A thesis presented to the Energy Research Centre: Department of Mechanical Engineering in Partial Fulfilment of the Requirement for the Master of Philosophy in Energy and Development Studies.

AN EXPLORATORY STUDY INTO ENERGY CONSUMPTION ACTIVITIES, ENERGY-SAVING ACTIVITIES, AND THE FACTORS THAT INFLUENCE ENERGY SAVING AMONG GRADE 7 CHILDREN IN KHAYELITSHA, CAPE TOWN.

by

SHANON LUSINGA (LSNSHA001)

SUPERVISOR: DR JISKA DE GROOT

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Abstract

Energy is the engine that drives most human activity and is it very important today in the context of global warming and the high cost of energy. Yet there is limited research focusing on children's energy use in developing countries, including the ways in which they use energy, save energy and the factors that influence such activities. This is a serious deficit in energy literature and problematic because in the near future, today's children will make decisions about energy systems and climate change. This study gained insight into the ways in which Grade 7 children in Khayelitsha, Cape Town, use and save energy, and the factors that influence their energy saving. The study adopted a case study design, and mixed-methods approaches were used, including surveys, energy diaries, an interview and a focus group. The results show that children in Khayelitsha demonstrated a broad understanding of the concept of energy including topics on the environment, basis of life and thermal energy. The children displayed understanding of broader socio-economic, environmental and health issues as they were cognisant of national and community issues, such as limited energy access and the dangers of indoor use of coal. They had lower scores on more abstract and technical topics such as energy transitions and differentiating between renewable and non-renewable sources on energy. 86% of the children in this study acknowledged the importance of saving energy, while more than 50% failed to recognise the importance of caring for the environment and moving away from fossil fuels.

The study results show that children use multiple sources of energy at home and that the majority of their energy activities were performed at home, followed by school and church. The children reported several energy consumption activities including cooking for others, using the kettle for bathwater and ironing their clothes – findings contrary to activities reported by children in developed countries. For some of the children, the results suggest that energy use may be accompanied by guilt as children want to reduce financial pressures at home, a finding consistent with existing literature. Energy-saving activities included switching off and removing appliances from the wall plug. Children were found to be motivated to save energy by several factors, of which financial considerations were the most dominant. The children demonstrate altruistic tendencies, as motivation to save energy seems to be influenced by the desire to help their families and communities. The study further identified that parents, the community, the school, peers and the relationship between the school and government departments had either a direct or an indirect influence on children. Parents with a positive attitude towards energy saving and the environment were more likely

to talk to their children about energy saving, which tended to focus on related financial issues. A conceptual framework is presented to analyse the data, which incorporates existing psychological and sociological frameworks and theories used to explain energy behaviour in addition to theories on child development.

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List of Acronyms

BEST: Bio-Ecological Systems Theory

ECF: Energy Cultures Framework

MPEB: Model of Pro-Environmental Behaviour

TPB: Theory of Planned Behaviour

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1 Introduction

A key challenge that governments and people around the world face concerns energy, including the continued use of fossil fuels, the need to adopt low energy-intensive lifestyles, limited access to clean energy in some parts of the world, and the promotion of renewable energy resources (Aguirre-Bielschowsky, 2014, United Nations International Children's Emergency Fund [UNICEF], 2015). These issues pose a threat to children and their quality of life, both in the short and long term. Yet, we currently have limited understanding of how children understand the concept of energy, the ways in which they use and save energy and the factors that influence their energy saving. This study contributes to filling this gap in energy literature by investigating these issues with children in Khayelitsha, Cape Town, South Africa. This chapter describes the research problem and the significance of this study in section 1.1. Section 1.2 then presents the research topic and the research questions. Finally, section 1.3 outlines the structure of the thesis paper.

1.1 Background and statement of the research problem

Energy is essential for most of our daily activities, whether we be at "work or at home, in schools or in hospitals, in the manufacturing or in the services sector" (Federal Ministry for Economic Cooperation and Development [BMZ], 2014:3). We depend on it for the fulfilment of personal, economic and social purposes (UNICEF, 2015), such as lighting, heating, cooking, cooling, heating, operating machines and transporting people and goods (BMZ, 2014). Access to energy has been linked to economic growth, poverty reduction, social development and improved child development (UNICEF, 2015) and it is expected that by 2040 energy consumption by economies in Africa, the Middle East, India, China, and Southeast Asia will increase worldwide energy use by one-third (International Energy Agency [OECD/IEA], 2015). However, the world's dependence on fossil fuels to power energy systems has contributed to climate change[1] (Intergovernmental Panel on Climate Change [IPCC], 2007: 2). Evidence of this has been observed in both natural and human systems (Pachauri et al., 2014). Climate change has been linked to weather irregularities and

[1] "The evidence for human influence on the climate system has grown since the IPCC Fourth Assessment Report (AR4). It is extremely likely that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forcings together" (Pachauri et al., 2014: 5).

to changes in: rainfall patterns; quality and quantity of water resources; migration patterns of marine and freshwater species; crop yields and other food systems. Developing countries and poor people in all countries are particularly at risk to the impacts of climate change and children are recognised as largely the most vulnerable population (UNICEF, 2013, 2015). Therefore, climate change can be considered the most important "societal challenge to the future of today's children" (Boudet et al., 2014: 439; Aguirre-Bielschowsky et al., 2015).

Given the complex interrelated nature of energy and the environment, also called the energy-environment nexus, education is seen to be an important element in helping people understand these systems and the impact of human behaviour on these systems (Ntona, Arabatzis, & Kyriakopoulos, 2015). Mitigating climate change will require global economies, including South Africa, to become less carbon-intensive (Department of Environmental Affairs [DEA], 2011), and to ensure that individuals, including adults and children, make decisions about their transport use, electricity use and food consumption that promote sustainability (Dietz et al., 2009; Boudet et al., 2014). Effective implementation of such mitigation goals necessitates that everyone first understands current energy behaviour and its drivers (Boudet et al., 2014). Although studies into residential energy behaviour have been carried out, most of these have focused on homeowners or bill payers (adults) and rarely on children (Toth et al., 2013; Fell & Chiu, 2014). Of the few studies that have included children in their samples, the findings have yielded limited understanding because parents speak on behalf of children and the child's voice is usually unheard (Boudet et al., 2014). Unlike research with adults, studies investigating children's energy behaviour generally focus on children's actions when they use and save energy rather than purchasing and installing energy technologies (Garabuau-Moussaoui, 2011; Aguirre-Bielschowsky, 2014).

Considering that access to energy assists and contributes to the development of children and that children will have to deal with the negative impacts of climate change, generally limited understanding of children's energy use, attitudes and behaviours is problematic and indicates a major deficit in energy literature (Boudet et al., 2014; Fell & Chiu, 2014). While there is a body of literature devoted to children and energy-related issues, most of these studies tend to focus on 'energy education and learning' (Fell & Chiu, 2014: 352) or the impact of limited energy access on children[2] (UNICEF: 2015: 10). Children's energy knowledge, attitudes and

[2] Some studies on energy poverty have investigated the impact that energy access has on children's health, education and wellbeing (UNICEF, 2010: 15) while educational studies have explored methods of knowledge

behaviour (energy literacy) has recently emerged as a topic (Aguirre-Bielschowsky et al., 2015) comparable to environmental literacy (DeWaters & Powers, 2008). However, most of these studies have taken a quantitative approach, focusing on high school children with few exploring such issues with primary school children and using qualitative methods (Aguirre-Bielschowsky, 2014; Aguirre-Bielschowsky et al., 2015). Examples of these studies and their methodologies are discussed in Chapter 2. This thesis fills a gap by exploring the energy behaviours of primary school children using both qualitative and quantitative methods. A developmental approach is taken to understanding energy behaviour; this allows the inclusion of both environmental and educational/pedagogy perspectives.

Another important gap in the energy literature is that many of the studies on children and energy have been conducted in developed countries, which limits the transferability of insights from these studies to developing countries. According to UNICEF (2015: 20), the challenge in developing countries is not only the lack of academic research but the unavailability of "any information of children's participation in the energy sector". Children are often excluded from research even though they are a significant group of energy users (Fell & Chiu, 2014). For instance, the Department of Energy (DoE) in South Africa published reports on residential energy-related behaviours and perceptions in 2012 and 2013 focusing only on persons aged 16 to 70+ (DoE, 2012, 2013). As a result, we have limited insight into the energy-related behaviours and perceptions of persons below the age of 16 and what interventions are necessary to promote sustainable energy behaviours. Thus, by improving our knowledge and understanding of children's energy-saving behaviours and related behaviour correlates, stakeholders in the energy sector such as policy makers, utilities, non-governmental organisations (NGOs) and programme developers, will be better positioned to plan and coordinate educational information and behavioural change efforts (Boudet et al., 2014) based on context-specific information.

In this study, South Africa was selected as the country of investigation because of its complicated context. This country has an energy-intensive economy based primarily on coal and is a significant contributor to global carbon emissions, yet it also faces overwhelming developmental challenges that can be traced back to the apartheid era (Winkler & Marquard, 2009). Moreover, in 2012, an estimated 36% (18.6 million) of South Africa's population consisted of children below the age of 18, of which nearly 33.3% lived in the poorest 40% of

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acquisition, the quality of energy knowledge and child agency of both primary and secondary school children (Aguirre-Bielschowsky et al., 2015: 2-3).

households (Hall, Meintjes & Sambu, 2014). These conditions make South African communities ideal for exploring children's energy activities. Khayelitsha, a community in Cape Town, was adopted as the study site as it is characteristic of the conditions in which some South African children live, such as poor service delivery, multiple use of energy sources, crime and unemployment (City of Cape Town [CoCT], 2013; Seeking, 2013).

There are, however, a growing number of studies that explore environmental issues with children in developing countries[3] (Trumper, 2010) that give insight into energy behaviours. In South Africa, Olufemi, Mji and Mukhola, (2014) identified academic work by Loubser, Swanepoel and Chacko (2001), and Adams' (2003) Master's thesis. There is also a 2011 UNICEF report on South African children and climate change and a Master's thesis by Sethusha (2006) on environmental education and primary school children. These studies reveal that children are already performing energy-saving activities, for instance a 2011 UNICEF report found that children aged between 14-17 years reported the use of energy-saving lights, and switching off lights and the geyser to prevent climate change. While these studies have improved our understanding of children's energy behaviour, the topic is investigated from a climate change/environmental perspective that does not consider other wider contextual factors. There are currently no published studies in South Africa that have explicitly investigated children's energy behaviour. This study therefore aims to investigate the factors that motivate primary school children to save energy (including environmental factors), and the various ways in which they use and save energy. This line of enquiry is necessary considering that Boudet et al. (2014), Aguirre-Bielschowsky (2014; 2015), and Garabuau-Moussaoui (2009), among others, have suggested that children's energy behaviours are influenced by cultural, geographical and other contextual factors.

Grade 7 children were chosen because they have received foundational energy education as part of their Grade 4 to 6 (Intermediary Phase) Science and Technology education. (The National Science and Technology curriculum is discussed in detail in section 3.1.1). They are also at a developmental phase (aged 12 years and above) in which they able to think and reflect on some of these issues, given that their reasoning and hypothetical thinking skills are starting to emerge (Siegelman & Rider, 2009). Refer to section 2.3.5 for further discussion. This thesis is therefore significant because it recognises that childhood is a time in which

[3] According to Trumper (2010) research reports are developed from multinational studies. An example is the ROSE studies supported by the Research Council of Norway, The Ministry of Education in Norway, The University of Oslo and the Norwegian Centre for Science Education.

children become aware of energy; hence, it is an opportune time to encourage the adoption of sustainable energy practices (Garabuau-Moussaoui, 2009, 2011). It also recognises that children are an important group of energy users and tomorrow's leaders (Fell & Chiu, 2014), whose current energy habits and attitudes will inevitably greatly impact their future decisions about personal and society's energy use (Toth et al., 2013). Given that children have been found to influence adults on social and environmental norms (Toth et al., 2013), there is also a great opportunity for children to influence adults around them to adopt environment- and energy-conscious behaviours.

1.2 The research topic and questions

Based on the problem statement described in the previous section, this study aims is to explore the "*energy consumption activities, energy-saving activities and the factors that influence energy saving among Grade 7 children in Khayelitsha, Cape Town"*. To achieve this, the following research questions were identified:

1.2.1 Main research questions

1. How do children in Grade 7 conceptualise energy?
2. In what ways do Grade 7 learners in Khayelitsha use energy?
3. What techniques do Grade 7 learners in Khayelitsha employ to save energy?
4. What factors influence child energy-saving behaviours among Grade 7 learners in Khayelitsha?
5. What reasons do children have for saving energy?
6. How can the existing frameworks and theories help improve our understanding of children's energy-saving activities in Khayelitsha?

1.3 Structure of the thesis

This thesis consists of the following six chapters:

- Chapter 1 Introduction
- Chapter 2 Literature Review
- Chapter 3 Methodology
- Chapter 4 Child energy activities and personal factors
- Chapter 5 External & contextual factors influencing energy saving
- Chapter 6 Recommendations and Conclusion

2 Literature Review

Having introduced the research study in the previous section, this chapter reviews existing literature on the topic. Section 2.1 briefly discusses the study of energy behaviour and provides an operational definition for children's energy behaviour. Section 2.2 describes children's energy behaviours that have been documented in literature, mostly in developed countries. Section 2.3 then reviews several models and theories used to explain factors influencing energy behaviours and to gain better understanding of children's energy behaviour. Finally, section 2.4 presents a conceptual framework to analyse the research results and thus understand the energy behaviours of children in Khayelitsha.

2.1 The study of energy behaviour

Energy behaviour is a complex construct that is influenced by multiple factors (Moezzi & Lutzenhiser, 2010). Although there is a rich and diverse body of literature, studying energy behaviour remains a difficult task (Sweeny et al., 2013). This is because literature spans across different disciplines (Stephenson et al., 2010), mainly engineering, economics, sociology, psychology (Keirstead, 2006: Moezzi & Lutzenhiser, 2010), and education (DeWaters & Powers, 2007) (see Table 2.1).

Table 2-1:Disciplines studying energy behaviour (adapted from Keirstead, 2006:3066; Moezzi & Lutzenhiser 2010: 210 and researcher's addition)

Discipline	Purpose/Focus	Objectives
Engineering/Technology	• To emphasise the characteristics of technologies and buildings • To understand and increase efficiency	• To develop efficient technologies • To implement behaviour change through policy via technology standards or regulations.
Economics	• The consumer/household is viewed as utility-maximising unit of production and consumption	• To understand the impact of taxes, prices and income level on consumers/households • To change behaviour by appealing to financial or service incentives
Psychology	• To explore internal/cognitive motives influencing energy behaviour	• To convince people that they are better off (on a variety of dimensions) using less energy or using more efficient products
Sociology, anthropology and social studies of technology	• To highlight the importance of social and contextual factors • To highlight how technologies impact cultures and influence aspects of comfort and cleanliness	• Target people's life circumstances, identify winners and losers • To understand variability and patterns of consumption and the social origins of these patterns
Education	• To gain insight into how knowledge and attitudes influence energy behaviour	• To improve energy literacy and proficiency in both academic and non-academic settings

Since the energy crises of the 1970s, each discipline described in Table 2.1 has developed numerous theories, models, frameworks and techniques (Keirstead, 2006) to explain and to change energy behaviour (Prager, 2012; Sweeney, 2013). This has created several challenges. Firstly, each discipline offers its own definition of the concept of energy (Keirstead, 2006) which raises the important question of what energy behaviour is. According to Stephenson et al. (2010), the term 'energy behaviour' has been used to refer to energy technologies used by customers, the way people use these technologies, aspirations such as cleanliness and healthy environments, and a combination of these categories. However, as mentioned above studies investigating children's energy behaviour generally focus on the actions performed when children use and save energy (Garabuau-Moussaoui, 2011; Aguirre-Bielschowsky, 2014). This thesis defines energy behaviour as actions performed that involve the consumption or saving of thermal energy and operational uses of energy. Because this study did not explore the behaviour formation process[4], the term 'energy activity' is used to refer to study findings.

Secondly, the existing theories and models target specific energy problems and different audiences, consequently creating a lack of consensus in the field (Sweeney et al., 2013). As such, Kollmus and Agyeman (2002), Keirstead (2006), Wilson and Dowaltabadi (2007), Stephenson (2010; 2014), Aguirre-Bielschowsky (2014), and many others maintain that an individual approach is appropriate for analysing a specific aspect of energy behaviour while integrated approaches can be used to provide a better, more holistic understanding of energy behaviour. To gain insight into the different aspects of child energy activities, this study has taken an integrated approach. Lastly, despite the existence of energy-focused theories, models and frameworks, none of them focus specifically on children (Wilson & Dowaltabadi, 2007; Aguirre-Bielschowsky, 2014). This is surprising, especially considering that childhood is a crucial time in which children develop a relationship to the world and understanding of their surroundings through interacting with energy systems (Garabuau-Moussaoui, 2009). Aguirre-Bielschowsky (2014) and Boudet et al. (2014) have acknowledged the lack of child-focused frameworks and identified the need for context specificity. These authors further developed heuristic frameworks to understand child energy behaviours in the USA and in New Zealand respectively. They applied the Theory of Planned Behaviour (TBP), Child Development and Socialisation Theories, Models of Pro-Environmental Behaviour (MPEB) and Energy Literacy to gain better understanding of children's energy behaviour. This study draws

[4] In this thesis, this term refers to a variety of processes that lead to energy behaviour represented in a sequential order. Refer to Aguirre-Bielschowsky (2014, 207) for further information

influence from the TPB (Ajzen, 1991), the bio-ecological systems theory (BEST) (Bronfenbrenner, 1994), the MPEB (Kollmus & Agyeman, 2002), the concept of energy literacy (DeWaters & Powers, 2008), the theory of cognitive development by Piaget (Sigelman & Rider, 2009) and the energy cultures framework, (ECF) (Stephenson et al., 2010). These approaches were chosen after the review of literature and recognition that children have different competencies compared to adults that need to be considered when investigating children's energy behaviours (James, 1995 cited in Morrow, 2008).

