targeting will receive FBE.
2. For new electricity connections, normal municipal connection fees are to be levied.
3. When monthly consumption exceeds free allocation, fixed charges will be applied and the consumer will have to pay the difference.
4. Allocated FBE will not be carried over to the next calendar month for both metered and prepaid customers.
5. The process of distribution of the allocated FBE must be simplified to avoid excessive administration costs.
6. FBE will not be allocated to consumers who have been disconnected from electricity supply for reasons of non-payment or tempering with meters.
7. No compensation will be payable as a replacement of FBE to households that are not connected to the national grid system.
8. FBE becomes effective when a self-targeting consumer has been connected to the national grid system (ibid: 23-24).

The policy framework assumes that consumers whose monthly domestic electricity demand exceeds the limit set out for FBE are able to afford the normal domestic tariff for their consumption. The policy does not prevent service providers from offering poor households lower tariffs as long as they comply with the set National Energy Regulator (NERSA) tariff structures (ibid: 26). The policy complements the study report because it provides for a government intervention aimed at assisting low-income or poor households meet their basic

energy needs. Although the policy does acknowledge that households could be larger especially where the living patterns include extended families, it fails to mention how this was accommodated when determining the base FBE benchmark of 50kWh per household per month. The 50kWh is a national standard but some municipalities with additional resources are able to provide additional FBE allocation. As has been highlighted in other surveys, the national benchmark is insufficient to meet the basic energy demands of low-income households (DoE, 2012; SALGA, 2013; Wolpe & Reddy, 2010, CESU, 2011).

2.4.2 Free Basic Alternative Energy

The DME implemented the Free Basic Alternative Energy (FBAE) policy of 2007 or the Solar Home System (SHS) to support low-income households falling outside of the INEP to meet their basic domestic energy needs (ibid: 9). This was an attempt to mitigate energy poverty for households that could not access grid-electricity and would therefore not benefit from FBE policy. The policy offers poor or low-income households other forms of energy sources such as paraffin, liquefied petroleum gas (LPG), coal or bio-ethanol gel (ibid: 16-29).

The FBAE policy is based on five key objectives. Firstly, the policy aims to facilitate the provision of alternative energy to poor households not connected to the national grid. The second objective is to address the socio-economic challenges experienced by these households in terms of energy poverty. Thirdly, the policy seeks to raise awareness among the communities on how to safely use alternative energy with the intention of reducing health risks. Fourth, the energy carriers chosen must be safe, sustainable and easily available for poor households. Finally, the policy aims to increase efficient use of the energy carriers to ensure optimized value for all beneficiaries (ibid: 8).

Proper identification of poor households is crucial for the policy to achieve its goal of increasing the impact of uplifting more un-electrified poor households (ibid: 7). Municipalities are tasked with administering and implementing the policy within their boundaries (ibid: 7). The funds for the implementation of this policy would be allocated to the Department of Provincial and Local Government (DPLG) through the equitable share grant (ibid: 9). Municipalities are advised to fund additional FBAE from their own revenues to ensure that more households receive FBAE.

The task of distributing and identification of qualifying FBAE recipients has been delegated to municipalities with funding from DPLG (ibid: 9).

Implementation of the policy must begin in areas that are further away from the national grid, where SHS is not planned, areas that have no immediate plan for electrification and mostly where there is a prevalence of energy poverty (ibid: 9). It is the responsibility of municipalities to select energy carriers for funding in line with the stated criteria of the policy (ibid: 10). Once the municipality has chosen the energy carrier it has the responsibility to raise public awareness on safe usage and storage in order to minimize health risks within the communities (ibid: 10). The municipality must manage the supply chain process and act as a service provider by distributing the energy carrier to poor households (ibid: 11). In the event that the municipality cannot facilitate distribution then it can appoint an external service provider who will carry out the responsibility of implementing FBAE under municipal supervision (ibid: 11). The municipality has the duty to report on the progress of FBAE to DPLG which will monitor the effects of FBAE on poverty alleviation and satisfaction among beneficiaries as one of the key outcomes (ibid: 12).

The FBAE policy provides a list of suggested energy carriers that municipalities can use (ibid: 16-19). However it does allow for other energy carriers to be considered for conventional household use (ibid: 10). Paraffin (which is used by both rural and urban households for cooking, lighting and heating) is easier to distribute because it is available country-wide in the open market but it can cause health and fire risks. Burning paraffin can lead to respiratory problems and fires, and it is more prone to lead to child poisoning because of lack of specified and secure containers for storage. Although, paraffin appliances are not expensive, the department recommends stoves approved by the South African Bureau of Standards - South African National Standard (SABS – SANS 1539) (ibid: 16 -17). LPG is mainly used in households for cooking and heating. It is considered a clean burning fuel and is more effective in heating than other energy sources. The main disadvantage is that both the energy and its related appliances are costly making them unaffordable for most poor households (ibid: 17). Coal is used mainly for cooking and heating in the domestic sector. However it is only available in

limited areas where distribution channels exist. It is high on air pollutants when burnt indoors which escalates risk of respiratory illnesses. Commercially produced household appliances for coal are expensive whilst homemade ones are inexpensive but more polluting (ibid: 18). Bio-ethanol gel is a relatively new energy carrier used for cooking purposes. Although it produces less pollution compared to other fuels and is affordable for poor households its availability is still a challenge as production and distribution systems are not yet fully developed (ibid: 18-19). Its calorific value has also been relatively lower and takes longer to cook compared to the alternatives (Ibid: 19).

The key difference between the FBE and FBAE is that FBAE has clearer guidelines on how the value of energy distributed will take into consideration inflation increases. The policy stipulates that municipalities are to give energy to the minimum value of R55 per poor household. This value would increase annually by the inflation rate plus 1.5 % for 5 years and would be revised every 5 years to ensure that the minimum is still effective in providing for the basic energy needs (ibid: 15). The FBAE policy provides a list of suggested energy carriers that municipalities can use (ibid: 16-19). However it does allow for other energy carriers to be considered for conventional household use (ibid: 10). However at the local government level, the Local Government Equitable Share Grant (LGES) is a non-conditional grant received from national government for the provision of free basic services but the municipality reserves the right to decide on how the grant is spent (ibid: 8). For some municipalities subsidizing energy for the poor might not be an immediate priority. According to the study, municipalities perceive FBAE as a policy not a subsidy and FBE as a constitutional obligation because the provision of electricity and gas are linked to the constitution (ibid: 7). The FBAE policy framework is relevant for this research because it is one of the interventions that government has implemented to address energy poverty. The policy focuses on alternative energy sources besides electricity. However the prevailing focus is more on availability and cost effectiveness when choosing energy sources while ignoring and not valuing long-term sustainability opportunities which could facilitate inclusion of alternative renewable energy technologies as well as behavioural interventions (CESU, 2011; DME, 2004).

2.4.3 Integrated Household Clean Energy Strategy

The DME implemented a programme on low-smoke fuels in 1994 with the objective of reducing outdoor air pollution levels (DME, 2004: 1). The combustion of coal in open fires leads to high levels of air pollution which in turn increases the incidence of respiratory tract illnesses especially among children. This leads to an increased health costs for the both affected individuals or households and the state (ibid: 1). The DME developed the Integrated Household Clean Energy Strategy (IHCES) based on the anticipated health-impacts through the mitigation of the effects of burning coal especially in winter months for space heating in low income settlements (ibid: 1). The short term objective of IHCES is to promote the manufacturing and distribution of low smoke fuels and appropriate appliances. The "Basa Njengo Magogo" method of fire generation (top-down ignition of coal fire and the related stoves) reduces emissions by up to 50% (ibid: 1-2). The long-term goal of the strategy document is to incorporate cleaner fuels and appliances (ibid: 2).

Although the government acknowledges that full electrification is the key long-term solution to the problems caused by burning coal, it is also aware that the constant increase in costs of electricity renders poor households unable to rely completely on electricity for their energy needs (ibid: 2). Therefore the DME implemented IHCES as a temporary measure to bridge the gap between the complete dependence on electricity for household energy needs and the continued use of coal (ibid: 2). The "Basa Njengo Magogo" project led to the easing of participating household's budget as they purchased less coal for space heating. The strategy recommends that national government continue to roll-out the programme by managing the process to ensure that there is coordination amongst all the stakeholders. The strategy is relevant to the research as it incorporates interventions that address low-income urban households' dilemma of electrification but being unable to afford the costs of electricity thus hindering the transition to utilization of electricity as a key energy source (ibid: 2-3). The "Basa Njengo Magogo" intervention has been more successful because it is behavioural and inexpensive approach, and it mitigates the quality of coal consumed (DME, 2004; Barnes et al. 2009).

2.4.4 Effectiveness of interventions

Most municipalities have failed to provide FBAE due to challenges in administering the policy and process (the report claims that only 2 municipalities reported on their FBAE subsidy implementation) (CESU, 2011: 14-15; Wolpe & Reddy, 2010: 6-7). In contrast, municipalities have found it easier to provide FBE because it is distributable under conventional infrastructure. Municipalities mostly composed of rural areas appear to struggle the most in achieving 100% electrification because the further away from grid infrastructure, the higher the costs of extending the grid (ibid: 14). Areas that fall under Eskom within the municipal boundaries tend to pose confusion as to who should bear the cost of electrification between the municipality and Eskom. These tensions create socio-political challenges for municipal and township managers who do not have control over the process but are accountable for service delivery to their residents (ibid: 14). However the report acknowledges that most residents in informal settlements prefer electrification over other energy alternatives offered under FBAE (ibid: 16). However, under FBE multiple households often share a single meter which leads to some poor households who would qualify for FBE to not receive this benefit because their combined consumption levels exceed the per month benchmark (CESU, 2011).

Bond (2000, 78) suggests cross subsidization and a declining block tariff system that government can use to make electricity affordable for domestic users. Currently the corporations pay lower tariffs on average for electricity and water compared to the domestic users and hence the suggestion that the reverse approach would enable a more equitable or ethical cross-subsidisation (ibid: 80). This would enable all domestic users to receive a life-line subsidy as an entitlement which once it has been used up, then the municipality can apply a declining block tariff (ibid: 81). The study further recommends that national government should apply the cross subsidy process in a systematic manner which would allow municipalities variations in order to achieve their redistribution, conservation as well as socio-economic development goals (ibid: 81-82).

CESU (2011: 16) argues that in order for government to provide 100% electrification, the regulatory frameworks need to be adjusted in order to accommodate diverse conditions within

the city including informal settlements and backyard dwellings. Cape Town has been singled out as an example of a city that has a well-defined policy to provide electrification to informal settlements and on land not zoned for residential use (ibid: 16). National government needs to provide resources to support the implementation and delivery that will enable municipalities to act on the policies. The cities need to build up capacity to tackle the challenges of informality – which they can achieve through leadership support from national government including the decentralization of authority from national to local government. There needs to be an integration of policy at both local and national levels of government in dealing with informality (ibid: 16).

2.5 Escalating energy cost

Thopil and Pouris (2013:1) note that electricity prices in South Africa have escalated (increasing yearly by about 25%) in the past 3 years. Electricity prices are regulated and determined by the National Energy Regulator of South Africa (NERSA) since 2000. Prior to that there was an agreement between Eskom and government that electricity would be capped at 15% below cost between the periods 1994 to 2000 (ibid). The priority for both Eskom and government was improving access to electricity, through INEP, to previously disadvantaged communities (ibid; Ruiters: 2009). This culminated in the disproportion between supply and demand leading to a shortage because generation capacity had not been improved during the mentioned period (Thopil & Pouris 2013:1; Sebitosi, 2008). In 2005, the Department of Minerals and Energy (DME) published its energy efficiency strategy which was in support of the White Paper on Energy Policy of 1998 (Sebitosi, 2008: 1591). The target set out in the strategy was to improve energy efficiency by 12% by 2015 which was to be achieved through legislative instruments and technological interventions (ibid: 1591). The strategy had further predicted that if energy usage patterns and trends remained unchanged there would be a need to invest in new power generating capacity by the year 2007 (ibid: 1591). Government denied Eskom's request for investment towards increasing generation capacity (News24, 2008).

However with both the White Paper and strategy in place, in April 2008, Eskom (the power utility company) initiated country-wide load shedding with the aim of stabilizing the national

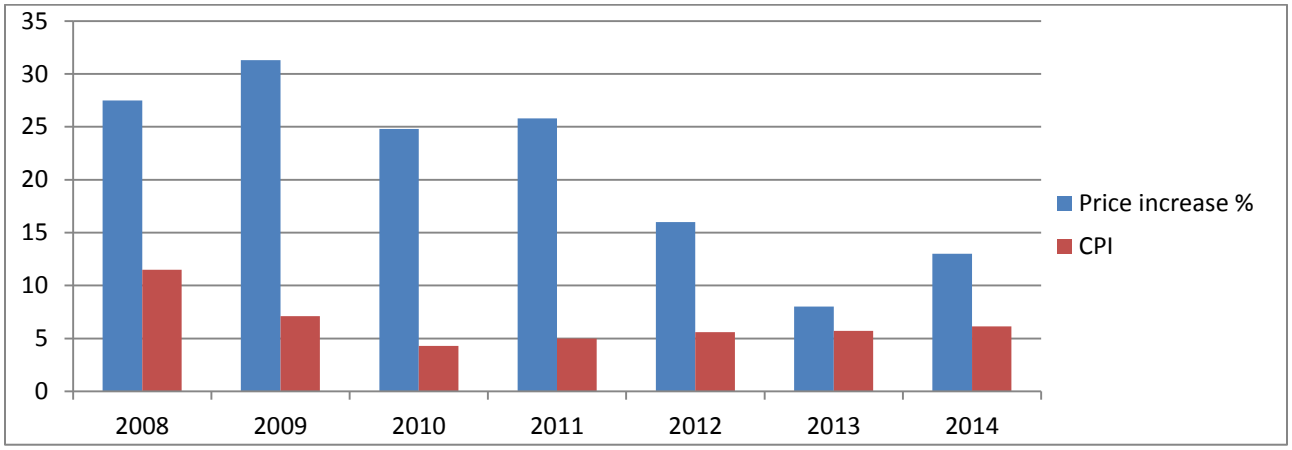
power grid through reducing electricity demand by at least by 10% (Sebitosi, 2008: 1591). The frequency of the power outages increased during the winter months when demand was high (ibid: 1591). This led to President Mbeki's apology to the nation for the crisis *"When Eskom said to the government: 'We think we must invest more in terms of electricity generation'... We said not now, later. We were wrong. Eskom was right. We were wrong"* (News24, 2008:1). The study posits that the country's lack of decisiveness in implementing policy beyond the formulation of the energy efficiency strategy was partly responsible for the electricity supply crisis that is still ongoing and negatively impacting on the country's economy (Sebitosi, 2008: 1591). In addition to the demand challenge the utility company was confronted with rising costs on other commodities such as coal and oil as a result of the global financial crisis of 2007/8 (Stephan & Bridgman, 2012). According to Thopil and Pouris (2013:1) in order to meet demand and maintain supply Eskom required an increase in revenues. NERSA uses a Multi-year price determination scheme (MYPD) based on the utility's cost recovery requirements in order to set tariff increases allowed for Eskom and municipalities (ibid). This was achieved through increasing electricity tariffs for all electricity users. There were loans taken to build new power stations and programmes to maintain existing infrastructure were put in place (Thopil & Pouris, 2013; Ashton, 2014). Brock (2014) argues that the failure to meet deadlines in completing new power stations and infrastructure maintenance worsens energy poverty. Country-wide load shedding continues to negatively impact on households and industries (Brock, 2014; Ashton, 2014). The table below depicts the price increases since 2008.

2.5.1 Trends in electricity tariff escalation

Table 1: Electricity tariff increases over the past 7 years. Source: Adopted from Eskom (2014a), Thopil & Pouris (2013: 2), STATS SA (2015) and Fin24 (2014).

Year	**Tariff increase %**	**CPI**
2008	27.5	11.5
2009	31.3	7.1
2010	24.8	4.3
2011	25.8	5

2012	16	5.6
2013	8	5.7
2014	13	6.13



The above chart demonstrates that electricity prices have in certain instances been five times the inflation rate. Although the increases granted by NERSA have been modest in the past three years but they still remain above the inflation rate. Most domestic consumers and especially low-income urban households have been the most affected by the price increases as they have had to rely more on combustible biomass fuel as one of their coping strategy.

2.6 Coping mechanism

Low-income urban households in South Africa use energy mix to cope with rising energy prices. The energy sources used are electricity, coal, wood and paraffin (STATS SA, 2013; Krohne, 1989). These sources are used to meet the domestic energy needs of the households. The households adapt their energy behaviours using different conscious and unconscious systematic measures that aim to lessen electricity consumption each time the tariff escalates (Sebitosi, 2008; Krohne, 1989; Dictionary.com. 2015). As a result of the reduced electricity consumption many of these households have become recipients of FBE grant of 50kWh per month. The choices and behaviours applied by low-income urban household to survive the challenges of energy poverty render them vulnerable to health and fire risks. The power utility company tariffs leave most users of electricity with no choice but to reduce their consumption.

For low-income urban households, the resultant burden on their household income lead to sacrificing of certain household needs which subsequently further threatens their well-being and survival. This study indicates that when households keep on this trajectory over extended periods, they are more likely to fall into indigence.

2.6.1 Indigence

This study argues that households experiencing extreme energy poverty over extended periods can be classified as indigent (Ekurhuleni, 2014). For such households, basic energy needs (such as space heating, cooking, refrigeration, ironing and entertainment) are only met intermittently as they are unable to cope with the recent escalation in energy costs (DoE, 2012). Urban low-income households are susceptible to experience indigence because they are unable to access natural sources of energy such as wood, cow dung and crop residues when compared to rural households (STATS SA, 2013). They are primarily dependent on purchasing power to acquire energy sources and are therefore vulnerable to economic shocks arising from such drivers as unemployment, retrenchment, loss of family members or social support and networks (Hart, 2010).

As a result of the financial crisis, most commodity prices have continued to increase hand-in-hand with unemployment especially due to weak economic growth in terms of GDP (Stephan & Bridgman, 2012). The theory of energy poverty focuses on the use of multiple traditional energy sources as a coping strategy but does not account for households whose energy needs are not being met as will be discussed in this study (UNDP, 2000). Sovacool (2012) argues that the energy coping strategies employed by the low-income households (with access to electricity) exacerbates their experience of poverty. Although the government has implemented energy poverty alleviation policies (FBE, FBAE), some of the indigent electrified households do not benefit because they do not qualify (usage is above 450 kWh) (DME, 2003; 2007). Future energy price increases will continue to adversely threaten survival and well-being of indigent urban households (STATS SA, 2013). As a result, alternative energy source interventions need to be implemented to mitigate the effects of energy poverty on such households (Wolpe & Reddy, 2010).

2.7 Alternative energy efficient sources

Sebitosi's (2008: 1592) suggests that sustainable development demands can be met through energy efficiency as a cost effective measure. According to Sebitosi (2008: 1591) Eskom implemented energy efficiency interventions post the 2008 electricity crisis to manage demand. These interventions included the roll-out of energy saving light (bulbs) mainly to low-income households, energy saving campaigns that offered consumers financial rewards for observing prescribed energy saving measures and tips as well as a solar water heating rebate programme (ibid: 1591-92). The study uses case studies from developed countries such as the United States, European Union and Japan in an attempt to highlight how, through a series of socio-political and technological strategies, energy and environmental conservation can be achieved (Sebitosi, 2008: 1592-93). Japan is particularly highlighted in the paper as being the world leader in terms of energy consumed per GDP (Gross Domestic Product) of growth which was achieved as a result of implementing energy and environmental policies since 1979 (ibid: 1592). The aim for including these case studies is to emphasize that strategy formulation must be complemented by systematic implementation of set measures in order to ensure that set goals are achieved. The author argues that the lack of technical skills constitutes one of the limiting factors towards implementing energy efficiency interventions in South Africa. Human capacity development is therefore argued to be a key requirement of the energy efficiency strategy (ibid: 1595).

The study posits that energy conservation model follows a hierarchical structure of prioritization which would be recommended for South Africa. At the top of the hierarchy is changing human behavior which highlights the need for sensitization and information sharing with engaging consumers (residential and non-residential) (Sebitosi, 2008: 1592). The study has identified issues which undermine consumer buy-in when it comes to energy conservation (ibid: 1593). These include the inconsistent reading of meters by municipalities which makes it difficult for consumers to monitor the effectiveness of their energy saving initiatives due to the weak feedback loop (ibid: 1594). The second level requires the application of energy efficient appliances where the study suggests that Eskom and DME should reward energy efficiency on the basis of overall energy savings (ibid: 1594).

The third level constitutes the deployment of distributed and renewable energy resources where power delivery losses could be mitigated by distributed energy resources such as renewable energy generation. This would be advantageous for South African climate, which has an abundance of solar radiation and wind resources (ibid: 1594-95). Renewable energy generation supports the research hypothesis that Free Basic Alternative Energy should be viewed as the long-term goal towards mitigating energy poverty in a sustainable and affordable manner. The majority of areas within South Africa have approximately 2500 hours of solar radiation per year (Warner, 2014: 1). This indicates that there is reliable solar energy that can be harnessed as a renewable energy resource (City of Johannesburg: 2008). City Energy Support Unit (2011: 24) posits that wind generation is more suitable for windy and coastal areas. Solar technology has been criticized for having enormous initial costs which restrict access to the majority of the residential sector (Haw, 2013). However, the life-cycle costs of solar PV mitigate both the initial costs as well as increasing electricity prices because once the user has paid off the cost of installation then solar energy is free (Ward, 2013; Haw, 2013; Eskom, 2011). Co-generation has the potential to supply clean energy but the lack of legislation hinders investor buy-in (Sebitosi, 2008: 1595).

The fourth is the adoption of low carbon technologies – nuclear energy could assist the country in reducing carbon emissions (ibid: 1595). According to UN-Habitat (2009: 40), nuclear energy could contribute to adverse environmental risks such as radiation as well as toxic and hazardous waste. The study highlights Pebble Bed Modular Reactor (PBMR) as the next generation of nuclear generators but the programme has been delayed indefinitely as a result of limited progress (Sebitosi, 2008: 1595). Finally, traditional coal generation should be the last resort (Sebitosi, 2008: 1595) due to greenhouse gas emissions which lead to associated health risks (Bond, 2000; Barnes et al. 2009). Although South Africa has a vast supply of coal resource, international demand for coal has driven up the prices of coal and in future Eskom will have to pay the same spot price determined by international demand (ibid: 1595). The author argues that the costs will be a burden to all consumers and especially the poor households as the price of electricity tariff would keep escalating annually (Sebitosi, 2008).

2.8 Non-payment of electricity services and illegal connections

According to Van Heusden (2009: 230) Eskom began extending the electrification programme to black communities in 1988 to extend their consumer base and as a poverty mitigation strategy. The power utility had a surplus generation capacity as a result of massive power generation additions in the 1970s (ibid). However the program was hindered by municipalities in black townships not having enough funding to extend the service and by civil society payment protests (ibid: 231). According to Van Heuden (2009: 231) non-payment of services was a strategy (struggle movements and civil) used mostly in the 1980s as a protest against the apartheid regime. This prompted the government to approach engineers to assist in the development of prepayment meters. These meters were put in place (piloted during a 1987 small scale roll-out) in order to counter payment boycotts (ibid: 231-232). Massive roll-out of the technology occurred post democratization (1994) and was largely marketed to consumers as an opportunity for them to take control of their electricity consumption (ibid: 236). Although initially targeting black townships, the prepaid meters were later rolled out nationally to all consumers (ibid: 235). The key advantage of the intervention for Eskom and municipalities was cost saving coupled with reduced administrative costs such as billing, managing arrears, re-connections and disputes over cut-offs et cetera (ibid: 231). However as electricity tariffs increased, civil society used different strategies to by-pass the meters to protest against the introduction of prepayment meters (ibid: 235).

The prepayment technology widely used to initially combat nonpayment of services in black townships has two functions. First, it provides access to national grid electricity and the second it closely aligns the consumption with ability to pay (ibid: 256). The prepaid meter has been criticized for causing poor households who cannot afford to buy electricity voucher for a month to incur transport and time costs as they travel to the vendor merchants frequently. Households are forced to borrow money to buy electricity in a bid to keep appliances such as refrigerators operational to save their food supply. In addition community solidarity is compromised as disconnection is perceived as an individual households' inability to use electricity sparingly (ibid: 258). As a result, there has been an escalation in illegal connections as

many poor households find ways to access the service without paying (ibid: 259). There are different types of illegal connections that have been recorded such as illegal extensions, illegal reconnections, by passing meters and illegally connecting to street lights. Illegally connecting ones neighbours has become an income generating business for some legally connected households (ibid: 259).

Estimates on the cost of illegal connections (and electricity theft) for municipalities, the utility (Eskom) and the public has ranged into the billions (Maravanyika, 2014: 1). The author argues that the city of Tshwane records a loss of about R150 million annually due to illegal connections and electricity theft which is mostly prevalent in informal settlements but also practiced in other communities (Maravanyika, 2014: 1). The city of Johannesburg recorded a loss of about R2.3 billion for the financial year 2013/14 (Slabbert, 2015: 1), while eThekwini municipality lost an estimated R190 million to illegal connections and electricity theft (Dawood, 2014: 1). Illegal connections are not only practiced by residential consumers as estimates indicate that the biggest loss is due to theft by industry and mining companies (Maravanyika, 2014: 1; Slabbert, 2015: 1). Eskom loses a total of R2.2 billion per year on illegal connections, meter tampering as well as illegal sale of prepaid meter vouchers (Maravanyika, 2014: 1). Eskom holds the view that high electricity tariffs and bleak economic conditions are the key reasons for escalation in illegal connections (Maravanyika, 2014:1). Through its campaign “Operation Khanyisa”, Eskom has managed to involve other stakeholder in partnership (such as Crime Line, and Business Unity SA) to combat illegal connections (SAPA, 2014). This has culminated in the increase of prosecutions of offenders (SAPA, 2014, Beaver, 2012). However it is not clear if cases have led to meaningful convictions to warrant the intervention as an effective deterrent (Dawood, 2014). Although no systematic studies have emerged in this field as yet, anecdotal evidence indicates that illegal connections and electricity theft are becoming entrenched coping mechanisms in view of the increase in energy poverty (Slabbert, 2015).

2.9 Theoretical framework

The United Nations Development Programme (UNDP) defines poverty in general as the inability of an individual to access basic services mainly due to inadequate income to cover the related

costs (UNDP, 2000: 43). Although poverty is a global challenge, it is worse in developing countries where the standard of living for the majority of the population is distressingly low (ibid: 44). The report (ibid: 44) argues that poverty alleviation is a growing political challenge because of the increasing gap between the rich and poor which poses a threat to socio-political stability. The report emphasizes the link between energy and poverty as it is through the provision of energy that certain basic services such as – lighting, cooking, the use of appliances, comfortable indoor temperature, water supply, sewerage and others – can be ultimately accessed and experienced or consumed (ibid: 44).

The report (UNDP, 2000: 44) specifically defines energy poverty as "the absence of sufficient choice in accessing adequate, affordable, reliable, high quality, safe, and environmentally benign energy services to support economic and human development". According to the definition, access to energy services in itself would not be adequate to meet the economic and social development needs as the failure to deliver or afford adequate levels of energy consumption can hinder such development (ibid: 45; Sovacool, 2012: 273). The report suggests that families that spend about 10% to 15% or more of their monthly (or annual) income on energy can be considered to be energy poor. The report highlights that in general a household's decisions on energy sources are based on the households' monthly income (Sovacool, 2012: 273; UNDP, 2000: 45). Other characteristics of energy carriers that are considered include "accessibility, convenience, controllability, cleanness, efficiency, current costs and expected distribution of future costs" (ibid: 45).