2.2 Children's energy behaviours

Studies show that children use energy in different ways. Garabuau-Moussaoui, (2011) reported that French children make their own breakfast, and Toth et al. (2013) found that the children in the United Kingdom (UK) use appliances such as toasters, hair straighteners, iPods, cell phones, computers and gaming devices. Similarly, in New Zealand, children reported using TVs, lights, heaters, stereos, microwaves, kettles, computers, wood burners and open fires (Aguirre-Bielschowsky[5], 2014). Children also report the use of energy when opening taps (Toth et al., 2013), the fridge, when cooking, (Aguirre-Bielschowsky, 2014) and when using the washing machine and dryer (Boudet et al., 2014: 442). Where location is concerned, Toth al., (2013) observed that children were more likely to report behaviours performed at home rather than at school. In support of this, Ntona et al. (2015) found that 66.7 % of children in Greece turned lights off at home while only 21.69% did so at school. Moreover, Toth et al. (2013) also found that older children were more likely to record their energy use at home while younger children recorded their use of energy at school, home and other settings. Fell and Chui (2014) also found that 9- to 11-year-olds in the UK were motivated to act at school because they were assigned responsibilities of checking PV panels and switching off light.

Regarding energy-saving activities, studies to date indicate that children's actions tend to focus on curtailment behaviour (Aguirre-Bielschowsky, 2014; Fell & Chiu, 2014). Children perform well-publicised actions such as switching off appliances, reducing the heat and removing plugs from the wall socket (Garabuau-Moussaoui, 2011; Toth et al., 2013). The

[5] The description of the household by the parents in Aguirre-Bielschowsky's study showed that 73.1% had portable electric heater, , 46.2% had wood burners and 19.2% used open fires with most families combining these technologies. Most households (69.2%) had energy-efficient light bulbs, but only about a third of them had other efficiency appliances such as fridges (34.6%) or washing machines (38.5%)

most reported behaviour across the range of studies is switching off lights (Solopova,2008; Dewater & Powers, 2008; 2011; Toth et al., 2013; Aguirre-Bielschowsky, 2014; Boudet et al. 2014). In addition, over 50% of children in New Zealand (Aguirre-Bielschowsky, 2014) and Greece (Ntona et al., 2015) reported switching off the TV and the computer, while 38% of American children (DeWaters & Powers, 2011) reported switching off the computer. Children were, however, less likely to report removing appliances from the wall plug (Aguirre-Bielschowsky, 2014), except removing chargers as reported by American children (Boudet et al., 2014). Children in Greece (Ntona et al., 2015) also reported closing taps when washing hands/brushing teeth and closing windows/doors before using heaters/air-conditioners. The use of cold water for laundry (by parents or themselves) was reported by 19% of American children, with fewer children reporting hang-drying (Boudet et al. (2014). In New Zealand, children highlighted using blankets or heaters at a low temperature, wearing extra clothing to keep themselves warm, wearing clothing for several days before giving them to their parents to wash, saving electricity by putting the baking tray close to the heating bars, not pre-heating the oven, and drinking fewer hot beverages (Aguirre-Bielschowsky, 2014). In their study, Fell and Chiu (2014) found that children in the UK were not always willing to reduce their energy consumption if it interfered with watching TV or playing video games. Moreover, children showed reluctance to save energy at home because it sometimes caused conflict and disagreements with their parents (Garabuau-Moussaoui et al., 2011). In support of this, Solopova (2008) concluded that in the absence of adequate knowledge and commitment, children may act pro-environmentally if they feel guilt or fear.

2.3 Theories, Models and Frameworks

As indicated above, this thesis draws influence from the TPB (Ajzen, 1991), BEST (Bronfenbrenner, 1994), the MPEB (Kollmus and Agyeman, 2002), the concept of energy literacy (DeWaters & Powers, 2008), the theory of cognitive development by Piaget (Sigelman & Rider, 2009), and the ECF (Stephenson et al., 2010) (see Table 2.2).

Table 2-2: Theories, Models & Frameworks

	TPB	**MPEB**	**ECF**	**Cognitive Development Theory**	**BEST**
Discipline	Psychology	Environmental Psychology	Sociology	Developmental Psychology	Developmental Psychology
Purpose	- to explain and predict human behaviour, - to develop interventions for behaviour change, and - to determine differences between people who perform behaviours frequently and those who do not.	- to explain the gap between having environmental knowledge/ awareness and behaving in a pro-environmental manner (includes saving energy/electricity).	- to incorporate the social context in which energy behaviours are performed -this discipline considers the 'role and demand for energy service'.	-to help us gain insight into children's cognitive abilities.	The BEST was developed as a response to dominate psychological theories that emphasised innate (biological and genetic) factors as the only determinants of children's behaviour.
Focus	Internal (cognitive) factors that motivate consumption behaviour.	Social and economic factors that support environmentally friendly action such as energy saving.	Explores energy behaviours by considering the physical and social context.	Considers the stages of cognitive development.	Explores the factors in child development.
Factors/ Determinants	The TBP states that the strongest predictor of human action or behaviour is intention. Behavioural intention is influenced by • attitude towards the behaviour, • subjective norm and • perceived behavioural control (PBC). These determinants are influenced by the information, knowledge or beliefs an individual has on the subject matter.	Pro-environmental behaviour results from the interaction of demographics • gender, level of education, internal factors • attitudes, motivation, knowledge, locus of control, awareness, responsibilities, values, priorities and external factors • culture, socio-economic issues and institutional issues.	The ECF suggests energy behaviour is strongly influenced by the interactions between • norms, • practices, • material culture and • the external factors that form the context.	It proposes that there are four major stages of cognitive development, namely the sensorimotor stage • from birth to 2 years; the preoperational stage • from 2 years to 7, the concrete operations stage • between the ages of 7 and 12 and the formal operations stage • from 12 years and above.	This theory suggests that child development is influenced by five systems namely: • the microsystem, the mesosystem, • the macrosystem, • the exosystem and • the chronosystem

Table adapted from Ajzen, 1991, Keirstead, 2006, White *et al.*, 2010[**TPB**]; Kollmus & Agyeman, 2002; Wilson & Dowaltabadi, 2007; Sweeney *et al.*, 2013 [**MPEB**] Keirstead, 2006, Wilson & Dowaltabadi, 2007, Stephenson *et al.*, 2010; 2015 [**ECF**]; Sigelman & Rider, 2009 [**Cognitive Development**] and Bronfenbrenner, 1994 [**BEST]**.

It is important to note that there are overlaps in the theories and frameworks (Moezzi & Lutzenhiser, 2010) illustrated in Table 2.2. This is because the same determinant is used to explain behaviour or different terms are used to explain the same determinants. These overlaps are, however, described in the following discussion and the use of each determinant in this thesis is clarified. The term 'determinant' is used interchangeably with the terms 'factors', 'variables' and 'constructs'.

2.3.1 **Theory of Planned behaviour (TPB)**

The TPB was used as a starting point to investigate some of the cognitive/internal factors that influence behaviour. Table 2.2 shows that behaviour in the TPB is influenced by attitude, subjective norms and PBC. Attitude in the TPB is defined as a "positive or negative evaluation of performing a behaviour" (Ajzen, 1991:188). In this thesis, however, attitude is defined as an enduring positive or negative evaluation that is attached to an object, behaviour or issue, as defined by Newhouse (1991). The difference is that the definition provided by Newhouse (1991) allows the researcher to investigate attitudes towards energy-saving (behaviour) and the environment (object/issue), while the latter applies only to attitudes towards behaviour. Investigating attitudes towards energy-saving is important considering that Solopova (2008), Aguirre-Bielschowsky, (2014) and Boudet et al. (2014) found that children in Russia, New Zealand and the USA respectively, value saving energy. Similarly, Ntona et al. (2015) reported that children in Greece acknowledged saving energy as essential to protecting human health and the environment and recognised the need to encourage others to save energy.

This thesis also explores attitudes towards the environment. As mentioned earlier, geographical location and social factors influence energy attitudes and behaviour. To show this, Boeve-De Pauw and Van Petegem (2012) found that Belgian children (developed country) showed more environmental concern than children from Vietnam and Zimbabwe (developing countries). Their results showed further that while all the children acknowledged the negative impact that mankind has on nature, the Zimbabwean sample consisting of children from rural areas held several views of the environment. They acknowledged humanity's impact on the environment, the need to protect the environment and humans' right to use nature for their needs. Boeve-De Pauw and Van Petegem (2012) concluded that their results suggest that people in developed countries view the environment as a means of self-expression and accomplishment while people in developing countries perceive the

environment as a means to fulfil survival needs. However, in his systematic review of the literature, Trumper (2010) argued that it should not generalised that people in developed countries have favourable attitudes towards the environment. given that some studies show that European children are disconnected from environmental issues. For instance, Ntona et al. (2015) expressed concern that 20.5% of the children in Greece displayed neutral attitudes towards moving away from fossil fuels and that 61.84% reported that the balance of nature is very delicate and easily disturbed. Moreover, in South Africa, Mji and Mukhola (2014) found that children from a mining town in South Africa displayed more concern for the environment than children from a non-mining town. These findings show that nuances can exist even within a single context; therefore, it is important to explore attitudes towards energy-saving and the environment from a context perspective rather generalising results from existing studies (Aguirre-Bielschowsky, 2014: 45).

Subjective norms in the TPB "refer(s) to the perceived social pressure to perform or not to perform the behaviour" (Ajzen, 1991: 188). The theory argues that people are more likely to perform a behaviour if it is viewed favourably by significant people or groups in their lives (ibid). In this thesis, subjective norms are used to explore the extent to which children in Khayelitsha feel encouraged or pressured by parents, peers and educators to save energy. Given the overlap between behaviour determinants, the children's perceptions of encouragement/pressure to save energy is discussed under section 2.2.6 as part of the microsystem. Finally, the concept of PBC refers to the perceived degree of difficulty associated with performing the behaviour. It considers past experiences and the perceived obstacles, resources and opportunities (Ajzen, 1991; 2002). This thesis did not seek to investigate the perceived difficulty associated with energy saving. Instead, the concepts of locus of control (LoC) and environmental awareness presented in the Model of Pro-Environmental Behaviour (MPEB) were used. The term 'environmental awareness' is used to ascertain the extent to which children are aware of the impact of their personal energy use on the environment. The term 'LoC' is used to find out if children think they can bring about change to environmental problems through their personal actions. The Model of Pro-Environmental Behaviour is discussed further in section 2.2.2. Although the TPB is widely applied to understanding human behaviour, it has received considerable criticism because it is based on the key assumption that people are rational actors (Conner & Armitage, 1998; Kollmus & Agyeman, 2002). Chen (2016) criticises the theory because it does not consider moral responsibilities and Guagnano et al. (1995) and Stern et al. (1995 cited in Keirstead

2006: 3067) point out that the theory neglects "social and cultural contexts of energy use behaviour". For these reasons, the MBEP was included to explore social-economic factors and motivation to save energy

2.3.2 **Model of Pro-Environmental Behaviour (MPEB)**

As highlighted in Table 2.2, pro-environmental behaviour results from the interaction of demographics, internal factors and external factors. Kollmus and Agyeman (2002) define pro-environmental behaviour as "behaviour that consciously seeks to minimise the negative impact of one's action on the natural and built world" (Kollmus and Agyeman, 2002: 240). In this thesis, pro-environmental behaviour includes energy saving. The following factors are explored to gain better understanding of the energy behaviours of children in Khayelitsha: gender, knowledge, environmental awareness, locus of control, motivation, economic factors, institutional factors and resource availability. Due to the overlap between variables, institutional factors, resource availability, and economic factors are discussed as part of external influences in section 2.2.4.

Regarding gender, research studies show that females tend to be more concerned about energy saving (Ayers, 1977 cited in DeWaters & Power, 2011) and the environment (Fliegenschnee & Schelakovsky, 1998; Lehmann, 1999 cited in Kollmus & Agyeman). DeWaters and Powers (2011: 1706) also found that females showed "greater positive attitudes and values towards energy issues and greater feelings of self-efficacy than males". Similarly, Aguirre-Bielschowsky (2014) reported that only girls had provided examples of saving electricity when cooking and doing the laundry. Moreover, Boylan (2008) and Chen, Liu and Chen (2015) found that males where more likely to score higher on knowledge dimensions than females. By exploring gender, this thesis aims to ascertain if there are differences between male and female children. Although grade differences are not explored, this study recognises that individuals who spend more time gaining education are likely to have more knowledge (Kollmus & Agyeman, 2002). However, an in-depth investigation in of differences in level of education was beyond the scope of this study. Studies also show that children have different several motivations for saving energy with financial and environmental reasons (Solopova, 2008; Aguirre-Bielschowsky 2014) being the most cited while other children cite safety concerns (Fell & Chiu, 2014).

Kollmus and Agyeman (2008:253) define environmental awareness as "knowing the impact of human behaviour on the environment". This construct was used to assess whether children

in Khayelitsha identify their energy consumption as a contributor to environmental problems. In their study, DeWaters and Powers (2011) found that about 50% of American children in their study were aware of the impact of their energy use. Locus of control (LoC) is defined by Newhouse (1991) and Kollmus and Agyeman (2002) as the extent to which an individual believes they can bring about change through their own actions. People with external locus control have low regard for the impact of their actions, and believe that change can only be accomplished by others while those with internal locus believe that they can bring about change through their actions (Kollmus and Agyeman, 2002). This construct is important as Aguirre-Bielschowsky (2014) reported that children in New Zealand thought their energy saving had positive financial benefits; Sethusha (2006) also found that South African primary children acknowledged their responsibility for improving pollution in their surrounding environments. Likewise, UNICEF (2011) revealed that South African teenagers (14-17) acknowledged their role and that of the government in bringing changes to environmental problems, just like Greek children in Ntona et al. (2015) who also reported that their personal actions could change environmental problems.

2.3.3 **Energy Literacy**

Keeping in mind that attitudes and beliefs are influenced by the information/knowledge that an individual has on a subject matter (TPB/MPEB), it is important to investigate children's energy knowledge. To achieve this, the concept of energy literacy was explored. There is no universally accepted definition for energy literacy, but existing literature provides multiple definitions. Within the education discipline, definitions for 'energy literacy' and 'energy-literate citizen' that have been adopted in developed and developing countries are offered by DeWaters and Powers (2007: 3; 2008: 3; 2011: 1700). DeWaters and Powers define energy literacy as comprising three domains, namely: conceptual knowledge (cognitive), attitudes towards resources (affective), and behaviour. They refer to an energy-literate person as someone who:

- understands how energy is used in daily life and the impacts of energy production and consumption on the environment and society;
- appreciates the necessity for energy conservation and the need to have alternatives to fossil fuel-based energy resources;
- is aware of the impact that personal energy-related decisions and behaviours have on the global community; and

- tries to make choices and decisions that reflect the attitudes and knowledge stated above.

The framework presented by DeWaters and Powers encourages educators to explore the local impacts of global energy decision and recommend a curriculum that is based on experiential learning, inquiry and the solving of real problems (DeWaters & Powers, 2011; Eitel et al., 2015:). Yet the statements above suggest that becoming literate will result in desired attitudinal and behavioural outcomes (Street, 2003). This is a similar approach to the knowledge-deficit theories that stress improving knowledge, awareness and attitude to improve behaviour. Batchelor and Smith (2014) also argued that the conceptualisation of energy literacy limits its application because it is biased towards academic settings to assess academic knowledge or the consumption of energy. Street, (2003) stressed that the problem with this view of literacy is that it fails to recognise local knowledge and experience and imposes Western cultural notions of literacy onto other cultural groups. The definition of an energy-literate person also seems to prioritise global issues over household or community level factors and therefore seems to ignore factors influencing energy use. However, because part of this study seeks to explore children's understandings energy, (re)sources, transitions and energy system, the variable of knowledge was adopted to ascertain if it has any influence on children's energy behaviours, attitudes and other behaviour determinants. Table 2.3 shows the key studies that have been carried out investigating children and energy behaviours.