Households that are energy poor are more likely to rely on multiple energy sources (traditional fuels) to meet their domestic energy needs (UNDP, 2000: 45; Sovacool, 2012: 273). Energy poverty exacerbates certain societal problems such as the inequality between the rich and the poor. The report (ibid: 273) posits that the poor spend more income on energy sources because of poor quality housing as well as cooking and lighting appliances that are not energy efficient (ibid: 274). Sovacool (2012: 272) criticizes both the concepts of "energy ladder" and "energy equity" because they fail to account for low-income households detailed usage of energy and the assumption that individuals seek to only move up the energy ladder (to ultimately use

electricity only). Evidence suggests that even middle and high-income households use multiple energy sources for various domestic needs based on availability, price and social expectations (ibid: 274).

The manner in which the poor in society access and use energy escalates their experience of poverty in general (UNDP, 2000: 40). Energy efficient appliances which could reduce consumption and energy cost are likely to be unaffordable for low-income households and as a result they are unable to switch to such appliances and related energy carriers (ibid: 46). Thus they continue to use traditional appliances that use combustion fuels and are likely to be inadequately maintained. The use of such appliances in poorly ventilated rooms leads to health problems due to indoor air pollution (ibid: 46). According to the report (ibid: 46) the speed at which the poor take advantage of the benefits associated with economic growth is compromised (perpetuating the poverty cycle) as a result of the negative impact of energy use on their health, nutrition and productivity.

Urban population growth has brought both challenges and opportunities in effectively dealing with energy poverty. The challenges involve increase in greenhouse gas emissions due to, population growth and associated increasing energy consumption as well as the increase in the gap between the rich and the poor. Middle to high income households are more likely to adopt cleaner alternative fuels because they can afford the initial up-front cost (UNDP, 2000: 45). The opportunities that characterise urbanization are economic growth and increased access to energy carriers in cities compared to rural areas. The author argues that urban centers have the ability to drive energy efficiency strategies that will benefit the poor if systematically facilitated through innovative sustainable energy policies and technologies. According to Sovacool (2012: 275) modern energy provides four key benefits. Firstly, increased productivity and poverty reduction– providing adequate and clean energy has the ability to increase income generation opportunities which can lead to mitigation of poverty. Secondly, general health improvement is associated with access to modern energy because electricity mitigates local pollution, simplifies modern preventative, diagnostics and medical treatment (ibid: 276). Thirdly, improved women health – the provision of modern energy allows women to refocus their time and resources on

other activities such as childcare (ibid: 278). As a result of indoor air pollution a lot of school time is lost through absenteeism due to respiratory illnesses. Lastly, better-quality education – modern energy also allows education facilities to improve the learning experience by enabling better lighting, computers and internet (ibid: 277). The negative impacts of modern energy cannot be over looked. Some of these impacts include deforestation, changes in land-use and greenhouse gas emissions which contributes to global warming and climate change (ibid: 278).

Sovacool (2012: 278) highlights that access to electricity and modern forms of energy has not successfully addressed the challenges of energy poverty for low-income households. Although policy makers may be in support of energy efficiency policies they are constrained because of limited funds due to other competing public needs (such as public health or education) that need to be met, as well as limited institutional capacity to roll-out an overall policy implementation (ibid: 281; SALGA, 2013: 10-11; CESU, 2011: 8). Budgetary constraints due to slow economic growth might hinder a government's ability to effectively deal with issues of cost effective alternative energy sources (ibid: 279). Technical barriers are linked to the lack of transfer of technology from manufacturing countries and lack of training of end-users on the installation and maintenance of energy efficient or renewable energy technologies such as solar water heaters (ibid: 280). Limited information and know-how on various energy efficient options for households often leads to households keeping with the energy carriers with which they are culturally familiar (ibid: 279, 281).

The theory of energy poverty is relevant to the research because it provides a link between energy and poverty such that the former (energy) can aggravate or perpetuate the experiences of the latter (general poverty) for the poor. The main argument is that access on its own is not enough to tackle the problem of energy poverty. Therefore, access to modern energy needs to be complemented by key traits such as affordable and adequate. According to the theory the government needs to provide energy efficient technologies to the poor as a poverty alleviation strategy to aid in meeting their domestic energy needs of space heating, household appliances and transport services (ibid: 47; ibid: 280). An increase in the price of fuels is more likely to adversely affect the poor in society, particularly women whose health can decline as a result of

cooking with traditional biomass fuels (ibid: 55). Urban population growth has brought both challenges and opportunities in effectively dealing with energy poverty. According to the UNDP report, urban centers have the ability to drive energy efficiency strategies that could benefit the poor through innovative energy policies which specifically targets mitigation of energy poverty (ibid: 55-56). The diagram below contextualizes the relationship between the three variables that contribute to energy poverty and the need for coping mechanisms.

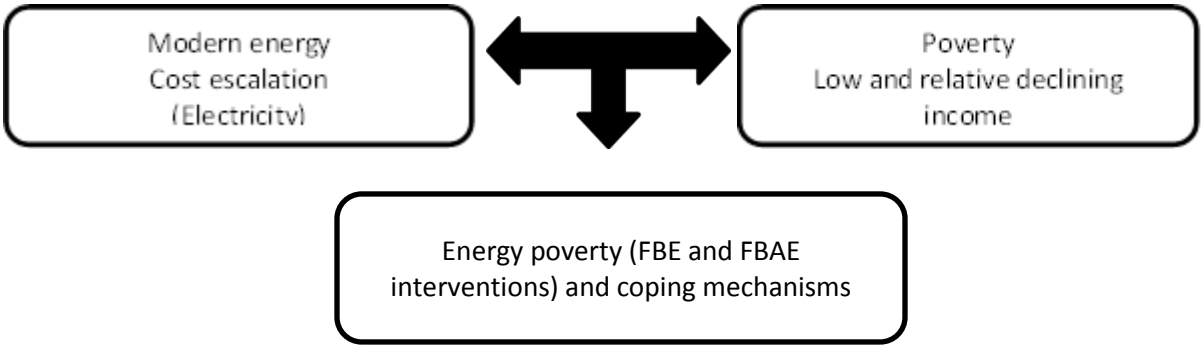


Figure 2 Theoretical Framework

2.10 Conclusion

Based on the theory of energy poverty, access to modern energy is not enough to effectively mitigate the effects of energy poverty. Appropriate appliances, affordability and the cost or price of energy carrier constitutes additional factors which could arise as barriers to accessing and consumption of clean (sustainable) energy especially for low-income households. Energy poverty exacerbates the experiences of overall poverty by the poor. The urban poor are more prone to the impacts of rising energy prices and experiences of energy poverty as a result of poorly constructed home structures. They end up spending more of their income on energy compared to middle and high income households. They are also more likely to use biomass fuels to mitigate the cost which puts their health at risk for ALRI and other associated health and fire risks. Despite government's initiatives to mitigate energy poverty for the poor by improving access and providing initial free 50kWh monthly through FBE, many poor do not benefit from the intervention particularly large-size households whose consumption goes beyond the maximum threshold of 450kWh per month. As a result there has been an increase in illegal connections from both residential and commercial sectors which has led to the loss of billions of Rands worth of electricity by both municipalities and Eskom which in turn has led to

an increase in efforts to prosecute offenders. Although the South African government has attempted to improve clean-energy access to all citizens, the response to the informal settlement challenge has been varied among municipalities. Therefore the use of alternative renewable energy sources would assist government and affected households in mitigating energy poverty in the current environment where energy costs continue to escalate. The subsequent chapters of this study have used DoE (2012) survey of energy-related behavior and perceptions in South Africa and STATS SA (2013) survey to provide secondary data for insight on the behaviours on energy and electricity over a period of 10 years (2002 to 2012). Secondary sources are discussed under chapter 3 (Methods) and reported in chapter 4. The key data interests are on the energy behaviours of low-income households in urban centers and the effectiveness of FBE policy. Chapter 5 appraises ethnographic data from a low-income household in Gauteng province to deepen understanding on the coping mechanisms of such households when faced with escalating energy costs.

Chapter 3
Research methods

3.1 Introduction

This section focuses on the research methods employed in the study. The study is exploratory in nature as it seeks an in-depth understanding of the energy related behaviours of the selected household. Ethnographic (Atkinson & Hammersley, 1994) and participant observations (Robson, 2002) are the two methods used for primary data collection. This chapter proceeds with an overview of the data collection tools, secondary data and data analysis approach. Finally, ethical considerations of the study are discussed.

3.2 Research approach

The key concern of the study is the coping mechanisms employed by low income urban households to mitigate rising energy costs in South Africa and the effectiveness of energy poverty interventions (FBE and FBAE policies) in improving quality of life of beneficiary households. Critical theory plays an important role in our understanding of the current world where context and meaning of action and thought change rapidly (Duvall & Varadarajan, 2003: 78). Cox (1996) as cited in Duvall and Varadarajan (2003: 79) argues that historical sensibilities of critical theory enables us not just to take into account the role of the past in constructing the present socio-economic political order but to also treat the present order as dynamic.

According to Shapcott (2008: 1) contemporary critical theorists define emancipation as freedom from pointless suffering and freedom to participate in dialogue, deliberation and consent with regards to matters that affect mankind. Critical theory gains the status of being interdisciplinary because it engages both the explanatory and evaluative with the intention of being practical (Shapcott, 2008: 1). Critical theory is applicable in the South African context because it facilitates engagement with the underlying historical context such as the legacy of apartheid and its contribution to energy poverty for low-income households as well as its prevalence among the black population (Streeter & de Jongh, 2013: 76-77). Through critical

theory the study is able to account for the current context whereby Eskom cannot meet the current demand as a result of the massive roll-out of INEP to the majority of the citizens who in South Africa were previously disadvantaged. The result has been escalating energy costs and the deepening of energy poverty.

The exclusion of the black population from provision of key infrastructure and services during apartheid led to the current backlog in the provision of electricity in both urban and rural areas (Hart, 2010; Streeter & de Jongh, 2013; Robinson, 1997). Although the government has implemented the national electrification programmes, FBE and FBAE, to mitigate the effects of energy poverty, the escalation of energy costs continue to entrench energy poverty thus undermining the quality of life for millions of low-income households (CESU, 2011). There are challenges in the provision of FBAE within municipalities as a result of inadequate co-ordination between local and national government (Streeter & de Jongh, 2013). On the other hand FBE fails to accommodate multiple households relying on a single meter in urban low-income communities (backyard dwellers and larger households) (SALGA, 2013). In view of this scenario the expectation of escalating energy poverty is constantly studied and reported. However, systematic studies on the impact of rising energy costs on quality of life of households and their coping mechanisms have not emerged. This study starts to fill the gap through a qualitative research approach based on secondary and primary data sources.

Secondary data were distilled from existing national statistics and reports. For primary data the research draws from the experiences of energy poverty of a preselected household based on ethnographic research method. Ethnographic research refers to social research that seeks an in-depth understanding of human experiences and behavior in their socio-cultural and natural contexts (Greenstein et al. 2003: 49). The research recorded the experiences of energy poverty in an urban low-income household as primary data source in order to facilitate for deeper understanding of the impact of escalating energy costs on the quality of life of the urban poor. Greenstein et al. (2003: 51-52) posit that qualitative research enables the participants and their situation to be understood according to their perspective but as a result of small sample sizes the results cannot be generalized. As a result of time and financial constrains the researcher

could not broaden the research to include a larger sample size in terms of households in different geographic spread (Greenstein et al. 2003: 52).

Ethnographic study requires direct observation of participants to understand both the verbal and nonverbal nuances as they mitigate their energy constraints within their day today interactions (Robson, 2002: 310). Although the recent survey by the DoE (2012) reports on energy poverty in South Africa and confirms the generally held perception that indigent households use multiple sources of energy to mitigate the rising energy costs, it does not mention other behaviours that these households have adopted to manage their energy consumption (demand-side) or other coping mechanisms. Although the theoretical concept of suppressed demand has now emerged as an area of study in energy poverty the behavioural dimensions of such suppression are not explicitly studied (Ruiters, 2009). The current study used ethnographic research method to observe these behaviours and record them as they occur within the household and the broader community that interacts with the household in order to understand how the quality of life of the participants is impacted through the energy-service choices they have to make within such constrained circumstances (Creswell, 2009: 176-177).

3.3 Research Methods

3.3.1 Ethnography

Ethnographic research was prioritised as the real-world social research approach which would allow the study to deepen the understanding of the coping mechanism of low-income households to energy costs in South Africa as guided by the research questions derived in Chapter 1 (Atkinson & Hammersley, 1994: 248). According to Atkinson and Hammersley (1994: 248), ethnographic research involves an in-depth investigation of limited cases whose purpose is to provide a deeper understanding of a social phenomenon. The critical theorists acknowledge the diversity in and within poor urban households of South Africa. Thus ethnographic approach is an appropriate tool to sense if FBE and FBAE is the more sustainable way to address energy poverty (Duvall & Varadarajan, 2003; Sebitosi, 2008; CESU, 2011). However the study approach was sensitive to the risk of the researcher taking the role of an

expert in the household which would lead to a hierarchical relationship between the researcher and the hosting household (Atkinson & Hammersley, 1994: 248-249). This was mitigated in this study through the researcher focusing on the observer approach and avoiding the 'guidance role' during the one week period of fieldwork.

3.3.2 Participant Observation

The role of the researcher was to be a participant observer thus allowing her to be part of the experience of energy poverty in the household under observation (Robson, 2002: 314). The researcher spent a week with the host household as part of the family engaging with their day to day lives. The members of the household were informed of the role of the researcher. This enabled the researcher to gain first hand holistic understanding of energy poverty among urban low-income households (Sarantakos, 2005: 210). The researcher was able to ask questions about the reasons behind certain energy behaviours and choices as they occurred (Robson, 2002: 315). The researcher acknowledges that one week was not sufficient time to gain full understanding of the energy behaviours but the aim of the observation was to provide a deeper sense of the coping mechanisms of low-income households in a way which complements the secondary data captured from published sources. The study is intended to be exploratory with the anticipation of similar additional studies in future.

3.4 Selection of household

The household that was selected for the research resides within a low income community and experiences energy poverty (UNDP, 2000). The house is an informal housing structure made of corrugated iron and has modern ablution facility outside (detached from) the house (CESU, 2011). The head of the household is distant aunt to the researcher who gave consent for participation in the ethnographic research. The size of the household is 2 adults and 5 children. The researcher did not contribute financially for her stay in order not to distort the energy related behaviours during the duration of the study. However in order to mitigate the costs related to the researcher's presence within the household, the researcher went shopping with one of the household members to buy their food according to the family diet. Ethnographic research allowed the researcher the opportunity of an in-depth experience and nuanced

understanding of poverty, energy poverty and coping mechanisms that is not captured in secondary data or through common tools such as questionnaires and census on households (Atkinson & Hammersley, 1994; STATS SA, 2013).

3.5 Data collection tools

Ethnography was used in this study as a primary data tool to observe and record (written notes) the energy related actions and behaviours of the pre-selected low-income urban household for a period of one week (Atkinson & Hammersley, 1994; Wratten, 1995). Observation allowed the study to record nuanced behaviours and activities about the coping mechanisms of low income households employed to mitigate energy poverty (Kawulich, 2005: 4; Sebitosi, 2008; Krohne, 1989; UNDP, 2000). The researcher recorded behaviour; that was geared towards energy savings (Sebitosi, 2008: 1591-92) and the use of energy mix (STATS SA, 2013; Krohne, 1989). The aim was to record the impact of the coping mechanisms and FBE grant on the quality of life of the members of household. The researcher took photographs of the household structure and energy appliances for illustrative purposes (Kawulich, 2005: 25). The study focused on activities related to acquiring alternative sources of energy to gain an in-depth knowledge such as: where do the family and community buy their energy carriers (multiple) (STATS SA, 2013; Krohne, 1989; UNDP, 2000), the quantities that they purchase as well as the costs (Stephan & Bridgman, 2012). The researcher observed some of the activities at the energy carrier's supplier when they accompanied a family member to the seller. The purpose of participating was to understand the decisions linked to the choice of energy source and holistic experience that low-income household go through in securing energy to meet their domestic needs (Barnes et al. 2009; UNDP, 2000; Sovacool, 2012). The study collected both descriptive (a description of the context, people and events) and interpretive data which was based on the experiences of participating in the daily activities of the household (Robson, 2002: 314-315).

3.6 Secondary data

The study used secondary data drawn from DoE 2012 and Statistics South Africa 2013 survey. The DoE survey reflects national data on energy related behavior and patterns in the residential sector. The aim of the survey was to gain insight into the customer's perception of the quality

and price of electricity. While the STATS SA survey provides data on energy related behaviours over a period of 10 years (2002-2012) its primary focus was on the effectiveness of INEP, FBE and other policies. For the purpose of this study, focus will be on INEP and FBE policies which will be instrumental in responding to the research question. The study also relied on other data sources such as books, journals, policy documents and newspaper articles with the aim of evaluating the effectiveness of FBE and FBAE interventions on energy poverty among low-income households.

In the study secondary data are presented, interpreted and analysed in chapter four. Chapter five focuses on the presentation, interpretation as well as the analysis of the primary data. Concerning data reliability, Lewis and Ritchie (2003: 286) suggest that reliability and validity can be established when secondary data is used to cross-check primary data. This study uses multiple research approaches - survey data to complement ethnographic data (Pearce, 2002: 104). Chapter six consolidates the key findings of the secondary and primary data in order to arrive at the overall finding on the research question and working hypothesis.

3.7 Data Analysis and Interpretation

Pearce (2002: 104) posits that using multiple research approaches to respond to a research question allows the researcher to gather varied evidence for the study. This allows the data to complement or prove (or disprove each other) as each method focuses on different aspects (ibid). This study will demonstrate that using survey data to systematically complement ethnographic data can lead to improved understanding of energy poverty which contributes to the deepening of poverty, exclusion and inequality. The procedure for data analysis for the study consists of using ethnographic data and survey data interactively (by using one to strengthen the other) to allow an in-depth understanding of the effects of escalating energy costs on low-income urban households (ibid: 104). The study applied ethnographic descriptive analysis for the primary data which consists of the analysis of the data collected from the field by the researcher through ethnographic study and participant observation of the preselected low-income household (Creswell, 2009: 183-184). The inability to qualify for FBE or to use available energy sources to meet some domestic energy needs as a result of a lack of

affordability was perceived as a coping mechanism that perpetuates energy poverty (DME, 2003; UNDP, 2000; Sovacool, 2012). In addition, sacrificing other household basic needs to mitigate rising energy costs was perceived as behaviour that leads to indigence (Ekurhuleni, 2014). On a daily basis the researcher read and analysed the data recorded on the field for the purpose of verification and accuracy (de Wet & Erasmus, 2005; Creswell, 2009). The objective of analyzing the data is to enable the researcher attempt to respond to the primary and secondary research questions mentioned in Chapter 1 (Babbie & Mouton, 2001a: 104). Maxwell (1998: 89) posits that coding affords the researcher an opportunity to breakdown the data collected from the field research into categories with the aim of drawing comparison to determine the patterns of association between the categories in the research context. The researcher coded the data according to themes mentioned in Chapter 2 in relation to energy related behaviours of the low-income households as they mitigate the challenges of rising energy costs and deepening of energy poverty (Creswell, 2009: 199; Thopil & Pouris, 2013; UNDP, 2000). The themes covered by the researcher; coping mechanisms (Sebitosi, 2008; Krohne, 1989; Dictionary.com. 2015), effectiveness of FBE (CESU, 2011), impact on quality of life (UNDP, 2000) and alternative energy sources (UNDP, 2000; Sovacool, 2012).

3.8 Derivation of findings

The working hypothesis of the study is that Free Basic Alternative Energy must be a long-term goal by incorporating the distribution of renewable energy technology to low-income urban households which is sustainable and cost efficient (Sebitosi, 2008). A recent survey on perceptions of energy related behaviours by the DoE (2012) indicates that low-income households are using multiple fuel sources to tackle energy poverty. However for low-income urban households there is heavy reliance on coal generated electricity as their main source of energy (Bond, 2000). As a result continued tariff escalations have impacted negatively on the disposable income of these households (Sebitosi, 2008; Thopil & Pouris, 2013; Wratten, 1995). Costs influence the type of energy choices low-income urban households make, with the possibility that they would most likely purchase the lowest priced energy sources (Barnes et al. 2009; UNDP, 2000; Sovacool, 2012). During winter months there is an increased reliance on polluting energy sources for space heating (CESU, 2011; Barnes et al. 2009). The study

anticipated that this would correlate with an increase in incidence of ARLI in the participating household (Barnes et al. 2009).

The study anticipated that most low-income urban households are not benefitting from FBE due to their monthly consumption of electricity being above 450 kWh baseline based on large household sizes or a single electricity meter shared by multiple households (backyarders) (DME, 2003; SALGA, 2013). Due to the challenges mentioned in implementing FBAE (CESU, 2011; Wolpe & Reddy, 2010) it was expected that the policy has not been systematically implemented by the municipality (DME, 2007; CESU, 2011). Although the national government seeks to reduce the impact of energy poverty on indigent households through FBE and FBAE policy frameworks (DME, 2003; DME, 2007; Ekurhuleni, 2014), recent literature seems to argue that energy poverty has worsened (Ashton, 2014; Brock, 2014, Thopil & Pouris, 2013; Fin24, 2014). In addition, monthly allocations under both policies are insufficient to meet the basic household energy demands (DoE, 2012; CESU, 2011; Wolpe and Reddy, 2010). The study therefore anticipated to encounter suppressed demand (Ruiters, 2009) as one of the coping mechanisms such that affected households go for prolonged periods without the minimum energy services needed for basic socio-economic functioning in modern society and economy.

3.9 Ethical Considerations

The study was guided by the ethical guidelines of the University of Witwatersrand. The study and its methods was not likely to course any harm to the participants within the participating host household (Giddens, 2006: 93) and the participants were treated with respect by the researcher (Wassenaar, 2006: 73). The researcher explained the purpose of the research and informed the participating household of their right to withdraw from the research at any time and that they would not receive compensation for participating in the research (Babbie & Mouton, 2001b: 523). The household's participation in the ethnographic research was voluntary (Wassenaar, 2006: 72; Atkinson & Hammersley, 1994). After informing the participants of the household about their rights the head of the household was presented with informed consent forms to be signed but under age (children) consent was provided by the parents. The information gathered by the researcher was treated as confidential and sensitive

personal information that was observed (but not crucial to the study) was left out of the study as agreed with the participants (Creswell, 2009; Babbie & Mouton, 2001b).

3.10 Conclusion

This study was achieved through the use of ethnography and participant observation research methods in complementing secondary data from two existing major data sets (DoE, 2012; STATS SA, 2013; Greenstein et al. 2003; Sarantakos, 2005). Various sources were used to gather information on energy related behaviours, perceptions and energy poverty. Ethnographic research shed more light on the coping mechanisms and the ineffectiveness of alternative energy sources in meeting the basic energy needs of low-income urban households. Participant observation allowed for deeper understanding of energy choices, related behaviours and the experiences of indigent households. The key findings of the secondary and primary data analysis were consolidated with the aim of responding to the research question. The study used ethnographic descriptive analysis which allowed the data to guide the formulation of categories or themes in Chapter five under which the research findings were derived.

Chapter 4
Energy related behaviour and perceptions

4.1 Introduction

The Department of Energy (DoE) survey (DoE, 2012) gathered evidence on energy-related behaviour and perceptions of the quality as well as the price of electricity service. The department had already implemented the FBE and FBAE policies with the aim of reducing energy poverty among poor households (ibid: iii). After consultation with the Department of Energy, Statistics South Africa released a survey in 2013 that provided insight on the behaviours on energy and electricity over a period of 10 years from 2002 to 2012 (STATS SA, 2013: ii). The government seeks to shed more light onto the effectiveness of the electrification programme (INEP) as well as other policy instruments such as FBE that it has implemented in mitigating energy poverty (STATS SA, 2013: ii). The approach aims to improve access to electricity and provide subsidies to poor household who might otherwise not afford the service. This chapter provides insights on the energy consumption behaviour patterns of South African households. Perceptions on electricity prices are discussed as well as their impact on indigent households. The chapter further explores the impact of energy poverty interventions to low income households as reported in the key secondary data sources cited above.

4.2 Energy related behaviour

Government aims to provide access to modern energy sources (electricity and renewable energy sources) to all households through INEP and reduce reliance on polluting energy sources (DoE, 2012: 5). The INEP has been successful in improving access to electricity which was 87% nationally (ibid: 1) and about 3.4 million households nationally that were without access to electricity when the programme started had been connected to the grid by 2012. (STATS SA, 2013: ii). In urban areas, households without access to electricity are those that reside in informal settlements especially in Gauteng Province where 30% of households are in this category (DoE, 2012: 16). In response to the energy poverty gap national government introduced the FBE that provides poor electrified households 50 kWh monthly per month

(DME, 2003) and FBAE policy that supports poor non-electrified households to provide alternative energy that is deemed appropriate by the municipality to the value of R55 per month (DME, 2007: 15). The objective of the energy poverty interventions is to ensure that poor households are able to take advantage of the associated benefits of INEP and universal access to basic energy services (DME, 2003; DME, 2007).

According to STATS SA (2013: 6) the residential sector consumed approximately 13.3% of national electricity in 2009 compared to 7.7% in 2002. Residential energy sources are often grouped into three categories – traditional, transitional and modern fuels (ibid: 10). Traditional fuels consist of wood, dung and crop residue. Coal, paraffin and LPG are considered as transitional fuels while electricity is classified as a modern fuel (ibid: 10). The International Agency for Research on Cancer (IARC) cited in STATS SA (2013: 7) argues that 70% of households in developing countries rely on traditional biomass fuels for cooking because these fuels are freely available from nature. This is contrary to the assumption of the energy ladder model which only associates the use of traditional biomass fuels to poor households (Sovacool, 2012). These biomass fuels are associated with negative health impacts such as ALRI (Barnes et al, 2009: 4) and environmental risks such as deforestation (STATS SA, 2013: 8). Urban low-income households are more likely to be exposed to increased levels of indoor air pollution and energy-related injuries (such as burns and paraffin ingestion) which can lead to emotional, financial as well as physical damage (STATS SA, 2013: 8). Women (about 56% in urban informal areas) are more likely to be affected by the health impacts associated with burning traditional biomass fuels because they spend more time cooking with the polluting fuels than men (ibid: 8).

There are differences in the energy sources that electrified and non-electrified households use to meet their domestic energy needs (DoE, 2012: 19). Electrified households use electricity for the following domestic activities – lighting, cooking and space heating (ibid: 19, STATS SA, 2013: 56). Approximately 90.3% of urban households with access to modern fuels use electricity for lighting and 6.5% rely on candles (STATS SA, 2013: 80). Cooking and space heating are considered to be energy intensive domestic activities by both electrified and non-electrified

households (DoE, 2012: 25, 27). About 47% of electrified households use electricity exclusively for cooking. Multiple use of energy sources for cooking is also common with electrified households (48%) (ibid: 34). Urban households residing in informal settlements are more likely to use paraffin (about 27%) as their alternative energy source for cooking and only 68% using electricity (ibid: 30). More than 50% of households in urban areas used electricity for space heating (ibid: 67). While 86 % of households used electricity for water heating in urban areas (ibid: 75).

Households with access to electricity still use some form of alternative energy sources like candles (87%), firewood (65%) and paraffin (83%). Non-electrified households mostly depend on candles, paraffin and firewood for their domestic energy needs. A limited number of non-electrified households use coal and gas as an alternative energy source (ibid: 19). The use of other forms of energy such as solar electricity and stand-alone generators remains minimal in both categories (electrified and non-electrified) (DoE, 2012: 19). This study will focus on the electrified urban households as set out in the research question.