Table 2-3: Studies on children and energy per year of publication

Authors	Year	Country	Methodology	Participants
Boylan*	2008	Australia	Quantitative 132 children	Grade 3 to 6
DeWaters & Powers*	2008	USA	Quantitative 955 middle and high school students	Grades 6 ,7 and 8
Solopova	2008	Russia	Qualitative 20 children	Grade 9 to 11 tears
Garabuau-Moussaoui	2009	France	Mixed methods	Aged 6 to 75 years
DeWaters & Powers	2011	USA	Quantitative 3708 secondary students	Middle and high school students
Garabuau-Moussaoui	2011	France	Mixed methods	Aged 6 to 75 years
Toth et al.	2013	United Kingdom	Qualitative Diaries, Focus groups & Stories 114 children	Aged 10 to 19 years
Aguirre-Bielschowsky * Research study published in journal as Aguirre-Bielschowsky et al. (2015)	2014	New Zealand	Mixed Methods Interviews & Focus groups, photographs 70 people from 5 schools 26 families (1 parent & 1 child) 14 individual children 4 teachers	Aged 9-10 years
Fell & Chui	2014	United Kingdom	Qualitative Focus groups (energy feedback devices) 2 schools 15 people	Aged 9-11 years
Chen, Lui & Chen, 2015*	2015	Taiwan	Quantitative 974 junior students 737 senior students	Grade 7 to 12
Ntona et al.	2015	Greece	Quantitative Questionnaire 805 students	Aged 12–13years

The asterisk (*) in Table 2.3 shows studies that specifically refer to energy literacy. Although several studies investigate energy literacy with high school and university students, this study aimed to review studies with children of a similar age. The review of the literature revealed that learners hold a variety of ideas about the nature of energy ranging from scientific to non-scientific concepts (Trumper, 1997 cited in Boylan, 2008). Children in both primary and high

school associate energy to elements such as fuel, movement, fire, water, storage systems, sun, food, chemicals and heat (Kirkwood & Carr, 1988 cited in Boylan 2008). In Thailand, Yuenyong and Yuenyong (2007) also found that most children in Grades 1 to 6 explain energy by referring to electric energy and children in Grades 4 to 6 show some understanding of energy transformation by indirectly referring to potential, gravitational and chemical energy. Moreover, Toth et al. (2013) and Aguirre-Bielschowsky (2014) reported that children in the UK and in New Zealand respectively, can identify solar, wind and tidal energy and discuss environmental impact such as global warming. Boylan (2008) also found that 91% and 69% the children in Australia can identify that the light coming from a bulb and sound coming from the radio were different forms of energy respectively. Moreover, when asked what type of energy is produced when wood burns, 75% of the children in Australia indicated that both light and heat are produced, 92% recognised that a person uses energy when running, and 83% recognised the sun is the source of energy for all life on Earth (Boylan, 2008).

Children however seem to show limited understanding of other topics. Boylan, (2008) found that children showed confusion between renewable and non-renewable sources as 52% identified natural gas and 59% identified nuclear energy as renewable sources of energy. Likewise, Boudet et al. (2014) found that 8% of the children in the USA knew that hot water heaters required a lot of electricity and just over 50% knew that compact fluorescent light (CFLs – energy-saving lights) were good for the environment. Yuenyong and Yuenyong, (2007: 295) also reported that the children could not distinguish between forms and sources of energy or "recognise energy degradation and the law of energy conservation". Toth et al. (2014) found that social problems related to energy production were rarely discussed by the children in the UK. However, Aguirre-Bielschowsky (2014) noted that a few of the children highlighted social problems related to distribution problems and one child whose father was originally from Africa highlighted limited access problems. The majority of the children in New Zealand were also largely unaware of environmental impacts of electricity generation and sustainability terminology. Similarly, Sethusha (2006: 71) found that most children showed were knowledgeable on the "the basic facts connected to pollution and conservation, only in and around their local community", however, they struggled to see it as "a place with living things and people".

According to Boylan (2008) and Aguirre-Bielschowsky (2014), the results of their respective studies suggest that children's energy knowledge is incomplete and confused as they struggled to show linkages between energy and environmental concepts. It is important to note that this thesis recognises that knowledge is not a prerequisite for pro-environmental behaviour, but that the lack of knowledge can act as a barrier to behaviour (Kollmus & Agyeman, 2002; Solopova, 2008; Toth et al., 2013; Boudet et al., 2014). This means that while it is necessary for people to have basic knowledge of environmental or energy problems to act in a pro-environmental manner (to save energy), having detailed knowledge does not improve the likelihood of performing the desired behaviour (Kollmus & Agyeman, 2002). This is because other factors such as socio-economic status and "cultural values can motivate people to act pro-environmentally without doing it out of environmental concern" (Kollmus & Agyeman, 2002: 250). For these reasons, the Energy Cultures Framework (ECF) is responsible for consideration of cultural and technological factors.

2.3.4 **Energy Cultures Framework (ECF)**

The ECF, as highlighted in Table 2.2, suggests that behaviour is strongly influenced by the interactions between norms, practices, material culture and the external factors that form the context (Stephenson et al., 2010; 2015). Material culture in the ECF is used to refer to "the technologies, structures and other assets that play a role in how energy is used" (Stephenson et al., 2015: 5). It is sector-dependent and at the household level it may include appliances, insulation, building materials and solar panels (Sweeney et al., 2013; Stephenson et al., 2015). This construct was included to investigate the type of technologies and appliances to which children have access. This is important, as Aguirre-Bielschowsky (2014) in New Zealand found that the children without access to technologies such as gas or electric heaters were unable to perform heater-related behaviours, instead, they used wood burners or open fires. In the same way, Fell and Chiu (2014) found that children in the UK without access to a playing area were more likely to be encouraged to use their electronic devices while those with a home garden were more likely to be encouraged to play outside. Aguirre-Bielschowsky (2014:) also found that children who could use technologies with minimal supervision from their parents reported more electricity-saving behaviours and were more likely to engage in activities such as cooking and cleaning. However, in the studies by both Aguirre-Bielschowsky (2014:) and Boudet et al. (2014) in the USA, activities such as cooking, laundry and installing CFL bulbs were mostly seen as an on-going process requiring

parental supervision because of the perceived risk and difficulty associated with the task. Parents restricted access to technologies when they felt that their children would fiddle and break appliances such as thermostats (Boudet et al., 2014), heaters and computers (Aguirre-Bielschowsky, 2014) and if they feared for the safety of the children with technologies such as heaters and wood burners (Aguirre-Bielschowsky, 2014). These research studies suggest that access to appliances and technologies is determined by the age and level of competence of the children and concerns of safety.

In the ECF, the term 'practice' refers to "both routinized activities and to actions that may occur relatively infrequently in the life of a subject, yet which are a common occurrence across their social peers" (Stephenson et al., 2015: 6). These are everyday practical energy behaviour, activities, actions and processes that individuals engage in to use and to save energy (Sweeney et al., 2013: 373). This construct was included to gain insight into the daily activities that children engage in as they use and save energy. This term also recognises that energy use is deeply entrenched in normal practices that people engage in to satisfy their needs and desires for services and goods (Stephenson et al., 2015: 6). The term 'norms' refers to expectations of what is normal – that is, how people view their current and desired material culture and energy practices (Stephenson et al., 2015). This can be achieved by examining "the level of service they expect from the use of energy", the level of importance that is given to energy efficiency, energy saving (Stephenson et al., 2015: 5) and concern for the environment (Sweeney et al., 2013: 373). In this study, norms were used to explore the parents' perceptions of their energy saving behaviours, attitudes towards the environment and satisfaction with household appliances. Because of the overlap in factors, parental factors are further discussed in section 2.2.4. Finally, external influence consists of "factors that are largely beyond the control of the subject in question, and yet have the potential to shape their norms, practices or material culture" (Stephenson et al., 2015: 7). This construct is similar to Kollmus and Agyman's (2002) external factors and therefore considers institutional factors, resource availability, and economic factors. In this thesis, external influence explores wider contextual issues such as the state of energy in the country, educational policy implementation, geographical location, access to energy and resources. These issues are important, as Boudet et al. (2014) also found that geographic locations constrained children's ability to engage in low carbon transport behaviour. Likewise, Kollmus and Agyeman (2002) highlight that people are less likely to engage in pro-environmental behaviour if they are not able to afford energy-efficient appliances and if necessary resources and infrastructure are not

available. Such factors are relevant. bearing in mind that the study context is characterised by poor service delivery and high unemployment. Although there are benefits to using the ECF, it has several criticisms. For instance, Ishak, Iman and Sapri. (2012: 894) stated that the framework does not "extend to understanding of the pattern of energy use". Croad (2014: 10) argued that the framework requires adjustment when applied to energy governance bodies and energy policy stability. Furthermore, as indicated in section 2.1, the ECF and the approaches discussed thus far do not focus specifically on children. For this reason, the Theory of Cognitive Development and the Bio-Ecological Systems Theory (BEST) were included. Both theories recognise that children have different competencies compared to adults that ought to be considered when studying their behaviours.

2.3.5 **Theory of Cognitive Development**

The Theory of Cognitive Development highlighted in Table 2.4 was developed by Piaget in the 1950s to improve understanding of cognitive abilities. It focuses on internal/cognitive factors and is therefore similar to the TPB and the demographic and internal factors highlighted in the MPEB. It proposes that there are four major stages of cognitive development, namely the sensorimotor stage; the preoperational stage, the concrete operations stage and the formal operations stage (see Table 2.4).

Table 2-4:The theory of cognitive development adapted (Adapted from Sigelman & Rider, 2009)

Cognitive Stage	**Basic Characteristics of the child**
Sensorimotor Thought: • Birth to 2 years	• Understands the world through movements and sensations • Starts learning that things exist even when they do not see them.
Preoperational Thought • 2 to 7 years	• Starts thinking in symbols, uses words and play to understand the world • Focus is on self (egocentrism) and fails to see the perspective of others
Concrete Operational Thought: • 7 to 12 years	• Starts thinking logically but it is limited • Egocentrism starts to fade as they become aware of other people views
Formal Operational Thought: • 12 years and up	• Starts reasoning and thinking hypothetically and abstractly • Adolescent egocentrism emerges

Considering that the children in this study were in Grade 7, with average ages between 12 and 13 years, their age group corresponds with the formal operation stage. According to Piaget, children at this stage start thinking about justice, fairness and fiction. They also start

to develop their own ideas of what is wrong with the societal systems such as the family, school and government (Siegelman & Rider, 2009). Singly, (2006 cited in Garabuau-Moussaoui, 2011: 496) further added that children between the ages of 10 and 14 years are in a transitional phase as they are neither children nor teenagers. This suggests that they experience both aspects of childhood and adolescence. This means that children continue to adopt what they are being taught as they develop energy awareness, they start to challenge what they have been taught and at the same time they want to minimise conflicts with their parents (Garabuau-Moussaoui, 2009; 2011). Although, the theory of cognitive development improves understanding of children's cognitive abilities, it does not consider the influence of the surrounding environment on the child (Sigelman & Rider, 2009). To overcome this challenge, the bio-ecological systems theory was included in this research study.

2.3.6 **The Bio-Ecological Systems Theory (BEST)**

Table 2.2 also shows the BEST which suggests that child development is influenced by five systems, namely: the microsystem, the mesosystem, the macrosystem, the exosystem and the chronosystem (Bronfenbrenner, 1994). This theory acknowledges the role of biological factors such as intelligences and skills (Yaw Amoateng & Kalule-Sabiti, 2013), and therefore views the child as an active agent who can exert influence on his/her environment (Bronfenbrenner 1979 cited in Härkönen, 2007).

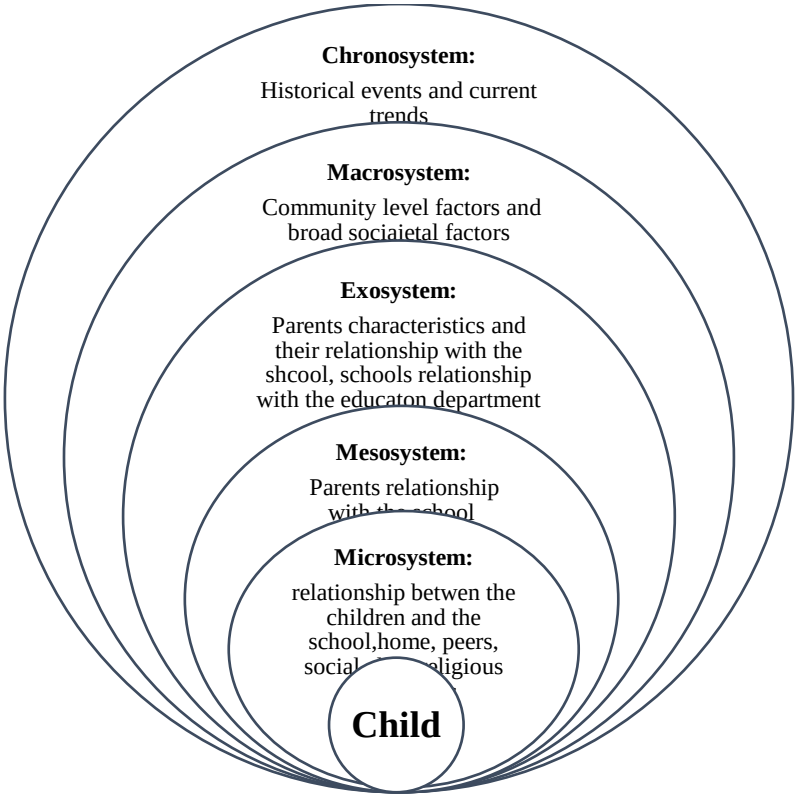

Figure 2-1: Bio-Ecological System Theory adapted from Bronfenbrenner, 1994

Based on Figure 2.1, the child is in the middle and the microsystem is the environment closest to the child. The microsystem consists of settings such as the family, school, peer groups (Bronfenbrenner, 1994) playmates, day-care, the neighbourhood (Krishnan, 2010), religious centres (Penn, 2005) music and sports centres (Boudet et al., 2014). The relationship between the child and microsystem are bi-directional, meaning that family beliefs or values can influence the behaviour of a child, and the children can in turn influence family attitudes and beliefs (Bronfenbrenner, 1994; Härkönen, 2007; Krishnan, 2010;). In this thesis, the microsystem was included to find out which locations children perform their energy activities and which individuals, or groups influence their energy knowledge, attitudes and behaviours. Exploring these factors is important as existing studies have established that children learn about energy and energy saving from multiple sources, including parents, educators, excursions/field trips, environmental and energy clubs[6],, friends and various media outlets[7]

[6] These are community based networks that provide information and resources on environmental and energy issues.

[7] Media outlets such as the TV, advertisements, the internet, leaflets, the radio, (Toth et al., 2013: 40), newspapers, books, magazines, documentaries and cartoons (Aguirre-Bielschowsky, 2014) were also reported as sources of information.

(Solopova, 2008; Ekström, 2010; Aguirre-Bielschowsky, 2014; Fell & Chiu, 2014; Toth et al., 2014; Ntona et al., 2015). In their study with 10-19-year olds in the UK, Toth et al. (2013) found that parents and guardians were the most important source of information alongside family friends, grandparents, sales persons, and general knowledge for younger teenagers. Likewise, Aguirre-Bielschowsky (2014) found that most children identified parents as the most important source of information and to lesser extent aunts, grandparents, and friends. The school was the second most cited source of learning in Toth et al. (2014) and Aguirre-Bielschowsky (2014), with the children in Aguirre-Bielschowsky (2014) reporting that they benefit from lessons with energy experts, and receiving reminders to save electricity from their teachers. Children also report that they learn about energy from participating in research projects (Solopova, 2008) and field trips either with parents or with their teachers (Fell & Chiu, 2014; Aguirre-Bielschowsky, 2014).

Existing studies also show that children's energy behaviours, attitudes and knowledge are influenced by parental demographics. In New Zealand, Aguirre-Bielschowsky (2014) found that parents with positive attitudes towards energy efficiency were more likely to perform more electricity-saving behaviours (switching off lights, unplugging appliances from wall sockets) and set an example for their children. It was also found that children and parents who shared similar attitudes and rationales for energy saving were more likely to communicate regularly and provide explanations for saving energy (Ibid). Likewise, in the UK, Fell and Chiu, (2014) found that parents who showed interest and understanding of environmental issues were more likely to discuss energy issues with their children. They also reported that children were more likely to develop positive energy attitudes and behaviours if parents were available to help children perform activities and understand behaviours. Yet, despite the importance of communication in fostering child energy-saving behaviour, Boudet et al. (2014) and Fell and Chiu (2014) found little evidence of energy being discussed in American and UK households respectively. Moreover, Toth et al. (2013) found that talking to peers about energy saving was perceived to be uncool by children in the UK. The mesosystem is the second system and considers the interactions that take place between systems that have direct contact with the child (Bronfenbrenner, 1994; Krishnan, 2010). Unlike the microsystem, this is not a physical setting rather an interaction space. For example, it considers relations between the home and the school and its influence on the child (Bronfenbrenner, 1994). In child energy research, this construct was included to explore the relationship between the parents and the school. In doing so, the study aims to ascertain if the

energy-saving information received from the school and at home complement each other. This is important, as Solopova (2008) found that 50% of Russian children reported implementing energy-saving measures learnt from school at home. Similarly, Aguirre-Bielschowsky (2014) found that children in New Zealand had started recycling, growing herbs and turning taps off when brushing their teeth after having learnt about such things at school. Ekstrom (2007), Aguirre-Bielschowsky (2014), and Fell and Chiu (2014) noted that implementation of some energy-saving techniques at home resulted in conflict between the children and the children's parents trying to enforce changes.

The exosystem is the next sphere of influence; it explores the interactions between a setting that contains the child and a setting that does not contain children. From a child's perspective, this includes how the parent's workplace impacts the relationship between the parent and the children, and from the parent's perspective, it considers how the relationship between the school and neighbourhood groups impact the child (Bronfenbrenner, 1994). In child energy research, this construct was included to explore the relationship between the school and government departments and how this impacts their energy education. This is important, as Solopova (2008) identified that the short length of the energy efficiency programme in Russian schools as a barrier to forming environmental behaviour.

The chronosystem is the final system; it considers consistency or changes in family demographics and explores the context in which the child lives (Bronfenbrenner, 1994). The chronosystem looks at the broader conditions in which children are growing up; it allows us to consider trends and innovations that may have an impact on children (Bronfenbrenner, 1994). This construct was included to explore the way time and events impact children, such as how apartheid shaped living areas and influenced access to information and resources.

The exosystem and the chronosystem are similar to the external factors in the MPEB and external influences in the ECF. Section 3.3 of the thesis provides a contextual description of how historical factors and the current state of energy in the country impact Khayelitsha. Although there are benefits to using the BEST, it becomes impossible to explore all the complex factors that influence behaviour in detail (Hook 2009). Moreover, if it is true all relationships are bi-directional (parents influence the child and *vice versa*), this framework requires one to collect a great deal of information, and to order the information in developmental significance which, according to Hook (2009), can become difficult and cumbersome.

2.4 Proposed heuristic model

As indicated earlier, there are overlaps between the constructs of the theories that have been adopted in this study. Table 2.5 shows the overlaps between the factors and how they fit in the proposed heuristic framework.

Table 2-5: Overlaps of the theories & frameworks

<table>
<tr><td>Theory of Planned Behaviour</td><td>Energy Literacy</td><td>Theory of Cognitive development</td><td>Model of Pro-Environmental Behaviour</td><td>Energy Cultures Framework</td><td>Bio-Ecological Systems Theory</td></tr>
<tr><td>Attitude</td><td rowspan="3">Knowledge</td><td rowspan="3">Cognitive Factors</td><td>Demographics</td><td>Norms</td><td>Micro-system</td></tr>
<tr><td>Subjective norm</td><td>Internal factors</td><td>Material Cultures</td><td>Mesosystem</td></tr>
<tr><td>Perceived Behavioural Control</td><td>External factors</td><td rowspan="2">External influence</td><td>Exosystem</td></tr>
<tr><td colspan="3">Personal Factors External Factors Contextual Factors ..</td><td>Macro-system</td></tr>
<tr><td colspan="3"></td><td>Chronosystem</td></tr>
</table>

Personal factors consist of all three determinants of the TPB, knowledge from the concept of energy literacy, demographic and internal factors in the MPEB and cognitive factors in the theory of cognitive development. External factors consist of norms, practices, material culture in the ECF and the micro-system and the mesosystem in the MPEB. Contextual factors consist of external factors in the MPEB, external influences in the ECF and the exosystem, the macrosystem and the chronosystem in the BEST. A conceptual framework to explore factors that influence the energy-saving activities of children in Khayelitsha is thus presented in Figure 2.2

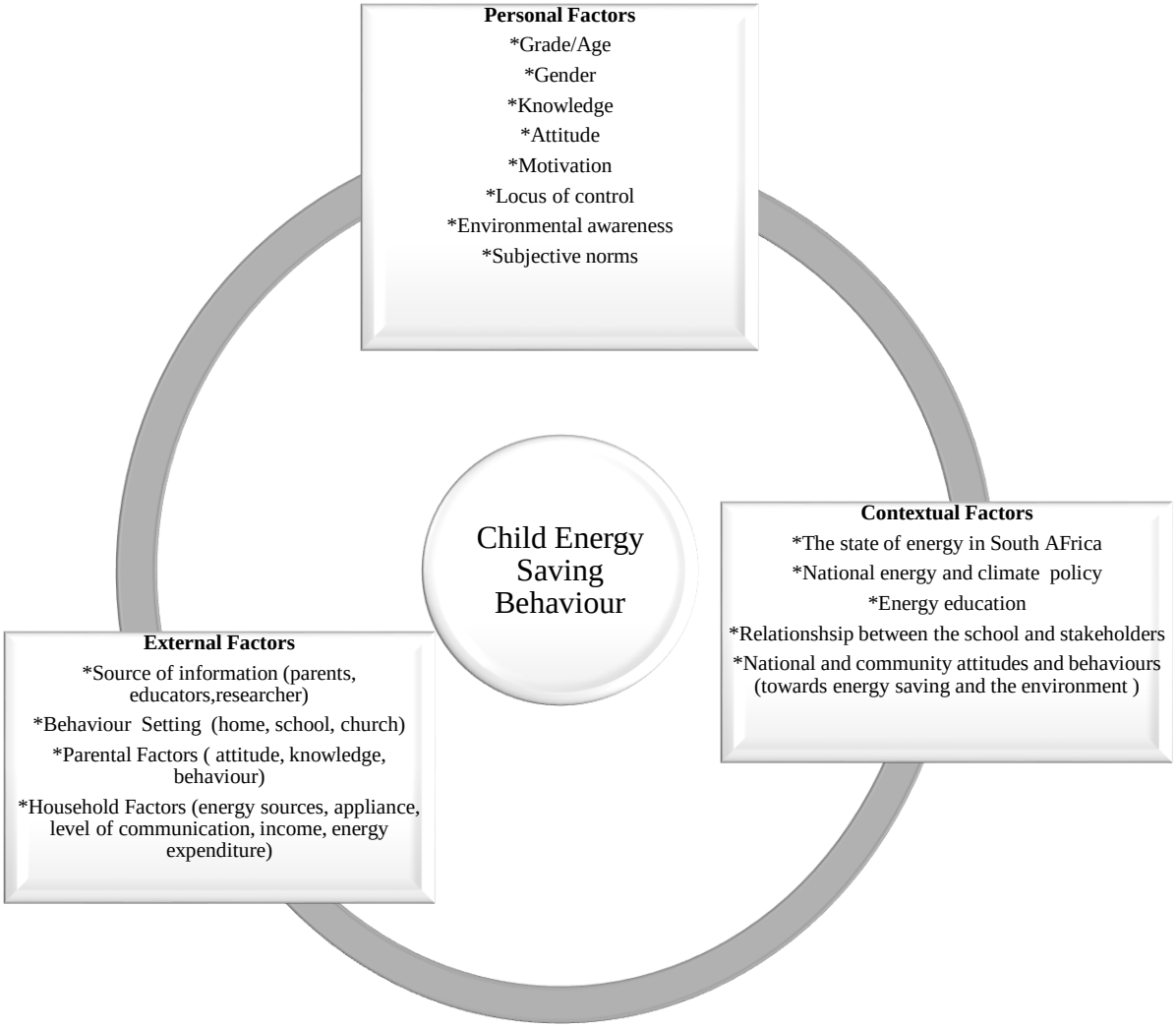

Figure 2-2: Factors influencing children's energy saving behaviour

This model/framework depicted in Figure 2.2 considers four aspects, namely the children's energy activities, personal factors, external factors and contextual factors. This heuristic framework places children's energy-saving activities (behaviour) at the centre to show that they are influenced by the information in the outer squares (behaviour determinants). The behaviour determinants are not placed in any hierarchical or sequential order – rather, they are placed on a circle to show that there is interaction between personal, external and contextual factors.

2.5 Conclusion

This chapter has briefly highlighted the challenges of studying energy behaviour. It has reviewed psychological and sociological models and theories used to explain energy behaviour as well as child development theories. These frameworks, models and theories were combined to create an integrated framework that will be used to analyse research results. This chapter also reviewed studies on children's energy behaviours and on children and the environment. The review has shown that children use and save energy in different ways and that they have different reasons for saving energy of which financial reasons are the ost cited. It has also highlighted that the location in which the behaviour is performed, and energy-dependant technologies are important factors. The chapter has revealed that children gain their knowledge from different sources of which the home/parents and the school/educators play an important role in developing knowledge and fostering behaviour. The following chapter discusses the methodology.

3 Methodology

The purpose of this chapter is to describe and justify the methodology that was implemented. Section 3.1 describes the nature of the research and outlines how research design decisions were made to adopt a case study strategy and the purposive sampling framework. It then describes the mixed methods research by outlining the tools and steps that were taken to collect and analyse the data in section 3.2. This chapter also provides a description of South Africa's energy landscape and the case study area, Khayelitsha, in section 3.3. Finally, section 3.4 presents the ethical issues related to research with children.

3.1 Research purpose, design and positionality

A research study can be used to: explore, describe, understand, explain, develop, discover, examine and/or predict phenomena (Babbie & Mouton, 2009; Creswell, 2009). The purpose of this study is to explore and describe the energy activities of children in Khayelitsha and the factors that influence their energy-saving activities. According to Babbie and Mouton, (2009), part of the research process involves adopting a research design, this helps the researcher decide on tools, participants, methods and resources that are necessary to achieve the purpose of their research. The research design is made up of the research strategy, the sampling framework, the data collection and analysis tools (Punch, 2005; Babbie & Mouton, 2009), and it is guided by the researchers' philosophical beliefs and the amount of resources at their disposal (Saunders, 2009).

3.1.1 Positionality

This thesis has adopted a constructivist paradigm, which assumes that the world is a social construct created through the interactions of individuals and groups (Creswell, 2009; Saunders, 2009). Humans are seen as social actors, shaped by historical and social factors, who attach subjective meanings to their experiences and objects (Creswell, 2009) and are motivated by personal values, beliefs and preconceptions (Saunders 2009; Walliman, 2011). The aim of research in the constructivist paradigm is to understand and interpret these meanings from the perspective of those who are involved; hence the view/voice of the participant is valued. In this paradigm, knowledge exists as more than one perspective and interpretation (Walliman, 2011), therefore allowing for people's voices to be heard. Unlike positivists who argue that truth and knowledge is uncovered through the rigorous application of scientific methods with no interference from the researchers (biases/misperception) (Guba

& Lincoln, 2008), constructivist take the stance that truth results from agreements between members of a community and it is therefore subject to negotiations and dialogue (Guba & Lincoln, 2008). Researchers within this paradigm also engage with research participants, recognising that their interpretation is also influenced by their own experiences (personal, historical and cultural) (Creswell, 2008; Saunders, 2009). With this in mind, the researcher is of the view that children are an important group of energy users, whose views and opinions ought to be heard. Moreover, the researcher is aware that her previous work with children has influenced the uptake of this research topic.

3.1.2 Case study research strategy

A case study approach was adopted in this study. The basic idea behind this strategy is that one or several cases are studied in detail to gain in-depth understanding of a phenomenon/issue using any necessary methods (Punch, 2005; Walliman, 2011). This method is suitable when the context under study has significant bearing on the findings and when the researcher wants to present detailed accounts of their study case (Yin, 1994, Creswell, 2009; Cohen, Manion & Morrison, 2011). Based on Yin (1994; 2014), a case study approach allows the researcher to: define the context along geographic or other boundaries, study a relevant contemporary phenomenon, use existing theories to guide data collection and analysis and to collect data from multiple sources using multiple data collection tools. Although the case study provides these benefits, Yin (2014) further states that there are challenges to using this method, it is argued that case study results cannot be generalised. However, according to Yin, (2014: 21), the goal of case study research is "to expand and generalize theories and not to extrapolate probabilities". Thus, the aim of case study research is to use existing theories and conceptual frameworks to gain in-depth accounts of the context and detailed insight into children's energy behaviours.

3.1.3 Sampling framework

A combination of typical case sampling, theory-guided sampling and criterion sampling were employed. These are types of purposive sampling used by researchers to select participants based on their characteristics that are viewed as useful and relevant to the study (Babbie & Mouton, 2009; Saunders, 2009; Silverman, 2013). Purposive samples are suitable for case study research and require researchers to have clarity on the parameters of the researcher to ensure that the respondents are appropriate (Saunders, 2009; Silverman, 2013). Typical sampling is used show readers what is typical of the subject matter. It was used to provide a description of the context the study respondents live (Palys (2008) and Saunders 2009).

The research respondents were selected after reviewing literature including research studies on child energy behaviours, theories of energy behaviour and child development, the National Science and Technology curriculum and primary school literacy assessment documents. The sampling process was as follows:

1. Khayelitsha was selected as the study area because it is a community close to the researcher that has conditions that are typical to the environments that some children in South African live in. These include poor service provision, poor housing, high unemployment rates and high crime rates (Seeking, 2013; Clarke, 2015).
2. Once ethical clearance was granted by the University of Cape Town and the Department of Education (see Appendix 1), several schools in Khayelitsha were provided with information sheets and consent forms requesting their participation. The research was made voluntary to the schools and to the students. The school was selected if it was in Khayelitsha and permitted the researcher to work with the children. One school accepted the invitation to participate in the study.
3. Grade 7 learners were targeted as the unit of analysis because they have finished intermediary phase education (Grades 4 to 6) and primary school literacy assessments take place at the end of Grade 6. Their studies provide foundational energy education as part of the National Science and Technology Curriculum.
4. A total of one hundred and five (105) grade 7s learners in the school were invited to participate in the study and they were given information and consent forms (see Appendix 2) to take to their parents for their consent. Learners with permission from parents were also asked to consent to the study themselves. Ninety (90) children submitted consent forms.
5. The parents of participating Grade 7 learners were asked to participate. A total of 57 parents participated in the study.
6. The participating educator had to have been teaching the Science and Technology curriculum at the consenting primary school to children in Grade 4 and above.

3.2 Research sample and data collection

Keeping in mind that mixed methodology research incorporates both qualitative and quantitative research, several tools were used to collect data from the research participants (see Figure 3.1).

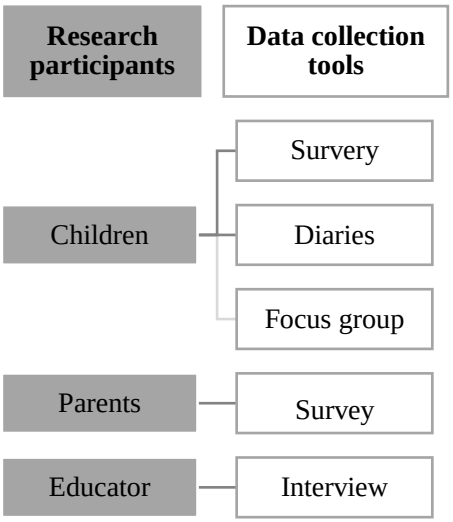

Figure 3-1: Research sample and data collection tools

Figure 3.1 shows that three methods, namely a diary, a survey and focus group discussion, were employed to obtain data from the children. This was done for two reasons: firstly, it acknowledges that children have different capabilities and use different mediums to communicate their views and opinions (James et al., 1998 cited in Marrow 2008). Secondly, having complementary data collection techniques would strengthen the quality of data given the limited timeframe (triangulation) (Aguirre-Bielschowsky, 2013). To collect data from the parents and the educator, a survey and face-to-face interviews were used respectively. Previous studies with children have employed these methods, for example Boudet et al. (2014) used a questionnaire and Toth et al. (2013) used both diaries and focus group discussions. The following sections discuss the benefits and disadvantages of each data collection tool. It should be noted that there are overlaps as children completed more than one method.

3.2.1 **Questionnaire Survey**

Surveys were used to collect data from both the children and the parents. This method is used to collect quantitative data and is appropriate for both descriptive and exploratory research (Saunders, 2009). This approach was chosen because it is cost-effective, designed to be easily understood, quick to administer across a large geographical area with minimal interaction (Saunders, 2009; Walliman, 2011). Participants are asked open-ended and/or closed-ended question to gain data (see Figure 3.2 for a sample of the questions).

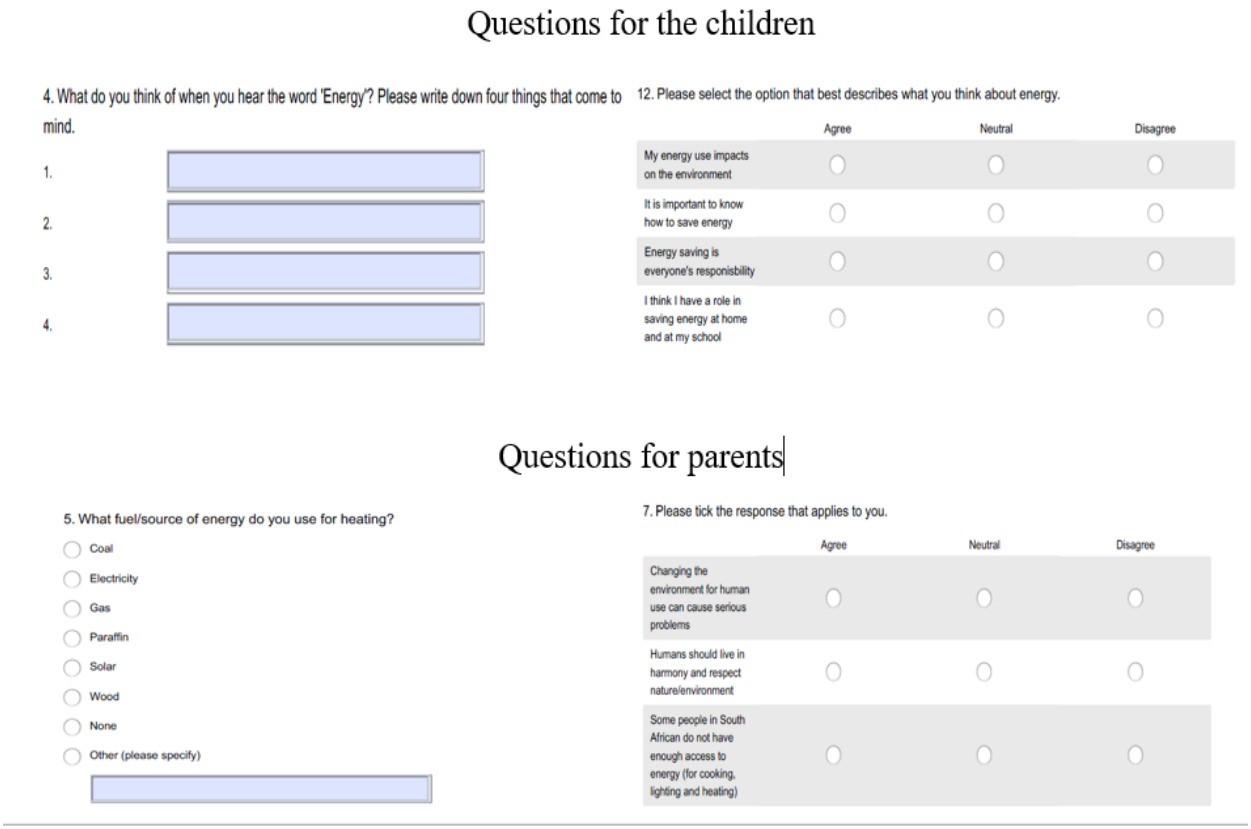

Figure 3-2: Sample of research questions

Open-ended questions allow participants to write down responses while closed-ended questions provide participants with response options. Surveys use quantitative tools to produce descriptive statistics and to infer "possible reasons for particular relationships between variables and to provide models of these relationships" (Saunders, 2009: 144). In designing the surveys (child and parent), questions were developed after consulting several previous researchers' works (Boudet et al., 2014; Ntona et al.; Solopova, 2008; Boylan, 2008; DeWaters and Powers, 2007, 2008) and the Intermediary Phase (Grade 4-6) Science and Technology curriculum. The curriculum is discussed further in section 3.3.1. Once this was done, SurveyMonkey was used to create the survey. Paper copies of the survey were then printed for piloting. Six children from the school and three adults in the community took part in this process. After their feedback, some of the questions in the survey were changed and others were simplified to suit the sample. According to Babbie and Mouton (2009: 244), pre-testing survey instruments helps to minimise mistakes such as ambiguous questions and inappropriate questions.