According to the STATS SA (2013: 87) survey electricity tariffs have increased significantly (111%) between 2005/6 and 2010/11 and is expected to continue rising in the near future. According to the DoE (2012: iii) report the international bench mark on energy poverty is at 10% and the average South African household spends more than 14% of their monthly income to provide for their energy needs. 69% of poor households have access to electricity and receive FBE nationally (DoE, 2012: 71). In addition to the FBE and FBAE (energy poverty mitigating policies) the DoE implemented Inclining Block Tariff in its 2010 pricing structure with the aim of charging higher tariffs for households that use more electricity (DoE, 2012: 86). The DoE (2012: 71) survey employed three approaches to determine the energy poverty profile namely expenditure, subjective and thermal inefficiency of households (ibid: 85). According to the expenditure approach about 47% of households are energy poor because they use more than 10% of their monthly income on energy (DoE, 2012: 2). According to subjective approach households are energy poor when the amount of energy they use is not enough to meet their basic energy needs. Thermal inefficiency approach refers to the poor performance of their

houses in maintaining thermal comfort levels (ibid: 85). The subjective and thermal inefficiency approaches suggests that approximately 42% of households in South Africa are energy poor compared to the 47% observed under the expenditure approach. The general trend in all the three approaches was that households in rural areas as well as low income households were more likely to experience energy poverty (ibid: 86).

4.3 Analysis and Interpretations

The provision of FBE varies in implementation across provinces as well as in the urban vis a vis rural areas (DoE, 2012: ii). According to the reports (DoE, 2012; STATS SA, 2013) recipients of FBE in low income households have a high probability of using electricity for cooking and space heating. Low income households that do not qualify for FBE are more likely to continue to use solid fuels for cooking and space heating (STATS SA, 2013: 95). There are three factors that contribute to the choice of alternative sources of energy in electrified households (ibid: 95). Firstly, urban electrified household's chances of using alternative energy sources are low. Secondly, low income households are prone to using alternative energy sources. Finally, household activities that increase electricity consumption such as space heating and cooking are most likely to be carried out using alternative sources of energy (ibid: 95). The availability of solid fuels in urban areas such as wood was limited across all household income groups as compared to paraffin which is easier to access both by cost and appliance technology (ibid: 59).

High income electrified households are more likely to be satisfied with the quality of electricity service that is being provided in their area of residence than low income households especially those living in informal settlements who are the least satisfied (DoE, 2012:60). According to the report (ibid: 61) South Africans generally feel that the price of electricity is too high. Since the last price increase most low income households have used the following behavioural strategies to cope; reduced amount and switched to other energy sources – such as paraffin, coal and firewood (ibid: 61). The reports suggest that more households would return to multiple energy sources if energy prices continue to increase (DoE, 2012; STATS SA, 2013). There is low awareness of energy saving measures amongst population groups characterized as blacks, uneducated and low-income households (ibid: 87). The majority of households are not aware

that they receive FBE based on a government policy implemented by municipalities. Protesting about energy access and prices is an acceptable behaviour whilst most were strongly against illegal connections (STATS SA, 2013: 97; DoE, 2012: 72).

STATS SA (2013: 11) argues that illegal connections were prevalent in South Africa because of a culture of nonpayment as a political tool (used by civil society in protest against apartheid), and increasing electricity tariffs. Although 96.8% of the respondents are against non-payment for electricity service, the recent escalation in electricity tariffs are likely to increase the prevalence of illegal connections (ibid: 12, 84). According to DoE (2012: 77) urban informal dwellers were among the groups least opposed to illegal connections and cable theft. According to Slabbert's interview of Bott (2015) corporate illegal connections are far more common than residential illegal connections and thus impacts on the municipal revenues more seriously. The national surveys used by the study do not however capture illegal electricity at corporate level because the focus was on residential perceptions and behaviours (DoE, 2012; STATS SA, 2013).

According to the survey, government policies on energy should focus on three priorities (ibid: 79). Firstly, it should maintain low electricity tariffs because currently the tariffs are too high and further increases will only increase the number of households experiencing energy poverty. Electricity tariffs have been escalating since the 2008 electricity crisis and they are likely to persist in future (STATS SA, 2013; Thopil & Pouris, 2013). The aim is to assist Eskom in increasing revenue for infrastructure maintenance and development of new power stations (Ashton, 2014). The second priority should be to reduce the number of times the service is interrupted (power cut and load shedding). The power utility company continues to experience challenges in meeting demand hence load shedding is used to stabilize the national power grid by reducing electricity demand (Sebitosi, 2008; Brock, 2014; Ashton, 2014). Finally, an increase in the allocation of FBE and FBAE to aid poor households to meet their basic domestic energy needs because the current grant is not adequate towards improvement of their quality of life (DoE, 2012: 79, 86). FBE and FBAE policies came into effect prior to the energy crisis thus they need to be revised in order to take into account escalating energy costs and the resultant burden to household income (Thopil & Pouris, 2013; Maravanyika, 2014). Energy poverty

requires a more sustainable response by government through meticulous implementation of existing policy on renewable energy sources which substantiates the research hypothesis (Sebitosi, 2008; Ward, 2013; Haw, 2013; Eskom, 2011; STATS SA, 2013). The majority

4.4 Derivation of key findings

The accelerated increase in electricity prices (escalation in tariffs) in order to meet the costs of generation infrastructure expansion has adversely affected the lives of poor households in South Africa who generally spend more than 10% of their monthly income on energy costs. DoE (2012) posit that households that spend more than 10% of their monthly income on energy costs are considered to be energy poor. Poor households living in Reconstruction and Development Programme (RDP), subsidized homes and urban informal settlements were prone to spending 20% of their household income on electricity (STATS SA, 2013: iii). Gauteng province has the highest number of households that spend more than 20% of their income on electricity as a result of cold conditions (ibid: 96; Isover, 2012). The perception of the majority of households (70%) is that electricity tariffs are high and their coping mechanism has been to reduce their electricity consumption. According to Ruiters (2009: 256) government strategies (FBE and the installation of prepaid meters) are systematically geared towards suppressing electricity demand among low-income households thus forcing such households to rely on alternative energy sources. The impact of the increasing electricity tariffs has been an increase on the household's expenses to about 47%. Maravanyika (2014) suggest that the increasing electricity tariffs will likely lead to an increase in illegal connections among low-income urban households. Contrary to expectations within the energy ladder model (which assumes that as the income of a household increases they are more likely to completely switch to modern energy (Barnes et al. 2009)) – all household income groups generally use multiple energy sources to cope with escalating energy tariffs (Sovacool, 2012; 274: DoE, 2012: 19). The incidence of use of traditional biomass fuels to meet domestic energy needs is more likely to increase further among most households in South Africa if electricity tariffs continue to increase in the near future irrespective of the income status of the household (DoE, 2012). This supports Sovacool (2012) view that there are multiple reasons that lead to the choice of use of

traditional biomass fuels beyond the economic position of the household. As the survey highlights, high and middle income households will also resort to using traditional fuels even though not as intensively as the low-income households (DoE, 2012).

Increased reliance on traditional combustible fuels by poor households (especially in the urban informal sector) to meet their domestic energy needs is likely to adversely affect their health. Traditional biomass fuels are associated with respiratory health problems as a result of indoor air pollution arising from the associated open fire combustion technologies and appliances. Equally low income communities are more likely to experience outdoor air pollution because of the widespread use of polluting fuels among the households (Barnes et al. 2009: 7). The situation is far more critical in informal settlements because they remain largely without access to electricity and for those that have access, high electricity tariffs is a deterrent towards adequate consumption (Wolpe & Reddy, 2010; DoE, 2012, STATS SA, 2013). CESU (2011) suggest that the current value of FBAE is insufficient to meet the basic energy needs of these households (ibid: 6). Women are more likely to be affected by the reliance in traditional biomass fuels because they are responsible for energy intensive activities such as cooking in the home (UNDP, 2000; Bond, 2000; DoE, 2012; STATS SA, 2013). The increase in ALRI incidences will impact on the national health budget as more people seek treatment from health facilities. This chronically affects the economy through impacting negatively on productivity as more employees lose time due to ill health (Barnes et al. 2009).

The general consensus on both surveys is that FBE policy grant is insufficient to meet the domestic needs of the indigent households (DoE, 2012; STATS SA, 2013). The introduction of the inclining block tariff by the Department of Energy is an indication that there is a universal lack of consultation from government with communities on intervention policies (Sebitosi, 2008). The inclining block tariff further disadvantages low income communities because they usually live in large family sizes (CESU, 2011) with some of them as backyard dwellers (SALGA, 2013). Although they fall under the category of low income household they do not qualify for FBE due to their consumption being above the national minimum threshold of 450kWh per month (CESU, 2011; STATS SA, 2013). The policies need to take into consideration that these

interventions for mitigating energy poverty are inadequate and do not make significant contribution to improving quality of life of indigent households in communities (SALGA, 2013). The DoE (2012) needs to consider more affordable alternatives as more households are struggling with the current tariff levels of electricity service. Government needs to consider a more holistic approach that goes beyond just providing the subsidy to consider providing renewable energy technologies (CESU, 2011) which is validates the hypothesis. The majority of households prefer energy sources (such as solar, wind and hydro) that do not have detrimental effects on both individual health and the environment (DOE, 2012: 81).

4.5 Conclusion

Although the government has significantly improved access to electricity through the INEP policy the increase in electricity tariffs has escalated the prevalence of energy poverty in South Africa. Informal households are the most affected because they mostly do not have access to electricity and those who have access spend more than 20% of their income on alternative energy sources. Further increases in electricity tariffs are more likely to give rise to illegal connections and use of traditional biomass fuels. Traditional biomass fuels are generally used by households in developing countries. However, more indigent urban households rely on combustible fuels for most of their domestic energy needs which leads to increased exposure to indoor air pollution and energy related injuries. Government's energy poverty interventions have a two pronged approach – the grants (FBE and FBAE) provide much needed supplementation to poor households but the inclining block tariff tends to worsen energy poverty. The next chapter will focus on the experiences of energy poverty of a low income household based on an ethnographic study approach in order to better understand their coping mechanisms.

Chapter 5
The social context of energy poverty in low-income urban households

5.1 Introduction

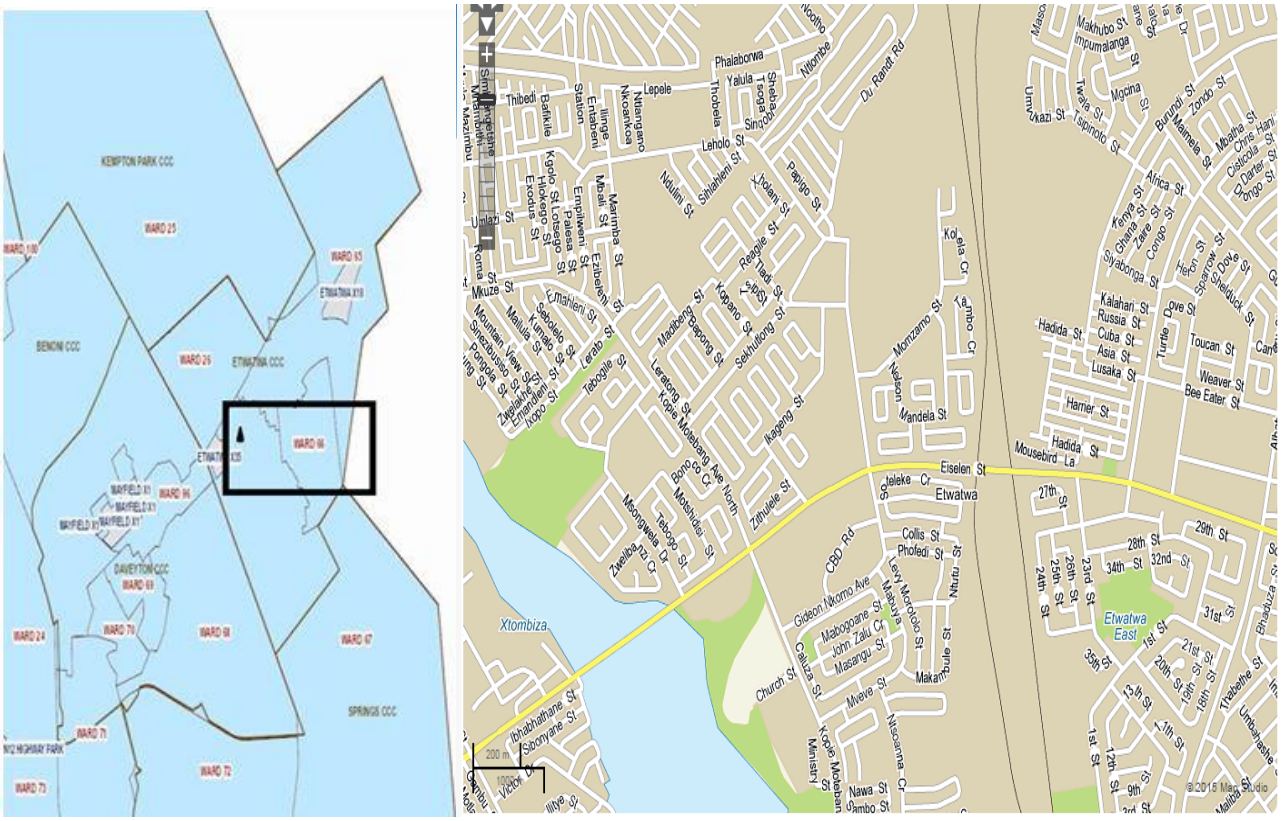
Primary data was collected through ethnographic methods at a low income household (the Msibi family) in Barcelona, Etwatwa. The researcher's role was that of a participant observer over a period of one week during the month of August 2014. This section describes Etwatwa which is part of the Ekurhuleni metropolitan municipality. Ekurhuleni is one of the municipalities in Gauteng province which has the highest number of households experiencing energy poverty in South Africa. The study has used pseudo names for the household to keep the identity of the family members anonymous. A detailed account of the energy related behaviours of the Msibi family is presented. An interpretation of the effects of energy poverty on the Msibi family are then analysed. Finally the chapter presents the key findings on the coping mechanisms of this low income household.