The survey was administered with 90 consenting children during a science lesson over 30-40 minutes. After they completed the survey, the children were invited to take home a survey for their parents to complete and return them to school. Of these, 57 parents returned their surveys. The children were also invited to participate in a diary exercise and those who accepted were given the diaries. The survey data was then exported onto SPSS and Excel to obtain descriptive statistics and generate graphs. To gain further insight into the relationships between variables, several Chi-square tests were generated on SPSS. Once the surveys from the parents were returned, the same data-capturing and analysis process was repeated. The challenge of using this approach is that there is also a limit to the number of questions that participants could answer, and participants were not compelled to answer all the questions or to complete the survey (Walliman, 2011). Although the researcher discovered that some the children and the parents did not answer all the questions, the data from generate from the surveys provides valuable insight into children's energy attitudes, behaviours and knowledge. Moreover, while this did not manipulate events and behaviour, it is likely that the manner in which questions were phrased could have influenced responses.

3.2.2 **Energy diary**

Diaries are research tools used by respondents to record their "reactions and feelings; specific behaviours; social interactions; activities" and be used for qualitative and quantitative research (Symon, 2004: 98). They are used to gain insight into ongoing everyday behaviour and they provide an account of phenomena over time. This approach was chosen to provide rich descriptions of children's attitudes, behaviour, motivation and knowledge in their own words. It is also less intrusive compared to other methods because it allows respondents to participate at times that are convenient to them (Synom, 2004). The children were provided with a structured diary requiring them to record their energy uses, how they save energy and their reasons for saving energy (see Figure 3.3).

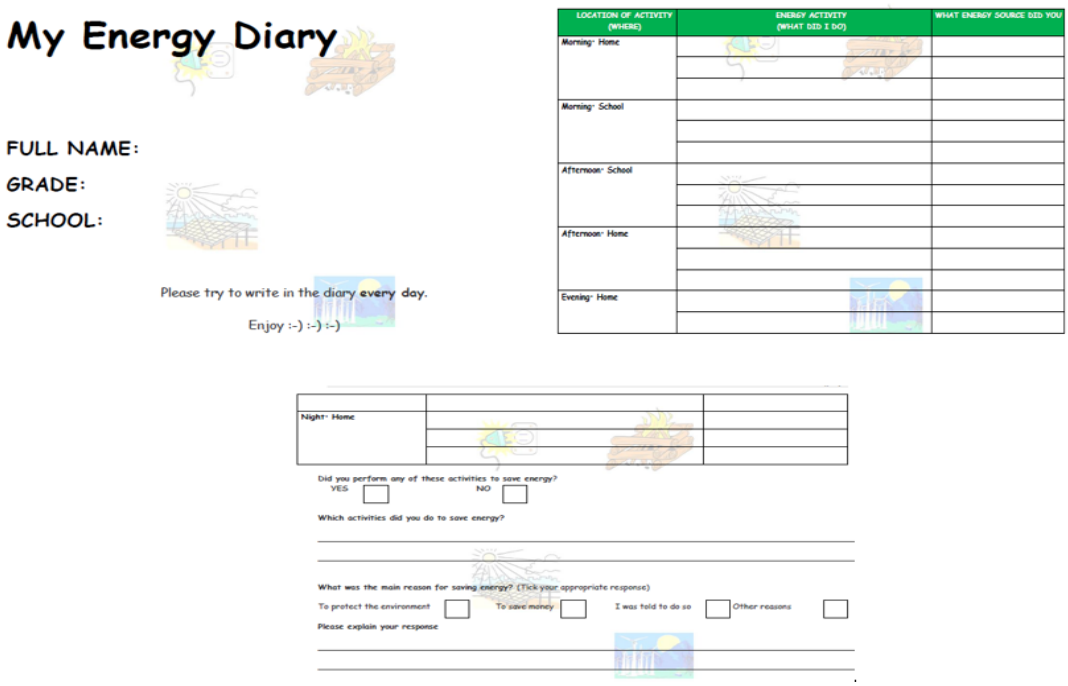

Figure 3-3: Energy Diary Template

The 90 children who participated in the survey were given seven days with the diary, with the aim of having them record this information over a period of five days and two days to familiarise themselves with the tool. It was developed after consulting Walsh (2007) and Toth et al (2013). Paper copies were then printed and piloted with the same six children who had piloted the survey. Piloting the diary was necessary, because as Synom (2004: 99) highlights, research diaries are different from personal diaries. Moreover, the researcher wanted to find out whether the children would understand what was required of them. Diaries were collected after one week, but some of the children reported that they had forgotten to bring them back so another batch was collected in the second week. The data was captured onto Nvivo and an adapted version of Tesch's (1990) analysis framework was used to analyse the data. This process involved analysing each script by placing labels and codes on ideas that emerged. This enabled the researcher to find connections between the different responses to develop themes and categories. This process was repeated several times. However, there are drawbacks to using the diary approach. Respondents are not always committed to writing in diaries and the structure of the diary can influence responses by not leaving room for participants to write freely (Synom, 2004). In this thesis, participation was voluntary, and children were given spaces to write freely. Similar to findings by Toth et al. (2013), some children did not submit their diaries and of those that were submitted, entries were incomplete. 49 diaries were returned, 7 had no usable content, therefore only 42 diaries were

analysed. The focus group discussion was then employed to verify data from the diaries and the survey and to seek clarification.

3.2.3 **Focus group**

The focus group discussion consists of a group of people with specific characteristics discussing a topic in an informal setting with the researcher or another acting as a facilitator (Saunders, 2009; Walliman, 2011; Silverman, 2013). Depending on the topic and the aim of focus group, the size of the group varies (Saunders, 2009). The benefit of using this approach is that it can generate a lot of data as a group of people can explore, evaluate and respond to a topic of issue. Moreover, group participants can corroborate and challenge each other's views (Saunders, 2009). In this study, one focus group discussion was conducted to clarify and probe the themes that emerged in the diaries and their survey. The discussion points were developed from those themes. The focus group discussion was conducted at the school during a computers lesson over 30-40minutes. It involved 12 children (all participated in the survey and some had submitted their diaries) and the researcher sitting in a circle and reflecting on the research findings. The researcher asked for 3-4 children from each class and together 12 children volunteered to participate. The focus group was held in an empty classroom and the children were informed of the use of an audio recorder. This tool is used to capture the discussion and ensure that participants were not misquoted during the transcribing stage (Babbie & Mouton, 2009). The recording was then transcribed using NVivo and analysed to draw out the main themes.

It is important to note that, unlike with Aguirre-Bielschowsky (2014) and Toth et al. (2013), the focus group was not the main data collection tool but rather it was used to clarify data from the survey and the diaries; hence, only one group meeting was held. This is a limitation to the study. Other challenges of using this approach is that it can be dominated by a few individuals who are out-spoken and it is also subjective to response bias because it is like an interview (Saunders, 2009). Moreover, the audio recorder can interfere with the interview process as the interviewees become self-conscious and it can be subject to technical problems (Saunders, 2009; Walliman, 2011). In this study the audio-recorder experienced some technical difficulties during the focus group discussion due to noise from the outside. therefore, some of the information was inaudible. This problem was overcome by the researcher as notes were made on a writing pad in accordance with the discussion points.

Moreover, the researcher encouraged participation by highlighting that there was no right or wrong answer and that their views are important.

3.2.4 **In-depth interview**

Once all the data had been collected from the parents and the children, the educator for Science and Technology in Grade 7 was interviewed. The educator indicated that she had taught the children in the previous year. A semi-structured interview was used with the educator to gain new insights, identify general trends and to "understand the relationships between variables" (Saunders, 2009: 322). This was done to gain insight into school resources and the relationship between the school and the parents. The questions were also developed to gain insight on the energy education system, and the relationship between the school and stakeholders in the energy sectors. The interview was conducted in the meeting room for about 45-60mins. The educator was informed about the presence of the audio-recorder and in the same manner as the diaries and the focus group discussion, the interview was transcribed using NVivo and an adapted version of Tesch's (1990) analysis framework was used to analyse the data. However, a limitation to the study is that only one interview was conducted. Also, interviews can suffer from the problem of interviewer and response bias (Saunders, 2009). To minimise response bias, the educator was informed of confidentiality and anonymity and to reduce interviewer bias, the researcher was aware of how personal factors had influenced the decision of this research study

3.2.5 **Profile of the respondents**

The analyses of the research results show an 85.7% response rate as 90 children answered the survey. It also shows that the voluntary journaling exercise had a participation rate of 46.7% as 42 pupils returned the energy diaries that had been distributed Table 3.1.

Table 3-1: Children-Response rate

RESPONSE RATE[8]			
		Frequency	**Percentage**
Survey	Asked to participate	105	100%
	Answered	90	85.7%
Diary	Distributed	90	100%
	Submitted	42	46.7%

[8] It is important to note that n values are different as some questions were not answered.

The participants' demographics were slightly skewed as more females (60.9%) than males (39.1%) participated in the survey; similarly, a higher percentage of females (71%) handed in their energy diaries while fewer males (29%) did so (Table 3.2). This structure is representative of this class but not of society.

Table 3-2: Participation by Sex/Gender

RESPONSE RATE			
	Male	**Female**	**Total**
Survey	39,1%	60,9%	100%
Diary	29%	71%	100%

The children who participated in the research study were between 11 and 15 years old and the majority (76.7%) were between the ages of 12 and 13. As part of this study, 90 surveys were also distributed to the children's guardians. The results show a response rate of 63.3%, as 57 surveys were returned. Where parents are involved, the results show that 84.6% of the survey was answered by mothers, while fathers and aunts each represented 5.1% and grandmothers and uncles each represented 2.6% of the sample (Figure 3.4).

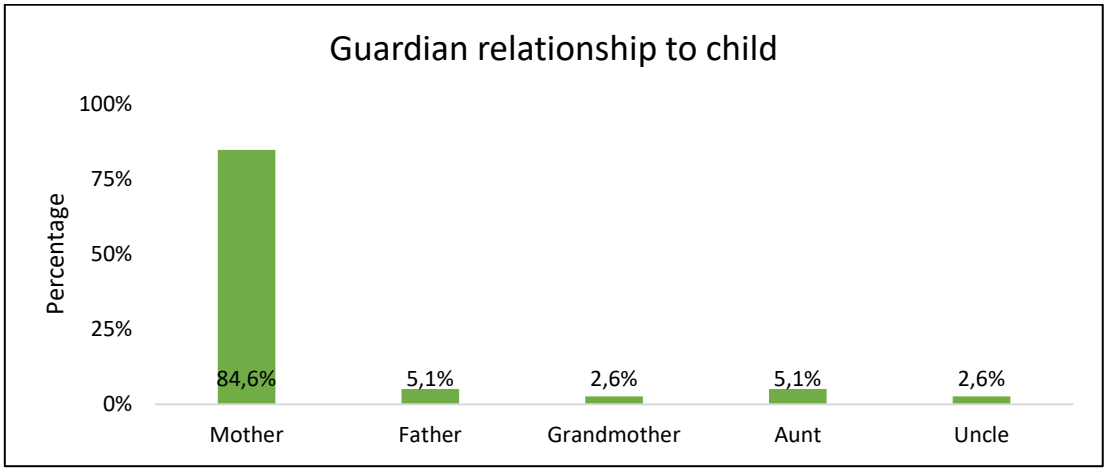

Figure 3-4: Guardian relationship to child (n=39)

The results also show that the majority (60.9%) of the guardians were married, with 28.3% having never married. The remaining 10.8% were separated, in a domestic partnership or living with a significant other. Figure 3.5 depicting their employment status, shows that of the 57 respondents, 20 were full-time employees, 8 were part-time and 11 unemployed; 14 of the

respondents chose not to state their employment status, with the rest (8) indicating that they are not looking for work or unable to work. These findings are consistent with the 2011 census results on Khayelitsha that suggest that unemployment is high and there is a shortage of permanent work (CoCT, 2013: 4).

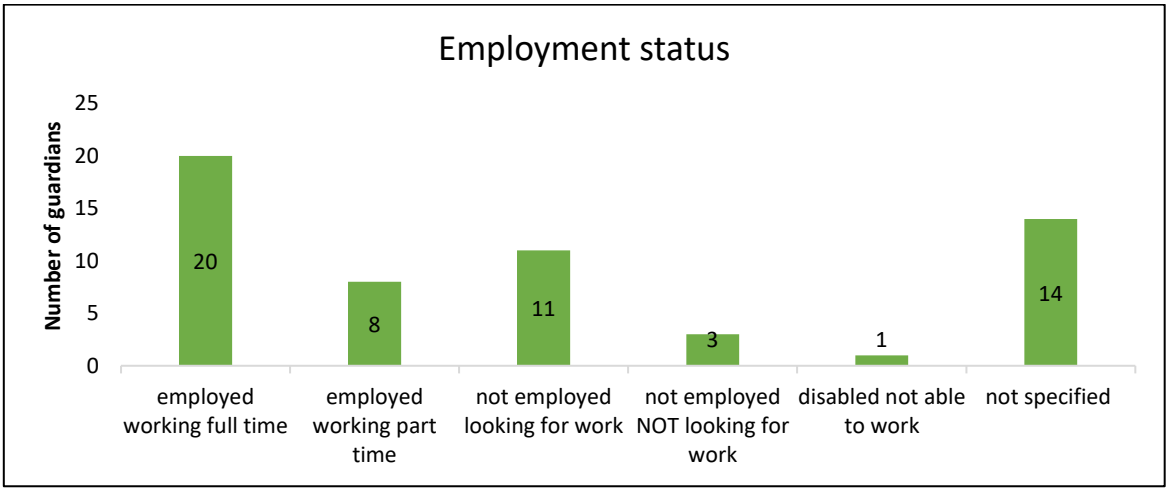

Figure 3-5: Guardian employment status (=57)

Regarding their educational level, Figure 3.6 shows that the majority (53.5%) of the guardians had some secondary schooling or had matriculated and that 4.7% had not attended school.

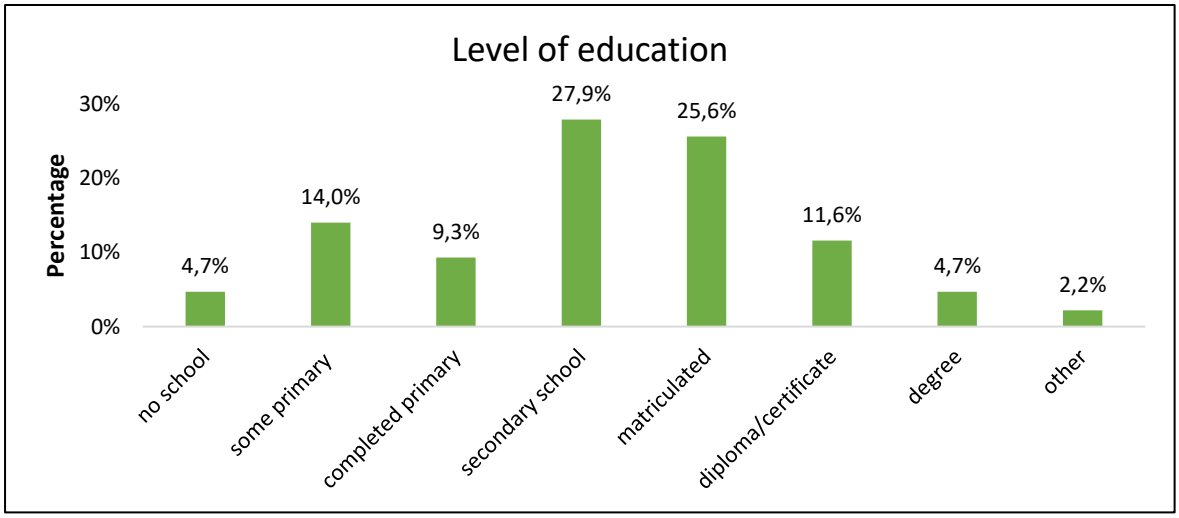

Figure 3-6: Level of education (n=43)

Of these guardian respondents, 23.3% had received some or completed primary schooling and 18.5% indicated that they had a diploma/certificate, degree or other qualifications. In comparison with the educational profile of Khayelitsha provided by CoCT, (2013: 4), in this study more guardians had diplomas or other qualifications while fewer had secondary schooling or matriculated. (2.9% had no schooling, 14.2% had primary schooling, 78% had secondary education and 5.1% had other higher or other qualifications). Considering the low levels of education in this community, it is possible that some of the guardians may not have felt confident to participate in the survey. Future researchers in this area could use other methods with parents to capture data.

3.3 Study context

As indicated in the previous chapters, the fact that most of the existing studies on children and energy have been carried out developed countries, necessitates the need to study children's energy behaviour in a developing country. This section provides a brief overview of South Africa. It highlights the state of energy in the country and the government's response to energy-environment problems, including energy education. It outlines national household energy use patterns, energy-saving behaviour and attitudes toward energy and the environmental. This section also provides insight into the historical significance and current conditions of Khayelitsha, the study site.

3.3.1 The State of Energy in South Africa: energy climate policy and energy efficiency

South Africa is an energy intensive country, contributing to global carbon emissions and to climate change (Winkler & Marquard, 2009). Since the 1970s, the South African energy sector has been largely driven by coal (Burton & Winkler, 2014; Baker et al., 2015). South Africa not only provides over 90% of Africa's coal demands, but coal also dominates national installed electricity capacity (85%) and primary energy demand (70%), and contributes significantly to liquid fuels (30%) (OECD/IEA, 2014; Burton & Winkler, 2014). An analysis of emissions reveals that South Africa is the largest emitter in Africa accounting for over 40% total emission and contributing 1.49% to total global emissions (Urban Earth, 2012: 7). The country's per capita emission (9.18 tonnes of CO_2) however surpass the world average per capita emission (4.49 tonnes of CO2 per capita) thus resembling per capita

emissions of developed countries[9].According to the World Energy Council, the energy intensity of South Africa in 2015 was 0.25 (million BTU per USD) while CO_2 emissions were 7.12 (metric tons CO_2 per capita) and GDP/capita (PPP, USD) GDP Group was 12,867 (III). There has been a reduction[10] since 2011 due to steps taken by government reduce emissions. According to Kohler (2017), the source of concern is that the reduction in South Africa's energy use per unit of GPD has been relatively smaller when compared to other BRICS countries, indicating that it is still high. Moreover, although South Africa has a history of high energy use, this has had limited positive impact on economic and social development. This is partly due to apartheid policies implemented pre-1994 that promoted infrastructural, economic and social development for the minority White population while largely neglecting other racial groups especially Black South Africans (Winkler, 2011: 31). While progress has been made[11], post 1994 macroeconomic policies have prioritised economic growth and social development has not occurred as excepted as such South Africa is still characterised by "systemic social and economic exclusion" (Sustainable Energy Africa [SEA], 2012: 1).

Since the end of the apartheid rule in 1994, the country has experienced both achievements and challenges (Gaunt, 2005; Bekker et al., 2008; Trollip et al., 2014) that have had a great impact on children. Institutional and policy changes in the energy sector started with the removal of racist policies and the extension of electricity access to other populations, mainly black South Africans. As a result, the electrification rate increased from 36% in 1996 to 85.5% in 2015 (Gaunt, 2005: 1310; StatsSA, 2015: 36). This also increased children's access to clean energy such that by 2014, 89% of children in South Africa had access to electricity (Hall, 2016).The DoE (2013:3) has noticed a modest decline in energy poverty (spending more than 10% of income on energy costs) from 47% in 2011 to 43% in 2013 and Stats SA, (2015) has also noted a declining trend in the use of alternative sources of fuels such as wood as more households use electricity to cook, meaning that fewer children are exposed to harmful fuels. The government has also taken steps to decarbonise the economy. Within the electricity supply sector, there has been an increase in the contribution of renewable energy sources through the Renewable Energy Independent Power Producers Procurement

[9] It is also higher than per capita emission of China (5.83 tonnes of CO2) and India 38 tonnes of CO2). South Africa's per Capita emissions resemble those of developed countries US(17.67) and Russia (11.23) (IEA 2009 cited in UrbanEarth , 2012: 7).

[10] In 2011 energy intensity which was at 0.32 (million BTU per USD), CO2 emission which was at 7.33 (metric tons CO2 per capita) and GDP/capita (PPP, USD) GDP Group which was at 10,219 (III)

[11] Particularly economic: GDP per capita (53rd) (UNDP, 2007 as cited in Winkler & Marquand, 2009: 48).

Programme (REIPPPP) (Baker et al., 2015). In the residential sector, energy efficiency measures have included the promotion of solar water heaters, appliance labelling, efficient lighting, improving housing standards (Department of Minerals and Energy [DME], 2009), fuel switching and geyser insulation blankets (Winkler & Marquard, 2009: 56) However, despite the improvements, the service provision gap between rich and poor household exists "with 99% of children in richest 20% of households having a mains electricity supply, compared with 85% of children in poorest 20% of households" (Hall, 2016). Delayed decision making and inadequate investment in the sector has resulted in an increasing electrification backlog (Trollip et al., 2014), regular load shedding in 2008 and 2014/2015 (Sustainable Energy Africa, 2015), an unreliable electricity supply and increasing electricity prices (OECD/IEA, 2014). Although no detailed studies of social impacts, particularly on children, have been undertaken, anecdotal media accounts have reported that load shedding disrupted children's school and eating routines (CNBC Africa, 2015; Rondganger, 2015). Further investments into coal-fired power stations highlight challenges in the implementation of national climate change mitigation policy as it continues to place South Africa in a high carbon emission development pathway (Burton & Winkler, 2014; Baker et al., 2015). In addition, over 75% of South African households use pre-paid meters, "which helps overcome the problem of non-payment" (OECD/IEA, 2014: 446). However, households that are not able to afford electricity continue to use wood (StatsSA, 2015; Trollip, 2014; OECD/IEA, 2014), paraffin (Tait, Merver & Sentatla, 2014) and coal (Surridge et al., 2005 cited in Barnes, 2014) that are more affordable and accessible. Geographically, 35% of households in Limpopo use wood as their main source of cooking energy while about 10% of households in the Eastern Cape use paraffin and 10% of households in the Western Cape use gas as their main source of cooking fuel (Stats SA, 2015). This continues to place children at risk of safety and health problems such as child acute respiratory infections, fires, burns (Barnes, 2014) and poisoning from ingesting fuels such as paraffin (Merver & Sentatla, 2014). The DoE (2013) also reported that service delivery protest is common, and they found that 33.3% of South African households felt like they pay too much for electricity while 25% indicated that the amount of energy available to them is inadequate to meet their needs. The education sector has been targeted as a significant aspect of the energy landscape to raise awareness of energy related issues and to encourage behavioural changes through from pre-school through to adult education (DME, 2005).

Energy Education in Primary School

According to Kandpal and Garg (1999), energy education is crucial in developing countries given the need to increase access to energy and to mitigate against climate change. In South Africa energy education has been introduced to primary schools (Wassung, 2010) and is offered as part of the Science and Technology curriculum to build learners scientific and technological literacy (Department of Basic Education [DBE], 2009). However, it is important to note that energy education differs between private schools and public schools, with some schools not including it in their curriculum and in some areas children as young as five years learning about electricity and renewable energy (Wassung, 2010). Based on the Science and Technology curriculum (DBE, 2009), knowledge areas for the children in the intermediary phase include 1. Matter and materials and structure; 2. Energy and change and structure; 3. Life and living and structure; 4. Earth and beyond and mechanisms.

- In Grade 4 energy studies explore energy change and structures which covers air and energy, mechanisms that use moving air, sound and musical instrument). Children are also introduced to topics about living and non-living things, the earth and matter.
- In Grade 5 the focus is on energy and change and mechanisms which include concept of energy, renewable and non-renewable, different forms of energy, lights, heat, sound, electrical, energy systems and machines. Children are also taught about fossils, benefits of renewable and non-renewable energy, the earth, food chains, life cycles of plants and animals and properties of materials.
- In Grade 6 children cover topics on energy and change which explore electricity circuits, conductors and insulators, energy transfer, basic safety and electrical circuit to solve a problem. They are also taught about, for instance, the environment and water resources, solar system, ecosystems, and a healthy environment. They are also informed about human impact on the environment and the need for personal actions to improve the environment and solar system[12].

In light of the curriculum and after the review of existing literature, this study sought to gain insight into the following knowledge aspects: i) how children understand the concept of energy, ii) their understanding of topics such as energy transitions, sources of energy,

[12] Page 57 of the Science and Technology curriculum states that "humans can have an negative or positive effect on the environment and part of the children work in grade 6 is to demonstrate "actions that they implement to improve the environment".

renewable and non-renewable energy, the natural environmental and mans impact on the environment; and iii) their ability to link environmental and energy concepts. An analysis of the curriculum shows that while energy is a major theme in the curriculum, there is limited emphasis given to linkages between the energy and environmental topics in Grade 6. Hence, considering that the children participating in this study at the start of their Grade 7 education, their understanding of these topics might be limited. Moreover, the curriculum makes little mention of behaviour change, a topic that is of great importance given the current status of climate change nationally and internationally. Wassung (2010) further points out that Demand Side Management is taken up by Eskom and they provide participating institutions (teachers, students) with resource packs and energy audit guide.

3.3.2 Household appliances and energy consumption behaviour in South Africa

According to the General Household Survey, (Stats SA, 2015) and the DoE (2013) the majority of South African households have electric stoves, TVs, refrigerators, irons DVD/Blue ray player, microwaves, washing machines and geysers. However, fewer households reported having solar hot water heaters, solar electrical panels, tumble dryers, dishwashers and air conditioning. The DoE (2013) also found that 57% of South African households use one energy source while 43% using multiple sources. In the case of lighting, 89% of the South Africans use a single energy source (electricity the most common) while 11% use multiple sources. When cooking, 60% of respondents used a single energy source with 40% using multiple sources (DoE, 2013: 47). Regarding heating rooms and keeping warm, 61% of household reported using a single energy source[13], 18% multiple energy sources, 19% relying on blankets, clothes and hot water bottles, and 2% having no energy source to keep warm. Finally, 80% of households use a single energy source while 20% of households use multiple sources for heating bath water. Appliances used for heating water include geysers, kettles, stove with some using paraffin and wood. The DoE, (2013) also found that South African use several energy-saving techniques (see Table 3.3).

[13] Electricity, firewood, paraffin, gas, coal or dry cell battery.

Table 3-3: Energy saving practices in South Africa DoE, (2013: 96)

	Awareness%	Often do%
Switching off the lights when you leave your house	89	64
Using energy-saving light bulbs	76	53
Use warm clothing or blankets instead of an electric heater	59	38
Switch off appliances at the wall when not in use	81	51
Boil only as much water with a pot or kettle that is needed	63	36
Switch off all lights except security lights in home when not is use	65	36
Take a short shower or bath with little water as possible	47	26
Switch off geyser at certain time during the day or at night	56	28
Electric stove use a lot of electricity so use the plates and oven as little as possible	60	30
Allow clothes to drip-dry instead of ironing	40	19
Close windows and doors when a heater is on	44	19
Insulate your geyser and hot pipes	28	6
Install a solar water heater instead of an electric geyser	37	4

Table 3.3 shows that switching off lights and appliances and using energy-saving light bulbs and were the most common practices. The respondents were less likely to close windows and doors when using heaters, insulate the geyser and install solar water heaters. The following section provides a description of Khayelitsha's geographical, economic and social setting

3.3.3 Khayelitsha

Khayelitsha[14], meaning New Home, is a low-income residential area in Cape Town that is commonly referred to as a township. This is a "colloquial term used to describe urban and peri-urban African settlements" (Clarke, 2015:2), but for many, it is an apartheid era label reminiscent of institutional racism (Seeking, 2013: 3). Established in 1983, it was expected to provide housing (small two-bedroomed house) for about 120 000 black South African people in Cape Town (Seeking, 2013; Clarke, 2015). However, due to slow progress, the people were housed in tents or temporary shacks. Thus, as the population continued to grow so did the number of informal settlements and backyard shacks in the area (Seeking, 2013). Khayelitsha is bordered by the N2 and by Mitchells Plain and it "now covers almost the

[14] According to Seeking (2013), there is limited information available on Khayelitsha especially in journals and academic writing. Most of the available data is found in census and survey results.

entire approximately triangular area up to Baden Powell Drive (the R310) to the south and east" (CoCT, 2013; (Seeking, 2013) (see Figure 3.7).

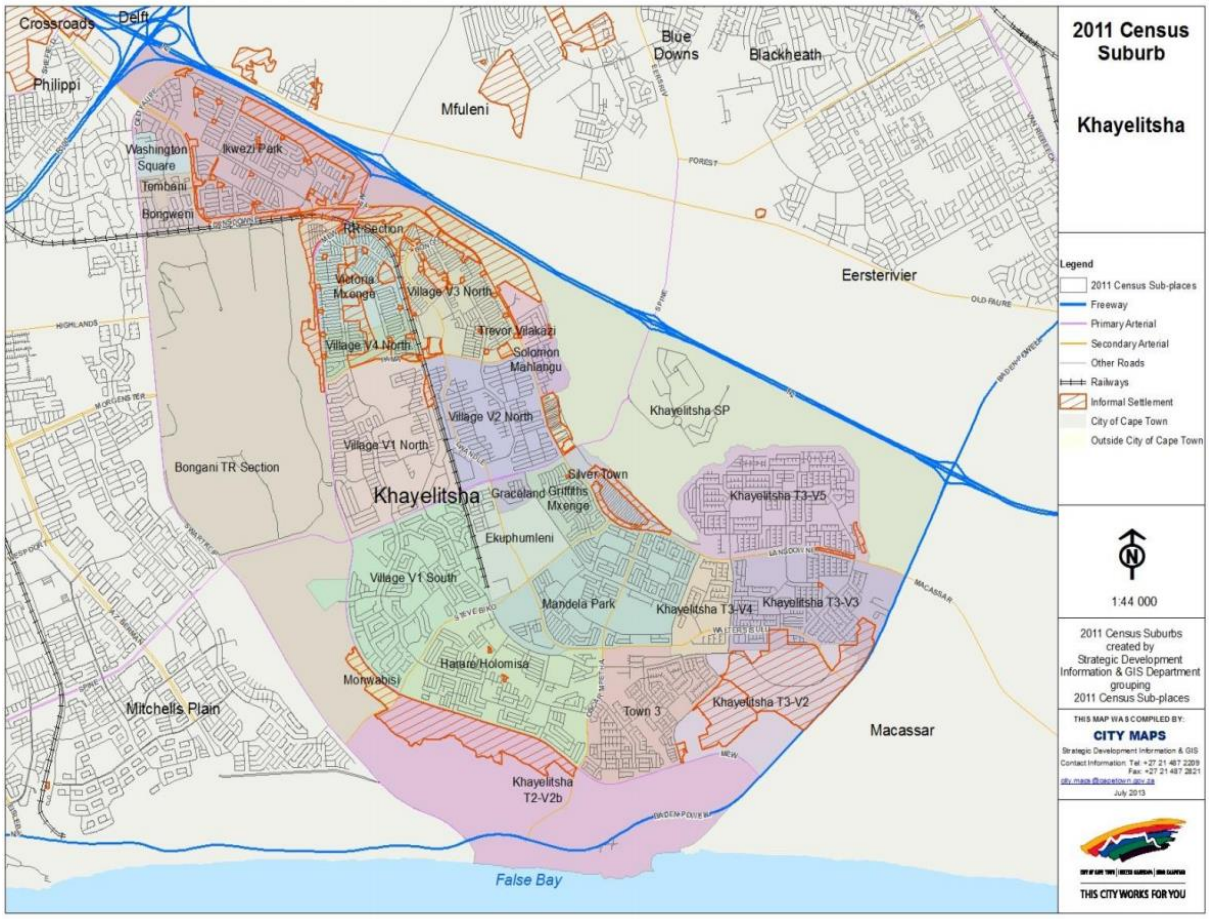

Figure 3-7: Suburb Map-Khayelitsha: CoCT (2013:1)

Given its geographical position, the township is cut off from the economic areas and therefore provides few work opportunities (Clark, 2015). Opportunities available in Khayelitsha are mostly in semi-skilled or even skilled occupations in schools, hospital and safety and security. Jobs are also available as shop assistants, cashiers, domestic workers, toilet cleaners, refuse collectors and in managing businesses, depending on qualification (Seekings, 2013). There is also a growing informal trading sector selling fruits and vegetable and other products (Clark, 2015). Crime is also a serious problem in Khayelitsha and is a source of anxiety for people during the day and a constraint to moving around at night, and is perceived to be a hindrance to self-employment (Seeking, 2013; Clark, 2015). It is estimated that about "10% of the Cape Town's population and about 27% of Cape Town's African population live in Khayelitsha" (Seeking, 2013). One striking feature in Khayelitsha is the increasing number of informal settlements, such that by 2011, 45% of the housing structures

were formal houses and 55% were shacks in informal settlements and in backyards, "mostly in settlement areas especially in the old Site B" (CoCT, 2013; Seeking, 2013). Most the formal houses in Khayelitsha are small, with a few spacious houses in richer areas such as Graceland, iLitha Park and Ikwezi Park. In 2011, the average formal house had four rooms while a shack had two rooms (whether in a backyard or a shack settlement) (Seeking, 2013). Of the population 98.6% is black, with 74% of the households earning R3200 or less a month (CoCT, 2013); 28.1% of the population was aged zero to 14 years, 70.2% aged 15 to 64 years and 1.6% 65 years and older (CoCT, 2013). In the case of infrastructure, there are three police stations, several magistrates' courts, a hospital, some clinics, sports halls and playing fields, among others. As of 2013, there were 33 public primary schools, 19 public secondary schools, and a few private schools. However, some areas do not have schools, meaning that children have to travel to neighbouring areas (Seeking, 2013). In the case of electricity access, Table 3.5 shows that multiple energy use in Khayelitsha is common.