5.2 Setting of the ethnographic component of the study



Barcelona ▪

Figure 3: Map of Gauteng showing the 5 municipalities and the location of Barcelona in Ekurhuleni (Source: City of Johannesburg, 2010)


KEMPTON PARK CCC
WARD 25
WARD 65
ETWATWA X19
BENONI CCC
WARD 26
ETWATWA CCC
WARD 66
WARD 96
DAVEYTON CCC
WARD 69
WARD 24
WARD 70
WARD 68
WARD 67
SPRINGS CCC
WARD 71
WARD 72
WARD 73
Xtombiza
Etwatwa
Etwatwa East
Eiselen St
Mandela St
Monzanno St
Kalahari St
Hadida St
Harrier St
Mousebird La
Weaver St
Bee Eater St
Toucan St
Russia St
Cuba St
Asia St
Lusaka St
Kola Cr
Kambo Cr
Jeleke Cr
CBD Rd
Collis St
Phofedi St
Levy Mompodo St
Nturu St
Gideon Nkomo Ave
Maboopane St
John Zulu Cr
Masangu St
Church St
Caluza St
Mvelwe St
Makambule St
Ibhabhathane St
Sibonyane St
Nawa St
Zambo St
Ministry St
Nkosana Cr
Du Randt Rd
Phalaborwa
Yalula
Thobela
Lepele
Nkoankoa
Ntlangano
Thibedi
Bafikile
Kgolo St
Hlokego St
Exodus St
Lotsego St
Palesa St
Empilweni St
Ezibeleni St
Marimba St
Mbali St
Lehlohonolo St
Emmanuel St
Ikopo St
Mauluka St
Mountain View St
Zwelakhe St
Lerato St
Teboga St
Madibeng St
Bapong St
Kgosana St
Seakhutlong St
Reagile St
Tsepo St
Tladi St
Pepino St
Nduluni St
Sihlahleni St
Lekholi St
Thibedi St
Ntombe
Mkuze St
Roma St
Umlazi
Mbombela
Makhubo St
Impumalanga
Mgcina
Tsipinolo St
Twala St
Umzikazi St
Burundi St
Zondo St
Mamela St
Moatha St
Africa St
Kenya St
Ghana St
Zaire St
Congo St
Siyabonga St
Stonechat Dr
Shelduck St
Dove St
Crane St
Turtle St
Swe St
Zeleke Cr
Etwatwa
Eiselen St
27th St
28th St
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1st St
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18th St
35th St
13th St
7th St
12th St
9th St
Tlebelhe St
Bhaduza St
Umbahashe St
Malibia St
Mosongwela Cr
Zwelibanzi Cr
Bono Go Cr
Motshidisi St
Ntlogeng St
Kopole Motebang Ave North
Kopole Motebang
Zithulele St
Lekgotla St
Tsepo St
Ikopo St
Emmanuel St
Zwelakhe St
Mountain View St
Sinqobisile St
Pongola St
Mkuze St
Roma St
Umlazi
Mbombela
Ntombe
Phalaborwa
Yalula
Thobela
Lepele
Nkoankoa
Ntlangano
Thibedi
Bafikile
Kgolo St
Hlokego St
Exodus St
Lotsego St
Palesa St
Empilweni St
Ezibeleni St
Marimba St
Mbali St
Lehlohonolo St
Nduluni St
Sihlahleni St
Lekholi St
Pepino St
Tladi St
Tsepo St
Reagile St
Seakhutlong St
Kgosana St
Bapong St
Madibeng St
Lerato St
Teboga St
Lerato St
Kopole Motebang Ave North
Bono Go Cr
Motshidisi St
Mosongwela Cr
Zwelibanzi Cr
Zithulele St
Ntlogeng

5.2.1 Characteristics of household



Figure 5: House structure

The structure of the house is a “shack” that is found amongst RDP houses. The shack is made from corrugated iron and has a metal door as well as two windows. It is L-shaped and partitioned into two rooms; bedroom and the other room is multi-functional (used as the lounge, kitchen and sleeping area) within the same space. The floor area is made of concrete.



Figure 6: Ablution and water supply

The household has access to ablution and water facility from a detached structure within the yard. The bedroom is the coldest room during winter months because there is no window for solar radiation into the room during the day. When it rains, all the rooms have rain water leaking into the house. The household uses silicon to seal the leaks but it does not last long. There is only one electric light in the house primarily due to faulty electricity connections. The household has one power supply connection and they use multiple extension cords to link all the electric appliances and lights. The family pays monthly rent of R350 to the landlord who relocated to the Eastern Cape. The rental money is deposited into the landlord's bank account. When some maintenance is required they use the rent money and inform the landlord of the work done and the cost incurred. The household uses multiple energy sources such as electricity, coal, wood and paraffin to meet their energy needs. Coal, wood and paraffin are used to mitigate the escalating electricity cost.

5.2.2 Composition of household

The household consists of seven members. Thembeka* is the head of the household and a parent to four of the children and grandparent of one grandchild. The family lives with an extended family member who has her own child. Thembeka* is the only member of the household who is employed. She works as a domestic employee in Benoni Small Farms (Agricultural Holdings) and earns an income that falls under the low income earner category (under R3500 as determined by the Department of Human Settlements) (City of Cape Town, 2015). The children's ages range from 22 years old to 9 years old. The extended family member is 19 years old, unemployed and has a daughter who is 2 years old. At the time when the study was conducted the extended member was applying for a social grant for her daughter. The granddaughter is the youngest member of the family at 10 months old. There are three school going children in Grade 12, Grade 9 and Grade 3. They go to different schools - two of the children are in high school and one is in primary school. The reason the children in high school go to separate schools is that the younger daughter could not be accommodated in the same school as the other one. The 22-year old daughter does part-time domestic work for her mother's employer when extra work becomes available and thus complements the household's income.

5.2.3 Access to electricity



Figure 7: Electricity Access Point

The state power utility company Eskom supplies electricity to Etwatwa as it is an outlying area located along the Gauteng provincial boundary. CESU (2011) suggests that Eskom normally provides electricity to outlying and rural residential areas.



Figure 8: Prepaid meter

There is a prepaid meter located, outside on one of the walls of the house. The household purchases prepaid electricity units from local garages and supermarkets. On a daily basis the units were recorded at the same time after 24 hours to determine the value of the units used. Their average consumption per day is around 18 units. The total units consumed during the week of observation was 130kWh for 7-days. The cost of the units purchased was R131.37 based on the Eskom tariff structure (Eskom, 2014: 33).

5.3 Electricity consumption patterns

5.3.1 Energy related activities recorded

Table 2: Daily recording of kWh units used

Days of the week	**kWh units**	**Water heating**	**Cooking**	**Lighting**	**Entertainment**	**Other Activities**
Sunday	22.45	Bathing and making tea	Lunch and Supper	2 indoor lights	Television set	Washing and Ironing

Monday	19.46	Bathing and making tea	Supper	2 indoor lights	Television set	Ironing
Tuesday	16.46	Bathing and making tea	Supper	2 indoor lights	Television set	Microwave oven to warm food for a neighbour
Wednesday	17.29	Bathing and making tea	Supper	2 indoor lights	Television set	Ironing
Thursday	15.85	Bathing and making tea	Supper	2 indoor lights	Television set	Ironing
Friday	18.47	Bathing and making tea	Supper	2 indoor lights	Television set	Ironing
Saturday	20.19	Bathing and making tea	Supper	2 indoor lights	Television set	Ironing

Weekends have higher consumption than weekdays, with Sunday showing the highest consumption (22.45kWh) and Thursday showing the lowest (15.85kWh).

Electric appliances

Table 3: Electrical Appliances

Energy Activity	**Appliances**	**Durability**
Cooking	two plate stove and microwave oven	The two plate stove only lasts for 4 to 6 months. They buy a new one and not repair the broken one because their experience with repaired stoves is that they become inefficient as they trip the

		main switch.
Ironing	Electric iron	It lasts for about 6 months
Entertainment	television	The family has had it for 5 years
Washing	Twin tub washing machine	The washing machine was a second hand appliance bought from the employer 4 years ago and is likely to be inefficient.
Food storage	Fridge	The fridge is also a second hand inefficient appliance that was purchased from a second hand shop 8 years ago.

5.3.2 Daily log of energy related activities

Sunday

Water heating begins in the morning at around 7am for bathing water for the whole family. The family shares two plastic basins for bathing and so they can only bath two people at a time. The water heating takes longer because they use a two plate stove to heat the water. While they heat the water for bathing some of it is used to prepare tea that will be served with bread for breakfast at around 9 am. Thembeka* does the washing on Sunday for the whole family using the washing

machine (bought secondhand). The television is turned on from the time the first member is awake till the family retires at night. Today is the only day of the week were two meals are cooked. The difference is that they cook one vegetable and they are conscious that it is one that is quick to cook. The daughters take turns in cooking meals for the family. Preparation for lunch begins at 11 am. The meal prepared is chicken, beetroot and mealie meal porridge 'pap' (takes about 30 minutes to cook). The meat is stored in the fridge which runs for the whole day. As evening approaches and the temperatures drop the family prepares to start the fire in the coal stove. The coal is not enough for space heating so they add wood. The indoor lights are switched on from 5:30pm. Supper is cooked from 6pm (pap and wors). The wood does not last long and as it is about to run out Thembeka* adds an old running shoe to the fire. Although the coal stove has a chimney, the appliance is poorly maintained and there is smoke escaping to the rest of the house. The burning shoe causes a lot of indoor pollution. The family retires to sleep at 10 pm. Five of the family members sleep in the bedroom and two sleep in the lounge (on designated sleeping place). All the members of the household sleep on beds (two single bases and one double bed).



Figure 9: Coal stove

Monday

Thembeka* woke up at 5am to heat up bath water for household members going to work and school. Thembeka* is first to leave as her place of employment is not within the township but in

surrounding suburbs. The children iron their uniforms daily in the morning before going to school. Thereafter the electricity units were finished and the family spent most of the day hours without electricity as the child who knew were electricity vouchers were stored was at school. The children go to school without having breakfast due to financial constraints. During the day the paraffin stove was used to heat water for bathing for the members of the household who stay at home and for water to make tea. Electricity units were loaded at 3:30pm when the teen-child was back from school. There first meal of the day was in the afternoon which was tea, bread and butter sandwich. The units loaded were 546.90kWh. The television set was turned on until the family retired at 9:30pm. The oldest daughter started cooking from 4:40pm and finished at 8:30pm. The meat was stored in the fridge which runs for the whole day. Super was boiled chicken and pap. Tonight there was no space heating (although the temperatures were expected to drop to about 6° during the night) due to financial constraints which limits affordability for heating alternatives.

Tuesday

The parent wakes up at 5am to heat bath water for herself and the school going children. Once they have left the only appliance that stays operational the whole day and most of the evening is the television set. At 3pm, when the children are back from school tea water is heated to prepare lunch (bread and butter sandwich). Supper is prepared from 5:30pm to 6:30. The fridge runs the whole day but it is only the freezer compartment that gets used. The meal is pap and wors. The family continues to watch television for entertainment until 8:45pm. There is no space heating because there is not enough funds to purchase either wood or coal. The average temperature for today is 24° during the day-time and 13° night-time (AccuWeather, 2014).

Wednesday

The routine in the morning is the same as the other days with the parent waking up to prepare bath water. The television set was on from 8 am until evening. Lunch was prepared at 3:30pm and involves the heating of tea water using the paraffin stove. One of the extension cords is not working. Every second month the family has to replace extension cords as a result of overloaded single power

point. Today the researcher went with a family member to the place where they purchase coal. It is about 900 meters away from the home. On the way back (around 6:00pm) there is a lot of outdoor air pollution as more households use combustible fuels for space heating in the area. Although it is cold again today the financial constraints does not allow the family to do space heating. The average temperature for today is 24° day-time and 11° night-time (Accuweather, 2014). For supper one of the daughters cooked pap and wors (which is stored in the freezer that runs the whole day).

Thursday

Thembeka* discovered that it was the stove that was causing the electricity to trip not the extension cord. They used the flame stove to heat up bathing water in the morning. The flame stove is then put outside after use to avoid indoor air pollution. The same patterns occurred as the other days mentioned above. The television set was on from 7:30 am until 9pm in the evening. The fridge runs the whole day to store the meat. Supper was prepared from 5:30pm to 6:45pm (supper was chicken and pap). The average temperature reported is 22° day-time and 9° night-time (AccuWeather, 2014). Although the family complains about the cold but there is no money to purchase combustible fuel.

Friday

The same patterns were observed with regards to morning routine. The television set was on from 8am to 10pm because next-day is not a school day. The fridge ran the whole day. Tea water was heated at 2pm when the children came back from school. Lunch was tea and bread. Supper was cooked from 6pm to 7:30pm (chicken and pap). There was no space heating despite the temperatures being very low today (with an average of 16° day-time and 3° night-time) because of a lack of funds (AccuWeather, 2014). The family members are coping with the low temperatures by wearing more layers of clothing.

Saturdays

On Saturdays Thembeka* wakes up at 7am to heat water so she can go to work on a part-time domestic job (a different employer). The children wake up later after 8am and start to heat bathing water. Some of the water is used to make tea for breakfast. The family has cooked pap, egg and

mango archaar (store bought) for lunch. The television is their only source of entertainment during the day and is turned off at 11pm. The fridge runs the whole day and today the vegetables (lettuce and tomatoes) were stored in the fridge. Supper was prepared for a period of 1 hour (pap and wors). The low temperatures continue (with the same average temperature as recorded yesterday) and there is no space heating. Thembeka* advices members of the household to wear more warm clothes to cope with the cold.

5.4 Implications

The family relies more on electricity for cooking, water heating, lighting, entertainment (television), refrigeration and ironing. It was evident that Thembeka* was struggling to spare enough money for the electricity or combustible alternative fuel needed by the household. The reason is that she is the sole income earner in the family and has to take care of all the children and grandchildren's basic needs. Although her first-born daughter works on occasional domestic jobs opportunities are irregular and unpredictable. She is not receiving any social grants for any of the children because they do not have birth certificates or identity documents. According to Thembeka* the father refuses to cooperate in order to meet the Department of Home Affairs requirements for the documents. The couple is estranged but they were traditionally married and stayed together for 11 years. Without any other source of reliable income the family is mindful of their electricity consumption. The electric appliances are disconnected when not in use. However, given that most of the appliances are bought secondhand, they are also likely to be of earlier models which were energy inefficient compared to most of the modern models.

5.4.1 Food preparation

The past two years of escalations in electricity prices have led to the family changing their dietary habits. The family no longer buys food items that take long to cook such as tripe and sugar beans. Previously, cooking used to be done three times a day (breakfast, lunch and supper) but it has now been reduced to once a day - for supper only. The young grandchildren are given instant porridge for breakfast and lunch. The instant porridge requires boiled water to prepare but in certain instances when there was no electricity units the water was not boiled. The fridge is used to store raw meat and once it has run out – it is disconnected from power supply to save on electricity.

5.4.2 Lighting

The household uses incandescent lamps which are not energy efficient and candles when electricity supply is interrupted. Although Thembeka* is aware of the longevity of fluorescent lamps, their cost is a deterrent. The family received free fluorescent lamps during the national roll-out programme. Fluorescent lights are energy efficient as they use 80% less electricity and last longer than incandescent lamps. The family has reduced the number of lights that are used in the household. They no longer have outdoor lamps but rely on the municipal street lights nearby. The toilet is an outbuilding and does not have a light. The family uses cellphone light when using the facility during the night. Indoors they have further reduced the number of electrical lights to two. The quality of light is very poor in certain parts of the home (especially the bedroom) thus affecting ability to engage in activities such as reading and homework for children without straining one's eyes. The children prefer to do their homework when they come back from school so they can use daylight. Lights are switched off from rooms when they are unoccupied.

5.5 Effectiveness of Free Basic Electricity

The household does not receive the 100kWh units provided by Eskom in the area in the form of free basic electricity which meets the legislation of FBE of 2003 as the government's attempt to mitigate the costs of basic services in low income communities (Bond, 2000: 46; DME, 2003: 5). According to Thembeka* the head of the household, the 100 FBE units received monthly would offer much needed relieve in assisting her family to meet some of the basic electricity needs. But she concedes that for large family sizes such as hers the units would not be effective in making a significant improvement in their lives. Her household used an average of 130kWh units per week during the ethnographic study. In terms of the FBE policy they do not qualify because their usage is above 450kWh units per month. Using the weekly consumption as an estimate they use an average of 520kWh units per month. Thembeka* is of the opinion that government should increase the free units provided for low-income households. This will improve the quality of their life as the money saved from buying electricity can be used in meeting other needs such as improving the family diet.

5.6 Impacts on quality of life

Life has changed significantly in the last two years for the family as Thembeka* is no longer able to buy certain basics for the children such as clothes and quality nutrition foods and this has deepened their experiences of poverty. The school feeding scheme provides the children with a balanced diet which mitigates the effect of going to school without breakfast. The increase in electricity tariffs has led to price increases in other sectors such as food. In addition to her income as a domestic worker, she had other businesses that provided additional source of income (ice cream and baking). The increase in electricity prices has led to the loss of additional income of R240 per month as the businesses had to be abandoned because the energy cost meant the businesses ceased to be profitable.

Thembeka* has increased the number of jobs that she has in order to increase the households' disposable income. She is permanently employed as a domestic worker and office cleaner for her employer who runs a business from home. During the week she also cleans a cottage within the employers' property during her lunch hour for extra income and on Saturdays she has a part-time cleaning job at a flat in Johannesburg city. As the guardian spends less time at home, family cohesion is compromised. This has caused her to harbor feelings of guilt for spending excessive time away from the family. The children have adapted to being less dependent on Thembeka* for child care and nurturing as the guardian spends more time away from home and other family members. Even with the above mentioned efforts to increase the household income the family's circumstances are not improving. Instead there has been an increase in the number of incidences that the family has had to go to bed on an empty stomach due to the practice of load shedding. In certain instances during load shedding the family cannot afford to buy alternative food (takeaway, bread and others) or alternative energy sources for cooking.

5.7 Alternative energy sources

5.7.1 Energy sources and access

The family uses multiple energy sources to cope with the rising energy costs. The household's energy mix for domestic needs is electricity, coal, paraffin and wood. Coal and wood is mostly used for space heating especially during winter months.

5.7.2 Coal and wood

There are small scale vendors who trade in coal and wood within the community. My observation is that most vendors do not sell multiple energy sources. Each vendor focuses on providing one energy type. Coal and wood pallets sellers are usually family run businesses running from the yards of the seller's primary place of dwelling. The choice of coal vendor for Thembeka's* household is a woman who has improved her business to provide a better service. The vendor's competitive advantage is that customers can phone in with their orders and her sons deliver the coal using the wheelbarrow.

The customers are able to purchase through two payment methods – cash on delivery or on credit. The coal is procured from Emalahleni (Witbank) and delivered to the vendor by truck. The quantity she orders is based on funds she has available at the time of placing the order – half or full truck. The woman concedes that just like in any other business there are risks involved in allowing credit but mostly people do end-up settling their debts. The vendor does not package the coal but uses 20 liter buckets to measure the quantity. There are two prices - 20 liter container worth of coal is sold at R30.00 and 60 liter is sold at R75. According to the vendor the coal business is profitable during winter months particularly between June and July. Therefore, like many other vendors in the area, she concentrates on other businesses like selling vegetables during summer month (August to May). However, if there is demand during summer months due to extreme cold weather conditions – she does make an exception to meet the demand.

The wood pallets vending business has competition in the community. However unlike the choice for coal vendor that is based on good service, the choice for wood pallets vendor is based on close proximity. The wood pallets are procured from wood factories in the East Rand and the vendor uses his own van to transport the wood pallets to his residential premises which is also the place of

business. The wood pallets vendor is a man who also uses the bucket system to measure the quantity of pallets. The pallets are sold in 5 liter buckets for R7 and it is a cash business. Given that the vendor does not deliver the family needs to collect the pallets. The business is operational throughout the year but demand is low during summer months.

5.7.3 Paraffin

Paraffin is used for cooking as an alternative to electricity during to load shedding or no money to buy electricity units. Paraffin vendors are usually owners of - 'spaza shops'- who are mostly foreigners and a few local vendors. The vendors use 1 liter bottles to measure the quantity but customers must bring their own containers. The cost of paraffin is R12 per liter. The shop owners run a cash business and do not allow credit. The vendors do not want to share information on where they procure the paraffin. Their business is also operational throughout the year. The family's choice of paraffin vendor is also based on proximity to the house.

5.7.4 Adequacy of alternative energy sources

The above mentioned alternative energy sources used by the household are suitable in meeting their intended functions. Coal and wood pallets improve the thermal comfort levels of the 'shack' during winter months and on extremely cold weather in summer months. The disadvantage as mentioned by Thembeka* is that coal produces more fumes than pallets but she is compelled to overlook the negative impacts as her main concern is keeping her family warm and coal has a longer burning time compared to pallets. However, most of the heat is lost due to the poorly constructed house structure.



Figure 10: Poorly installed door

Paraffin also assists the family in cooking and water heating when the electrical stove malfunctions or during load shedding as well as when there is insufficient electricity units. However, the family is not very keen on using paraffin because they are concerned that “their clothes would smell of paraffin”.

The use of alternative energy sources is not sustainable for the family because of the burden of costs that these sources place on the family. The family purchases 60 liters worth of coal for the value of R75 which lasts a period of approximately 6 days. During cold winter months such as June, the family would have to pay R375 for coal to maintain internal thermal comfort. According to Thembeka* they use up to one 5litre bucket of wood pallets which is worth R7 in 2 days. Thus they would require R105 to purchase wood pallets for the whole month. Whilst 1 liter of paraffin at a price of R12 takes the family through 3 days, they would need approximately R108 to procure a month’s supply.

5.7.5 Implications

Thembeka* explains that she is unable to afford to purchase a month’s supply of any alternative source. There have been days when the household has had to endure cold winter nights and going to bed hungry because there is no money to purchase any form of alternative source of energy.

During one of the days, the household was observed burning a running shoe in order to keep warm. Thembeka* explained that it was an old pair of running shoe and that the rubber on the outsole burns longer. She also explained that they do burn other forms of old shoes as well. The process releases toxic gases which could be harmful to the health of the family members in the long run (EPA, 2011: 1). In addition to the harmful toxins the family is exposed to indoor and outdoor air pollution through their reliance on coal and wood pallets (which is a characteristic of most low-income communities such as in Etwatwa). Exposure to these pollutants has led to an increase in lower respiratory infections. The two youngest members of the family are the most affected by ALRI as they have each had four visit to the clinic already with symptoms of common cold and excessive coughing.

5.8 Analysis and Interpretations

The policy instruments (INEP and FBE) implemented by government in order to reduce energy poverty for poor households have had a marginal effect in the last 2 years. Due to the increases in commodity prices and infrastructure development needs, electricity prices have escalated yearly by about 25% over the last few years (Stephan & Bridgman, 2012; Ashton, 2014; Fin24, 2014; Thopil & Pouris 2013:1). Escalating energy costs have increased the burden on the household income of the Msibi family in the past two years. UNDP (2000: 45) argues that access to electricity is not enough to mitigate energy poverty for the poor especially where costs of the energy-service is unaffordable for the poor households. Evidence from the ethnographic data corresponds with the current arguments that although FBE has been a necessary social benefit for the poor, its allocation has been insufficient to make a significant impact to the quality of lives of low-income households (CESU, 2011; Wolpe and Reddy, 2010; SALGA, 2013). Although the Msibi family is a low income household it does not qualify for FBE due to electricity consumption that is above the national benchmark which was set well before the tariff escalations since 2008.

Low-income households are struggling with the current high electricity tariffs which make it difficult for them to use electricity service to meet their basic domestic energy needs (UNDP, 2000). The Msibi family has adopted various energy saving behaviour such as reducing the number of household lights, unplug appliances when not in use and changing their diet to fast cooking food to

mitigate high electricity prices. Despite the above measures, the incidence of basic household energy needs (such as cooking and space heating) not being met has increased for the Msibi family due to a weakening of affordability. Escalating energy costs pose a structural challenge that exacerbates the experiences of poverty especially among low-income urban households (Wratten, 1995; Sovacool, 2012). Low-income households in urban areas are further disadvantaged because they do not have access to alternative free solid fuels such as cow dung and wood (Barnes et al. 2009; STATS SA, 2013). The above structural challenges have led to the increase in the use of pollutant energy sources among such households in meeting some of their domestic energy needs (UNDP, 2000) which in turn renders them susceptible to respiratory health risk (Barnes et al, 2009).

5.9 Conclusion

It can therefore be argued that the coping strategies by low-income households such as the Msibi family are unsustainable and need to be systematically mitigated to ensure the transition towards inclusive sustainable cities nationally and globally. The qualifying benchmark of 450kWh per month for FBE grant prevents urban low-income households such as the Msibi family from receiving much needed relief. The quality of life has deteriorated over the last two years despite Thembeka's efforts to increase the households' disposable income. The poorly constructed house structure increases the burden for thermal comfort which leads to an increase in lower respiratory infections that are linked with exposure to combustible energy sources and their related toxins. The family is adversely affected by energy poverty as is the case with many other low income households. The next chapter focuses on the key findings of the study in response to the research questions.

Chapter 6
Overall Findings and Conclusions

6.1 Consolidation of background

Urban poverty has unique challenges that make the urban poor vulnerable to economic shocks. These are compounded by the legacies of SAP's and apartheid in South Africa. SAP led to the commodification of state functions which means that the citizenry has to pay for basic services (Hart, 2010). The urban poor are the most affected as a result of a shrinking employment market due to widespread retrenchments in the aftermath of the 2007/8 financial crisis (Stephan & Bridgman, 2012; Sebitosi, 2008; Ashton, 2014). Apartheid legacy created an environment where the majority of the poor are black and living in the periphery of most South African cities (Wratten, 1995; Andreasson, 2011). These areas are characterized by minimum or lack of services (informal settlements) such as access to electricity and sanitation (Wolpe & Reddy, 2010). In accordance with the constitution, government has initiated various interventions to provide equal access to all citizens.

The 2008 electricity crisis in South Africa further deepened energy poverty as more urban households resort to using energy mix to cope with the increasing energy costs (UNDP, 2000; Sovacool, 2012; DoE, 2012; STATS SA, 2013). Government implemented various policies in the form of grants and improving access to electricity to mitigate energy poverty (DME, 2003; 2004; 2007). These interventions have not been sufficient in mitigating energy poverty as has been highlighted in this study. Secondary data presented in the study, provides information on the strategies that low-income urban households employ to mitigate energy poverty and primary data provides information on the ineffectiveness of the coping mechanisms employed(DoE, 2012; STATS SA, 2013). The aim of the study was to contextualize the coping strategies and their effects. The next section will discuss the framework used to consolidate the secondary and primary data analyses and findings.

6.2 Overall framework of the integration and comparison

The survey research data used was from Department of Energy (2012) and Statistics South Africa (2013) which primarily focuses on energy related behaviours with regard to energy poverty and the perceptions of the quality of electricity service. According to the survey data low-income urban households are relying on energy mix as a coping mechanism. The study used other sources such as books, journals, policy documents and newspaper articles which assisted in substantiating the research hypothesis. Primary data was collected through ethnographic and participant observation from the selected household (Msibi Family) in Barcelona, Etwatwa. The study used survey data to systematically complement ethnographic data to capture the effects of escalating energy prices on urban low-income households and their coping mechanisms. The evidence from this study suggests that low-income households are not coping with escalating energy costs as their basic energy needs are not being met. The data sources (primary and secondary) concur that energy poverty mitigating policies are too limited to make a difference in the quality of life of the affected households.

6.2.1 Key themes of the comparison and integration

The key themes (escalating energy cost, coping mechanisms, and indigent households) used in the comparison of the secondary and primary data were informed by the recorded and observed energy related behaviours. The study focused on the energy related behaviours of cooking, lighting and space heating. The effects of the behaviours on the host household are discussed in the next section. The analysis uncovers the ineffectiveness of the energy poverty mitigating policies such as the FBE and FBAE. The study goes on to further assess the adequacy of the alternative energy sources (wood, coal and paraffin). Finally the implications (in relation to nutrition, health and education) of the unmet basic energy needs of the household are discussed.