Table 3-4: Services provision in Khayelitsha (CoCT: 2013:4-5)

	Electricity	**Gas**	**Paraffin**	**Wood**	**Candle**	**Coal**	**Dung**	**Solar**	**None**	**Other**
Cooking	75.2%	12%	12.1%	0.1%	-	0.1%	0.1%	0.1%	0.3%	0.1%
Lighting	80.8%	0.4%	14.6%	-	3.8%	-	-	0.2%	0.2%	-
Heating	20.6%	3.4%	55.6%	0.3%	-	0.3%	0.1%	0.3%	19.4%	-

It reveals that in 2011 electricity was the main source of energy for cooking and lighting while paraffin was the main source for heating (CoCT, 2013). There is also poor service delivery as slightly more than a quarter of the household did not have access to a flush toilet or weekly refuse collection and more than a third did not have access to piped water within dwellings in 2011 (CoCT, 2013; Seeking, 2013). As a result, protests highlighting the challenges of poor service delivery are a regular occurrence in Khayelitsha (Seeking, 2013). In 2011, the labour absorption rate was 40.4% and the unemployment rate was 38% (CoCT, 2013: 4). According to Seeking, (2013), both high unemployment and low employment levels support poverty in Khayelitsha as 32%-46% of households were calculated to live below the StatsSA food poverty line. Regarding education, in 2011 2.6% of the population had no schooling, while 14.2% had primary schooling, 47.3% had some secondary education, 30.7% had matriculated and 5.1% had other higher or other qualifications (CoCT, 2013).

3.3.3.1 Household characteristics

The survey asked the guardians several questions to ascertain the types of energy sources and household appliances to gain insight into the type of fuel sources and appliances children have at home. Firstly, regarding energy sources, Figure 3.8 shows that electricity is the main source of energy for cooking in 95.7% of the households, followed by gas (21.7%), wood (9.1%) and paraffin (4.5%).

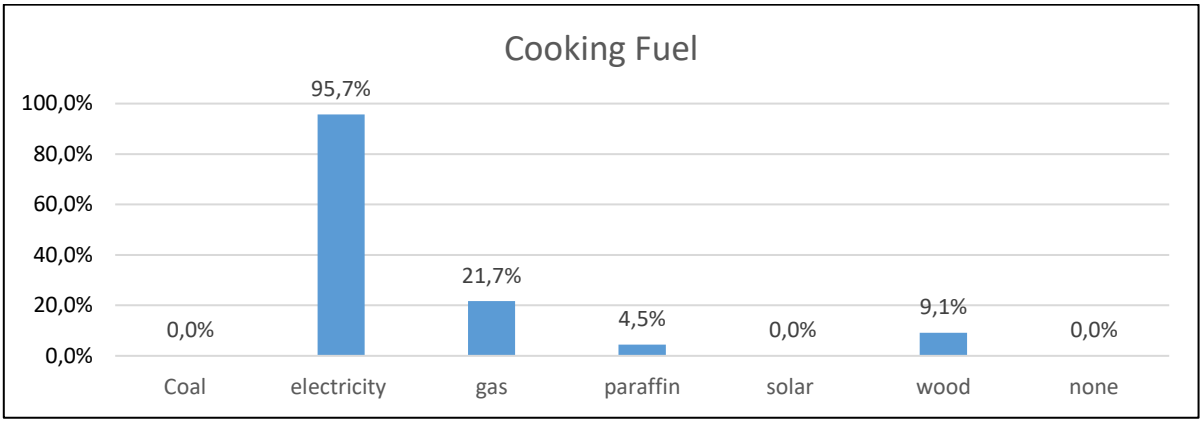

Figure 3-8: Cooking Fuel: (n=23)

Similarly, electricity was also reported to be the main source of energy while other parents also stated the use of candles (8.7%), gas (4.3%) and paraffin (4.3%) (see Figure 3.9).

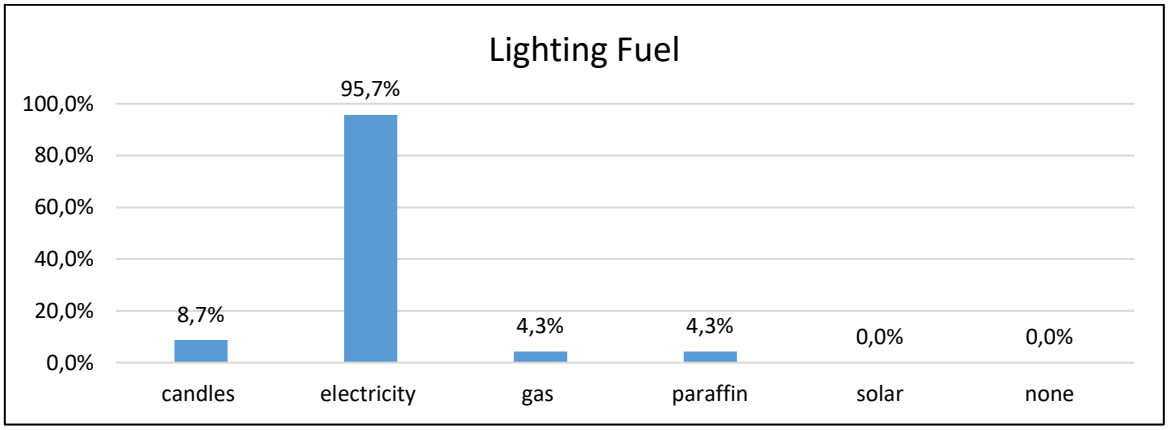

Figure 3-9: Lighting Fuel: (n=23)

Unlike heating and cooking, the majority (63.6%) of the guardians reported paraffin as the main source of energy for space heating in the home, followed by electricity (7), gas (2) and wood (1). Three of the parents indicated having no source of heating (see Figure 3.10).

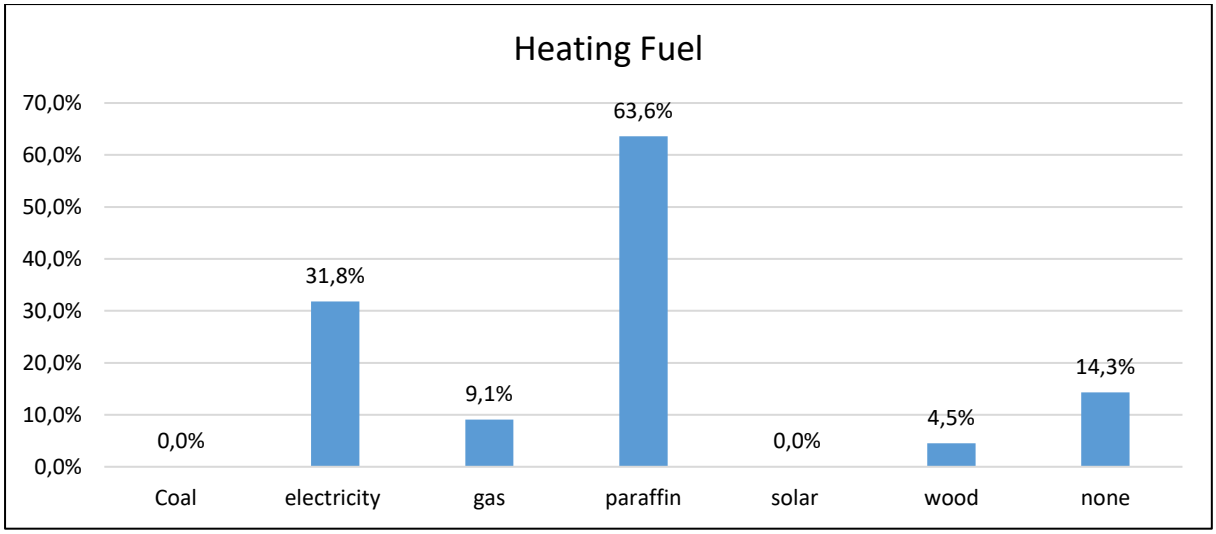

Figure 3-10: Heating Fuel (n=22)

These household energy patterns reported above show that multiple energy use is a common practice at home. This finding supports Tait, Merver and Sentatla (2014), Trollip (2014), and StatsSA (2015), who indicated that multiple energy use is common among some South African households, although as a declining trend (StatsSA, 2015). This finding is consistent with the 2011 Census statistics that show electricity as the main source of energy for cooking and lighting purposes among households in Khayelitsha and paraffin rather than electricity as the main source of space heating (CoCT, 2013). The report also revealed that a substantial number of households in Khayelitsha lacked heating fuels. In the case of appliances, the results revealed that the households had several energy-dependent appliances. Figure 3.11 shows that the most common appliances that were identified by the parents were stoves, refrigerators, cell phones, lights, televisions (TVs) and microwaves, while the least cited were computers, washing machines and video games. This finding is consistent with the general household survey that shows that most South African households have electric stoves TVs, refrigerators, cell phones and microwaves (Stats SA, 2015). Analysis of the results further revealed that on average, each household has three (2.94) appliances.

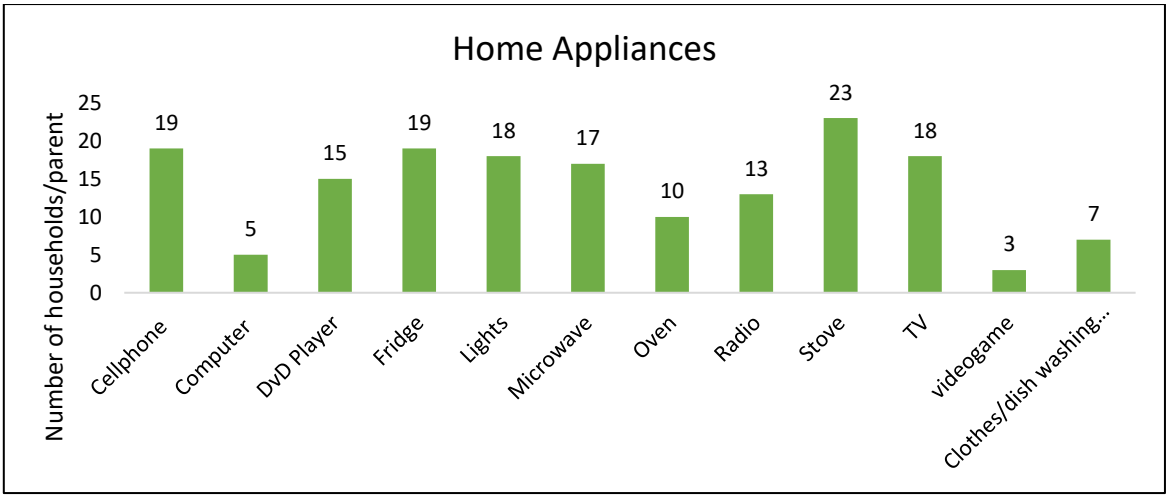

Figure 3-11: Appliance access at home (n=167)

The results also showed that 67.4% of the 43 respondents reported that they paid attention to their monthly household energy expenditure. This was revealed in that 24.4% of the 45 guardians reported spending[15] R0-R250, while 20% reported spending R250 to R500 and another 20% reported spending more than R500 a month. These findings therefore suggest that 64.4% of the parents in this study knew their energy expenditure and are therefore inconsistent with Boudet et al. (2014), who found that parents of Girl Scouts in their study had checked their energy bill in the last three months. However, in this study more parents seemed to be aware of their monthly energy compared to Boudet et al., (2014) who found that less than 50% parents in America checked their energy bills. This is likely due to the need for families living in low income communities to keep accurate accounts of their expenditure. In keeping with the ECF (Stephenson et al., 2010, 2015), reviewed in Chapter 2, insight into the household appliances, the type of energy fuel used and the monthly energy expenditure may aid understanding of children's energy activities. Section 4.2 will now explore energy education and children's knowledge of energy and related environmental issues.

3.4 Research with minors and ethical considerations

In conducting research with children, it is important to be aware that children around the world are not only regarded as a vulnerable population who are in need of society's protection but that they are also seen as future leaders (UNICEF, 2013). They have been

[15] 1USD equals 13.32ZAR as of 16/10/2017 ($0-$18.76) ($18.76-$37.55)

accorded rights and privileges to enable them to contribute to society (UNICEF, 2013) and under the United Nations Convention on the Rights of the Child (UNCRC), children have the right to participate and contribute in matters that concern them, including research (Marrow, 2008). The South African government has committed itself to upholding these rights. As such, in line with article 71.3a ii and article 71.3a iv of the National Health Act (61 of 2003 as amended. 2004), the researcher was granted permission to work with the children by the parents, the school and the Department of Education and the children themselves before embarking on this research. According to Dominelli & Holloway, (2008) Babbie and Mouton, (2009) De Vos, Strydom, Fouche & Delport, (2011) Other ethical considerations includes the following:

- The right to confidentiality: All participants' (children, parents, educator) actual names are not divulged in the research report but given aliases.. Also, the name of the participating school was not revealed. However, confidentiality was limited in the event that the participants revealed anything that could cause harm to themselves or to others.
- No harm to participants and protecting privacy: The study was conducted within the school setting and, therefore, only exposed the participants to the risks found in their normal environment. Data collection was conducted in a manner that caused minimal interference with the school's programme.
- Deception of subjects: In this study, the participating institution, the guardians and the children were informed of the research purpose, the intended benefits of the study and the data collection tools.
- Power and dominance: In this study, the data collection tools were selected to minimise intimidation and any power that the researcher would have over the children.
- Use of research findings and dissemination of information: the research study has informed this Master's thesis. The thesis will be made available via the University of Cape Town library. The findings from this study may also be published in a journal article. All the data collected (diaries, artwork, recordings, and transcripts) is kept safely locked away by the University of Cape Town for five years. When this time has lapsed all the data will be destroyed. The researcher will make a copy of the final research report available to the participants if they which to view it.

3.5 Conclusion

The chapter has outlined and justified the methods used to gather research data. The benefits and challenges of using a case study strategy and mixed methodology approach were highlighted. This chapter has also described the context of the case study and has revealed that the South African landscape is faced with multiple energy-related challenges that warrant accurate understanding of children's energy behaviours. It has also presented, Khayelitsha, Cape Town as the study site. Finally, this chapter has provided a profile of the respondents, described their household characteristic and outlined ethical issues. The following chapter presents the research results on children energy activities and personal factors that influence energy saving activities.

4 Child energy activities and personal factors

Chapter 3 has outlined the tools used to collect and analyse the data and described the research participants and their household characteristics. This chapter presents the empirical results collected through the survey, diaries, interview and focus group. Sections 4.1 and 4.2 present children's self-reported energy use and energy-saving activities respectively. Section 4.3 presents and discusses personal factors that influence energy-saving including and section 4.4 concludes the chapter.

4.1 Child energy use

This section presents children's self-reported energy use. It discusses the activities the children engage in and reveal the energy practices described in the ECF. It also highlights the sources of energy used and the location of their energy use.

4.1.1 Thermal applications

Analysis of the energy diaries revealed that many children were involved in cooking activities at home. Of the 42 diaries that were submitted, 88% of the children reported cooking or preparing a meal for themselves or for other family members (See Appendix 3 for diary entries on cooking). The children in this study reported preparing breakfast, and detailed that they used stoves and microwaves to cook and to warm up their food. Others reported the use of a kettle to boil water for tea/coffee for parents, especially their mothers. Regarding the source of cooking fuel, most children emphasised the use of electricity, while the use of gas, and coal/wood to cook were each reported once. This finding substantiates the use of electricity as the main source of cooking among the households in the study. Further exploration of cooking in the focus group discussion revealed a range of cooking experiences among the children. For instance, while some of the participants indicated that they cook for themselves and family members in statements such as *"I cook for everyone"* (Sophia, female, 13), *"I cook for myself"* (Trevor, male, 14) and *"I make lunch boxes for myself and my sister"* (Tami, female, 12), others indicated that their mothers cook for them with one learner stating, *"mother cooks soups and then I have it with bread…*" (Phuma, male, 12). Other learners, however, expressed not having anyone to cook for them; instead they said, *"we eat bread"* (Ndumiso, male, 12*)* and *"we eat bread and spread Rama"* (Karabo, female, 12*)*. The focus group discussion also revealed differences regarding the days of the week on which the children cook as some shouted out, *"I cook on weekends"* (Linda, female, 13), *"I cook on Saturdays"* (Pamela, female, 13), *"I cook every day"* (Sipho, male, 13) and *"I cook on*

Friday" (Thabo, male, 13). At the end of this discussion, there was no clear pattern regarding which days of the week children cook, however, they made it clear that they cook when they said, *"we cook ourselves sometimes".* These findings are consistent with Garabuau-Moussaoui (2011) and Aguirre-Bielschowsky (2014), who reported that the 9 to 10-year-old children in their France and New Zealand surveys respectively, used kitchen appliances and prepare some meals for themselves. However, unlike some of the children in these studies, who are learning to cook under parental supervision, the children in this study described preparing meals (mostly supper) for their families alone. These results reveal that cooking for themselves and for other people is a responsibility that children are given in the home. None of the other studies with older children in their samples that were reviewed in Chapter 2 explored cooking as an energy activity; hence this finding is important.