6.3 Analysis and Interpretations

Most households in Gauteng spend between 10 - 20% of their income on energy sources and perceive the price of electricity to be high (STATS SA, 2013). The poor are struggling with the current high electricity prices that make it difficult for them to use the service to meet their basic domestic energy needs (UNDP, 2000). The policy instruments (FBE and FBAE) implemented by government in

order to mitigate energy poverty for poor households have had a marginal effect in the last 2 years (DME, 2003; DME, 2007). The policy's application varies across the municipalities with the grant ranging between 50kWh to 100kWh (DoE, 2012; CESU, 2011). According to Thembeka* Ekurhuleni municipality grants 100kWh free units but because of her large family size their electricity consumption is above the minimum qualifying criteria of 450kWh (DoE, 2012; STATS SA, 2013). Although her family is a low-income household it does not receive any intervention from government due to its high consumption. They would also not qualify for FBAE because they are already connected to the grid (DME, 2007). As argued by CESU (2011) most municipalities struggle with securing the funds to implement the FBAE policy which adversely affects low-income urban households in unserviced informal settlements.

The FBE policy is about 12 years and FBAE policy is approximately 8 years into implementation. At the time of their conception electricity was still relatively cheap because it was sold to consumers below costs (Barnes et al. 2009; Thopil & Pouris, 2013). But in the years following the global financial crisis and excess demand (depletion of excess capacity), electricity tariffs in South Africa have escalated to a level of being unaffordable to low-income households (Stephan & Bridgman, 2012; Sebitosi, 2008). The quality of life has deteriorated in Msibi family as various coping mechanism adopted to save electricity and use solid fuel for space heating (coal and wood) have led to them falling into indigence. The grants under both policies are unresponsive towards meeting the basic energy needs of low-income urban households which thus render them indigent in view of the unstable and declining income. This has led to an increase in the use of combustible solid fuels which are associated with health risks such as ARLI and indoor (as well as outdoor) pollution risks (DoE, 2012; STATS SA, 2013; CESU, 2011; Wolpe and Reddy, 2010; SALGA, 2013). The youngest members of the Msibi household are more susceptible to lower respiratory infections (Barnes et. al. 2009)

STATS SA (2013) suggests that households who do not qualify for FBE are most likely to use combustible biomass fuels for energy intensive activities such as cooking and space heating but as observed in the Msibi family alternative sources of energy are mostly used for space heating. Electricity is their main source of energy for cooking, water heating, refrigeration, ironing, washing

and entertainment. The use of paraffin for cooking occurs when the electricity service is interrupted either for load shedding and when they run out of prepaid electricity. The preferred alternative energy for space heating is coal and wood. In addition the household has even resorted to the practice of burning clothing items such as used-up shoes for space heating.

Ruiters (2009) argues that the poor are supplied with poor quality electricity which leads to them having to replace most of their appliances. Thembeka* has to replace most of her essential appliances quite often as they end up not functional which is different from the experiences of high income households who are satisfied with the quality of electricity they receive. The current interventions by government (poor electricity quality and minimal grants) suggest that demand for electricity among low-income urban households is controlled (DME, 2003; 2007; Ruiters, 2009). There are claims that the use of technology such as the prepaid meter is meant to maintain the current energy levels of energy poverty for the poor who are already excluded from other municipal services based on their place of residence (Ruiters, 2009). Low-income urban informal settlements are perceived by the state as mainly illegal settlements and have consistently been secluded from service delivery (CESU, 2011; SALGA, 2013). According to DoE survey (2012) government has made significant efforts to increase access to electricity for previously disadvantaged groups. Thembeka* is one of the households that have benefited from INEP but the UNDP (2000: 45) argues that access to electricity is not enough to mitigate energy poverty for the poor especially if related appliances and the service cost becomes unaffordable. Therefore, other factors such as affordability and adequacy need to be taken into consideration when mitigating energy poverty in low-income communities (Sovacool, 2012).

6.3.1 Research questions

In response to the primary research question, energy costs have increased more than twice the normal inflation rate and therefore can be seen as escalating and unexpected. Escalation has led to an increase in the households' reliance on alternative energy sources to meet some of their domestic energy needs. Low-income urban households are not coping as most of their basic energy needs are not systematically met in a secure, safe and reliable manner. The past two to three years

have seen the household regressing from poverty to indigence primarily due to energy poverty even as nominal income levels increase.

The study will respond to the three related secondary research questions. How are low income households in South African urban areas coping with rising energy costs and the deepening of energy poverty? Urban low-income households have adopted two strategies in attempting to cope with the rising energy costs. The initial strategy has been to reduce consumption of energy by adopting various energy savings techniques. The Msibi family reduced the number of household lights, changed their diet to food that can be cooked faster and unplug appliances when not in use. In addition, they rely on other sources of energy for space heating (which is important for the household taking into account the state of house structure) as well as cooking. However the measures have not been successful in improving the quality of life of the family.

What has been the effectiveness of FBE and FBAE as interventions to mitigate energy poverty? The study finds that the energy poverty interventions (FBE and FBAE) grants are not sufficient to meet the basic energy needs of low income urban households (DoE, 2012; CESU, 2011; Wolpe and Reddy, 2010; SALGA, 2013). They are too limited to make a significant difference in the lives of such households. The FBE policy does not accommodate large family sizes such as in the case of the Msibi family which is generally the case in low-income urban townships (CESU, 2011; SALGA, 2013). Similarly, the FBAE policy excludes such families altogether on the very basis of its ability to access electricity which has been proved to be inadequate (DME, 2007). This situation perpetuates energy poverty for low-income households such as the Msibi's.

What does this tell us about the "energy ladder model" of understanding energy transformations especially within communities in developing countries? Access to electricity is not the only determining factor when it comes to the choice of energy source. The driving factor for uptake of resources is affordability by the household. Urban low income households continue to rely on biomass fuels for energy intensive activities despite access to electricity. According to the STATS SA middle and high income households in urban areas also use multiple energy sources such as solid and transitional fuels (STATS SA, 2013). This is contrary to the energy ladder model that assumes that as the income of a household increases they are more likely to completely switch to modern

energy (Barnes et al. 2009) – all household income groups generally use multiple energy sources to cope with energy prices (Sovacool, 2012; 274: DoE, 2012: 19). The incidence of the use of traditional biomass fuels to meet domestic energy needs is more likely to increase further among households if electricity tariffs continue to increase as expected in the foreseeable future (Sovacool, 2012; STATS SA, 2013). Sovacool (ibid: 272) criticizes both the concepts of "energy ladder" and "energy equity" because they fail to account for middle to high income household's usage of combustible energy sources and the assumption that individuals seek to move up the ladder to exclusively consume clean energy.

6.4 Key findings

6.4.1 Escalating energy cost

South Africa's energy costs have been escalating since 2008. The study has demonstrated that the continued rise of energy costs has made energy unaffordable for most low-income urban households. These households are more vulnerable to the markets because unlike rural areas, they do not have access to biomass energy sources such as crop residue and cow dung. The increases have been generally more than two times the inflation rate. Future expectations are that the energy costs will continue to escalate as government attempts to improve supply through various strategies that include power station constructions and other sources of energy. Suppressing demand has been the response adopted by government as they struggle with matching supply to demand. NERSA through the Multi Year Price Determination (MYPD) process takes into consideration inputs from various stakeholders such as industry, civil society, trade unions and others. The early success of INEP led to an increase in electricity demand while the tariffs remained at 15% below costs. Therefore the power utility needs to deal with a historical backlog of generation capacity expansion and maintenance of infrastructure which leads to the escalation in electricity tariffs.

6.4.2 Coping mechanisms

The study has demonstrated through ethnography that low-income urban households with access to electricity responded by systematically applying various coping mechanisms. These mechanisms were mainly centered on reducing electricity consumption by increasing the use of combustible

fuels such as wood, coal and paraffin. The study argues that coping means that households are able to have their energy needs met through the use of multiple energy mix. The choice of using combustible fuels intensified the exposure of low-income urban households to various risks such as health (ALRI), fire and poisoning. The main aim of adopting the coping mechanism was to survive energy poverty. However the persistent escalating energy costs lead to the quality of life deteriorating even further as low-income urban households well-being was rapidly undermined. The secondary data (DoE, 2012; STATS SA, 2013) discussed in the study assumes that the households are coping through the use of paraffin for cooking and wood as well as coal for space heating. In addition it highlighted that FBE policy has assisted in enabling some of the domestic energy needs to be met. But the study has highlighted that the households are not coping especially because the cost of the alternatives adopted have escalated as well.

6.4.3 Indigent households

Low-income urban households have been trying to cope with the escalating energy costs for the past 5 years (since 2008). The unexpected increases have contributed to domestic energy needs not being met. The households no longer afford to provide energy that will cater for a month's supply of their energy needs. Thus energy poverty has deepened to a level of indigence which threatens their survival. Therefore such households can no longer afford to use energy mix as a coping strategy. They cannot afford to purchase enough electricity units for lighting, cooking and entertainment. Paraffin as an alternative energy source for cooking is no longer affordable. Therefore when the electricity units are used-up or during the practice of load shedding indigent households go without cooked meals and in certain instances have to skip meals due to energy shortfall.

6.5 Overall findings and conclusion

The use of alternative energy is a key coping mechanism for the Msibi household but the DoE (2012) surveys also highlight that other income groups also rely on multiple energy use which contradicts the energy ladder model that assumes a linear movement to modern fuel when household income increases (Sovacool, 2012; STATS SA, 2013). The above challenges have led to the increase in the use of polluting energy sources among the poor to meet some of their domestic needs (UNDP, 2000) which renders them susceptible to health risks (Barnes et al, 2009; DME, 2004). The youngest

members of the Msibi family are the most vulnerable and are now showing symptoms of ALRI. The Msibi household is indigent because Thembeka* can no longer afford the energy mix that the household used to initially mitigate energy poverty. This is despite the financial position of the family improving through the additional jobs that Thembeka* has taken. The benefits of increased income are eroded by the escalating energy costs. In addition there is the burden of replacing small appliances such as the two plate stove, iron, kettle and power extension cables quarterly as a result of the poor quality of the electricity service that is received by the household.

Escalating energy prices are a structural challenge that worsens the experiences of poverty among the poor urban households (Wratten, 1995; Sovacool, 2012). The quality of life of the household has been adversely impacted. The related effects of energy poverty have affected the household income, nutrition, education and family cohesion. The guardian is forced to spend more time in income generating activities and less time with the family and she has had to stop her other business activities because they become unprofitable following the escalation in electricity tariffs that led to increases in other sectors (such as food) of the economy (Sovacool, 2012). The nutritional changes related to energy poverty include not being able to purchase nutritious food such as vegetables, preparing fast cooking foods to preserve energy and the children going to school without having had breakfast. The schools feeding scheme therefore contributes significantly to the diet of the children and is therefore important for their ability to perform at school.

Contrary to the findings from the secondary data, Thembeka* is aware of most of the energy saving measures and has applied them stringently which has led to deepened experiences of poverty for the family - hence the experience of suppressed demand (UNDP, 2000: 40). The poor indoor night light affects the studying patterns of the children (which now has to be done mostly during the day). Although a majority of households are opposed to illegal electricity connections (STATS SA, 2013; DoE, 2012) but future increases in electricity tariffs are more likely to trap households into illegal electricity connections and illicit trade in stolen electricity units (prepaid meter) which is reported to be on the increase among low-income communities (Maravanyika, 2014). However residential electricity theft is not as prevalent as that perpetuated by industries (Slabbert, 2014). Therefore as depicted below for indigent households the escalating energy costs perpetuate a vicious energy poverty cascade.

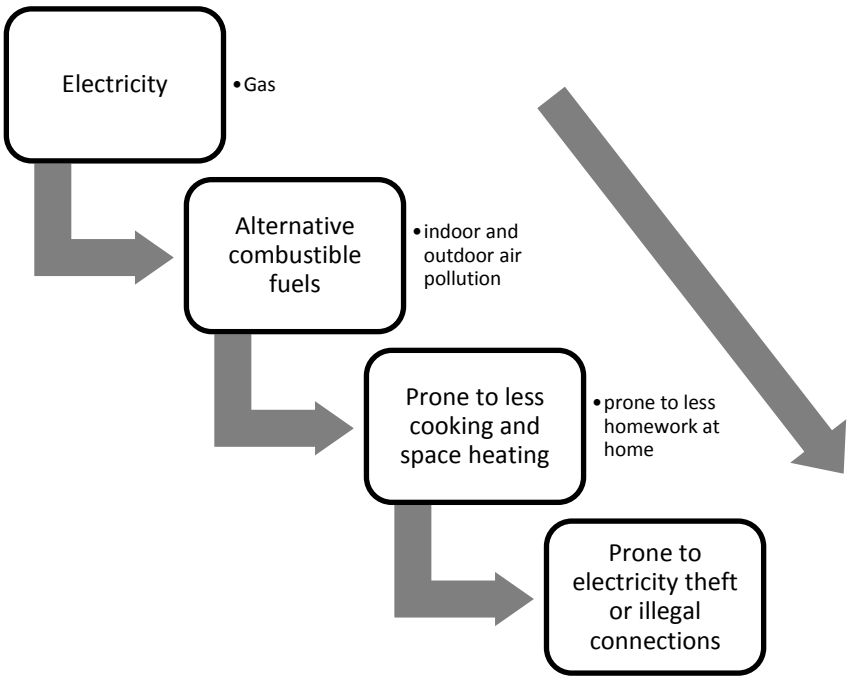

Figure 11: The vicious energy poverty cascade as conceptualised from the study findings.

6.6 Recommendations

Based on the above findings the DoE needs to consider affordable alternative sources of energy as more low income urban households are struggling with the ongoing escalation of electricity tariffs. The department needs to consider renewable energy sources such as solar, wind and water as a better strategy than grants for low income urban households – with or without access to electricity. Households that do not qualify for FBE but are energy poor should be accommodated on FBAE through the distribution of renewable energy technology to alleviate energy poverty. This supports the research hypothesis that - Free Basic Alternative Energy should be a long-term goal by incorporating the distribution of renewable energy technology which is sustainable and cost efficient. The majority of households prefer energy sources that do not have detrimental effects on both individual health and the environment such as; solar, wind and water (DoE, 2012: 81). Since indigent urban households are more likely to stop paying for electricity service renewable energy distributed by municipalities would prevent the loss of revenue as a result of illegal connections and electricity theft. Finally, it is important to highlight that this was an exploratory study and that one family's experiences of energy poverty do not represent the wider segment of low income

households. Further research with a larger sample size is recommended to capture differences in coping mechanisms among indigent urban households.

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