4.1.2 **Space and water heating**

The children engaged in heating activities at home including space and water heating. In the case of space heating, 35.7% of the 42 children wrote about the use of heaters (the ones that require physically operating the dial to switch them on and off) while Tshidi (female, 12) and Phuma (male, 12) also mentioned the use of portable wood or coal burners locally known as *imbawula*. In their diaries, most of the children reported the use of electricity as the main source of heating while only Stella and Phuma (male, 12) highlighted the use of paraffin. These issues were further discussed and corroborated in the focus group discussion as the children cited the use of paraffin, electricity and wood/coal as sources of energy for space heating (see Appendix 4 for heating activities). Ntona (2015) and Aguirre-Bielschowsky (2014) report similar findings among children in Greece and New Zealand respectively, as they use heaters, with some children in the latter reporting the use of open fires or wood burners. However, unlike some of the children in the Aguirre-Bielschowsky study (2014), who did not have permission to touch the heaters because their parents feared that they might break the appliance, the children in this study seem to have both access and control over the heater. This is shown by a statement reported by Tshidi (female, 12), that she builds and ignites the fire used for warming up the house: *"*I make *imbawula* so that we can be warm *..."*. Further probing in the focus group discussion, on the use of the *imbawula* which some of children referred to as '*nqwengs'* (slang), revealed that it is mostly used in the Eastern Cape (rural homes) which is often unelectrified. Moreover, there seems to be some incongruence between responses from the parent and the children, as only two learners reported the use of paraffin while most parents highlighted paraffin as the most common source for space

heating. With regards to water heating, the diaries showed that children also use the geyser or the kettle for hot water. The results show that of the 42 children that completed the diaries 14 children reported the use of a geyser in the home with 11 children stating that they switch the geyser on; 22 children referred to boiling water in the kettle either to wash their bodies, dishes, their clothes or their siblings (see Table 4.1).

Table 4-1: Water heating purposes

Child	Statement
Jordaan (male, 13)	*"I boil water to wash my body...then I boil water for dishes".*
John (male, 13)	*"I boiled the water I wash my washing".*
Grace (female, 12)	*"woke up and boil water so that I can wash my body".*
Lesedi (female, 13)	*"I boiled water to wash dishes… I boiled water to wash myself".*
Jane (female, 13)	*"I wake up boil water so that I can wash… I boil the water and wash the dishes".*
Tshidi (female, 12)	*"I use kettle to boil water so that I can wash my little brother"*

These findings imply that the children recognise that water heating involves the consumption of energy and therefore support Aguirre-Bielschowsky (2014) and Boudet et al. (2014), who respectively found that children in New Zealand and in the USA recognised that water heating requires the use of electricity. However, unlike Boudet et al. (2014) – whose sample consisted mostly of children who had access to dish- and clothes washing machines and geysers – most the children seem to boil water in a kettle for bathing, washing dishes and doing their laundry. In this study, only two of 42 children highlighted using washing machines to do their laundry and none indicated using a dish-washer. Moreover, while the children in Aguirre-Bielschowsky's report (2015) could relate the use of hot water cylinders as big kettles, none of them reported using the water boiled in a kettle to bath; 38.5% had access to washing machines. Such differences may be expected, given that Khayelitsha is a community that is challenged by high levels of unemployment and low salaries (CoGT, 2013) as such some of these appliances maybe seen as luxuries. Although Aguirre-Bielschowsky's (2014) study considered low-income households, contextual difference and access to technologies and appliances could explain the different results.

4.1.3 **Lighting, charging and entertainment purposes**

Children also reported switching on lights, charging electronics and the use of entertainment devices at home as part of their energy consumption. Based on the diaries, all 42 children wrote about switching on electric lights at home, while Thato (male, 13) was the only child who demonstrated occasionally using a torch at home when he wrote *"I switch on my torch"*. This finding makes switching on lights the most common behaviour among the children in the study followed by cooking or meal preparation which was reported by 37 children. Further analysis of the diaries revealed that charging cell phones was reported by 61.9% of the children who have access to a phone at home with about 54.8% of the 42 children stating that they connect the cell phones to a charger and 11.9% children referring to charging laptops at home (see Appendix 5 for other activities diary entries). These findings concur with Toth et al. (2013) and Aguirre-Bielschowsky (2014), who report that switching on lights and charging devices are common behaviour among children. With regards to entertainment purposes, the results show that children engage in activities such as playing video games, watching TV and listening to the radio. The analysis showed that 19% of 42 children reported plugging in and using video games, 66.7% children referred to the TV with about 57.1% recording the act of switching the TV on and 11.9% children recording switching the radio on. These findings are consistent with Toth et al. (2013) and Aguirre-Bielschowsky (2014), who with found that switching on the TV, the use of gaming console and radios are activities reported by children in the UK and New Zealand as part of their energy consumption.

The discussion above highlights that children have access to several energy-dependant appliances and technologies at home, including stoves, kettles, heaters, video games, wood fires and microwaves. In addition to these, the diaries show that 14.3% of 42 children highlighted the use of other appliances such as hairdryers, and 52.3% children reported ironing clothes, which in most cases turned out to be their school uniforms. While use of hair appliances was reported by children in Toth (2013), it is important to note that among the studies that were reviewed in Chapter 2, none of the children reported ironing as part of their energy use, even though the children are of a similar age. These findings are however consistent with the behaviour of South Africans highlighted in the DoE (2012; 2013) surveys. This may point to socio-cultural differences possibly existing between the difference samples; hence, it could be an area for further research. Ironing and the use of the kettle for get bath water seems to be a result of the context in which children in Khayelitsha live.

4.1.4 **Energy use outside the home**

Most of the reported behaviours have focused on the home environment, yet children also reported energy activities outside the home. The school environment was the most prominent environment as 21.4% of the 42 children reported switching on lights within school premises, and several children highlighted that they prepare tea/coffee for educators and to warm up their teacher's food in the microwave in the kitchen area. Some of the children also reported charging cell phones and laptops for teachers at school. For example, two students indicated charging their teachers' cell phones and four students reported having access to their teachers' laptops, three of whom described charging the laptops. One child (Pearl, female, 12) referred to using the computer lab at school, which was surprising considering that in the focus group discussion, all the participants who indicated that they use the computer lab were aware that computers require the use of electricity. Although studies by Toth et al. (2013) and Aguirre-Bielschowsky (2014), who found that computer use was reported by some of the children the UK and New Zealand respectively, most of the children in this study seem to ignore the computer and its energy consumption. This finding therefore implies that there is a disconnect between energy consumption and the perceived use of energy. The results also show that one child (Pamela, female, 13) referred to religious affiliations/institutions in her diary when she highlighted the use of electricity inside the church when she wrote "*I switch on church light, I light the keyboard on…".*

The recording of energy consumption at school and at church suggests that some of the children in this study consider these activities as their own energy consumption, yet the fact that only a few children report such activities implies that most children do not necessarily personalise energy activities outside the home. This finding therefore supports Toth et al.'s (2013) assertion that children do not take responsibility for energy use outside the home. Interestingly, the diaries also showed several children described using and saving physical energy while other reported the same concerning the environment and nature. For instance, in explaining what activities they performed to save energy Mary (female, 13) wrote: *"I save energy from the sun, air",* Ntombi (female, 12) wrote *"I exercise every morning weekend to keep my body energy"* and Mondi (male, 11) wrote *"I sit down and listen to the radio. I watch TV".* A summary of the children's energy consumption activities is provided in Table 4.2.

Table 4-2: Children's energy consumption activities (n=42)

	Themes	Categories
1	Cooking or preparing meals	For themselves For others
2	Heating	Space heating • Heater • *Mbawula*/fire Water heating • Boiling water to wash their bodies • Boiling water to wash siblings • Boiling water to wash dishes and clothes • Switching on the geyser
3	Lighting	Switching on lights at: • Home • School • Using a torch
4	Entertainment	Plugging in video game Switching on TV Switching on the radio
5	Communication/charging	Cell phone • Personal & Family • Teacher Laptop/computer • Personal & Family • Teacher
6	Other uses	Computer use at school Using the washing machine Ironing Drying hair with a blow dryer

4.2 Child energy-saving activities

This section presents the techniques used by the children to save energy. In the same way as the previous section, it discusses the energy practices described in the ECF and it focuses on the children's self-reported activities performed inside and outside the home.

4.2.1 **Switching off appliances and removing appliances from the wall plug**

Switching off appliances such as the geyser, TV, lights, the stove and the iron were reported by the children as a way of saving energy. For instance, the diaries show that switching off lights was reported by 73.8% of the children, thereby making it the most common energy saving activity among the children in the study. The children wrote about switching off lights in the house while others specified the rooms such as the kitchen, their bedroom or their parents' bedroom. Some children described turning off lights as an activity performed before

going to sleep or when leaving a room. This finding is supported by the survey (n=88) in which 72.7% of the children reported that they always turn the lights off when they are the last person to leave a room. This finding seems to support Solopova (2008: 59); Toth et al., (2013); Dewaters and Powers, (2008) and Aguirre-Bielschowsky (2014: 106), who reported switching off lights as the most cited energy-saving behaviour among the children in Russia, the UK, the USA and New Zealand respectively. It is also consistent with the UNICEF (2011) study that showed South African children switching off lights as part of their pro-environmental behaviour. This thesis study therefore concurs with Toth et al.'s. (2013) assertion that because lights are the most visible technology both children and adults are more likely to perform energy behaviours associated with lights. The diaries also demonstrated that children save energy by turning off the TV, an activity that was performed by 61.9% of the 42 children as well as switching off the stove, an activity reported by half of them (Appendix 6 for diary entries on energy saving). Turning off video game consoles was reported by 9.5% and switching off the radio was reported by 14.3% of the children. In addition to these activities, turning off heating appliances like the geyser was reported by 19%, while the iron and the heater were each reported by 7.1% of the children. Finally, turning off kitchen appliances such as the kettle and microwave were performed by 30.9% and 14.3% children respectively. This finding is also corroborated by the survey in which 32.2% and 49.4% of the 90 children reported that they sometimes and always switch appliances off after using them. These findings support Aguirre-Bielschowsky (2014), Boudet et al. (2014) and Fell and Chiu (2014), who reported that switching off appliances such as TVs and video games were energy-saving practices cited by children New Zealand, the USA and the UK respectively.

Two of the children in the study indicated that they switch off gas cylinders after cooking for instance, Tumi (male, 11) wrote *"I switched off the stove whe finished, I switche the gas off"*. It is possible that the other children did not have access to a gas stove or that they were not allowed access to the gas cylinders. However, this was not explored in this study and a possible area of study for future studies. Furthermore, in his diary Phuma (male, 12) wrote that he put out the braai (open fire used for grilling meat/barbeque) after his aunt had finished cooking when he wrote *"I stopped the fire".* In this statement, Phuma showed that biomass as an energy sources is something that can be saved, if it is done appropriately. These findings along with Tshidi's (female, 12) reference to starting an open fire in the previous section differ from Aguirre-Bielschowsky (2014: 120), who reported that some of the children in her study were restricted from open fires or wood burners because of their age and that some

parents viewed such appliances and technologies as dangerous. Unfortunately, this aspect was not explored with the parents who participated in this study, but could be explored in future studies.

In addition to switching off appliances some of the children in the study described saving energy by removing appliances such as the iron, hair dryer, chargers and video game consoles from the wall socket. For instance, Zama (female, 13) and Ntombi (female, 13) wrote about removing the iron from the wall socket, while Stella (female, 12) and Jane (female, 12) wrote about removing all appliances before going to play outside. Other children reported removing cell phones and laptops from the charger and from the wall socket as a way of saving energy. For example, Phuma (male, 12) wrote *"I removed the cell phone charger and adapter from the wall socket".* This finding is also supported by the survey (n=90) in which 60.7% and 31.4% reported that they sometimes and always remove appliances from the plug when they finished using them. These findings imply that some of the children in this study are mindful of the fact that appliances continue to consume energy even after the power button has been switched off. This finding is consistent with Toth et al. (2013) and Aguirre-Bielschowsky, (2014), who found that removing plugs from the wall sockets were energy-saving behaviours practised by the children in their studies. However, unlike Boudet et al. (2014: 443), with a few exceptions, the removal of cell phone chargers from the wall socket was not recorded in the diaries as a common practice among the children in Khayelitsha.

4.2.2 **Curtailment, 'energy wasters' and other ways to save energy**

The children highlighted other ways of saving energy, one of which is curtailment behaviour. In the diaries, Mondi (male, 11) wrote *"I don't light too much and like to watch TV after I've done playing so that I can save energy"*. Similar sentiments were expressed by Pearl (female, 14) who wrote *"I do not plug water all the time"* and *"I do not spend electricity all the time and I do not spend energy all the time"*. Pearl further stated that *"I di(d)n't waste electricity ..."*, a concern that Namhla (female, 13) shared when she wrote *"I save energy to not (be) a waster for example i don't live the TV or stove when I am done"*. These findings support Fell and Chui (2014:354-355), who found that some of the children in their study referred to themselves as "energy wasters" because their energy use came with a sense of guilt. The results of this study seem to suggest that there are children feel guilty when using energy because they want to reduce financial pressures on their parents. The survey also show that, 87% of the children reported that they sometimes/always wear warm clothes instead of using the heater. During the focus group discussion, the children also mentioned restricting the

number of times they open the fridge to save energy, as Phuma (male, 12) said *"My mother always says that the refrigerators at home wastes electricity a lot. So if you don't know what you want in the fridge (and) then you mustn't open the fridge".* The use of solar chargers was also mentioned by few of the children who pointed out that they use them when they are in the Eastern Cape. Tshidi (female, 12) highlighted another unique way of saving electricity in her diary when she wrote *"I cook early so that the electricity can be safe or saved*". This idea that children come up with their own ways of saving electricity is also reported by Aguirre-Bielschowsky (2014: 191), who found that a few respondents would close curtains and take short showers without being told to do so by their parents. A closer analysis of the diaries revealed a few gender differences, for instance most of the cooking and ironing are performed by female children, and Tshidi (female, 12) was to only one to provide suggestions for saving electricity when cooking. This finding supports Aguirre-Bielschowsky (2014), who found that only females gave suggestions on how to save electricity while cooking and doing the laundry.

4.2.3 **Saving energy in other settings/location**

In the same way children use energy outside the home, the results show that children also save energy outside the home environment. For instance, Lesedi (female, 13) and Stella (female, 12) reported removing their teachers' laptops and cell phone from the chargers, and Pamela (female, 13) reported switching off the devices and instruments she used once she was done with the church service. The results also show that 19%, consisting of eight out of 42 of the children, reported switching the lights off in the classrooms at the end of the school day. The educator highlighted that all learners are encouraged and have been given the responsibility to save electricity at school when she said *"if the weather is … hot we switch off the lights because we can see … they must know that if they are going home they must switch off the lights".* This was confirmed in the focus group discussion when the children indicated that they switch the lights off when the opportunity presents itself as expressed below:

Researcher	*Okay. How does that work? Does anyone switch off or is there a specific person?*
Group	*Everyone*
Researcher	*How? So everyone!*
Jabu	*Even you can switch off the lights.*
Researcher	*So it's no one's responsibility.*
Manga	*No one is obligated to do so. When it is our turn to sweep the class we switch off the lights*

Although the nature of assigning the responsibility of switching off lights differs to the one highlighted in Fell and Chiu (2014), the authors found that children who had been given the responsibility to switch off lights and perform other energy saving were likely to feel encouraged to save energy. None of the children in this study, however, reported switching off the computers after the computer lessons. This is likely because the children may be expected to leave the computer on after the lesson for other learners. The energy-saving techniques used by children are brought together in Table 4.3.

Table 4-3 Children's energy saving activities (n=42)

	Theme	Categories
1	Switching off appliances	Lights Radio Stove Iron Geyser
2	Removing appliances from the wall plug	Cell phone Laptop Appliances
3	Curtailment behaviour and other behaviour	Not cooking/boiling too much Not watching too much TV/playing outside Not being a waster Cooking early Not opening the fridge

4.3 Personal Factors influencing energy saving

In analysing the research results, it is important to keep in mind that the conceptual framework described in Chapter 2 does not explore personal, external and contextual factors in a sequential order rather all the factors interact with each other. The following sections present and described personal factors.

4.3.1 **Children's energy knowledge and energy education**

To answer the first question of this study (Chapter 1), which was to find out how children understand the concept of 'energy', the children were asked to write down words or phrases that come to mind when they hear the word 'energy'. A word frequency query using Nvivo software revealed that children have a diverse understanding of the concept that includes environmental, nature, the basis of life, as well as physical, mechanical and thermal topics. These findings are consistent with Yuenyong and Yuenyong (2007), Kirkwood and Carr (1988 cited in Boylan 2008) who found that children have a broad understanding of the

concept ranging from physical energy, to kinetic energy and understanding of nature. The seven most common words used by the children in this study to express their understanding of energy were: electricity, sun, food, water, heat, light and exercise (Table 4.4).

Table 4-4: The most common words used to define 'energy' (n=140)

Word	**Similar words**	**Mentioned by children**
Electricity	electrical, electricity	**25**
Sun	solar, sun, sunlight	**24**
Food	food, foods	**21**
Water	water	**21**
Heat	heat	**18**
Light	fire, light, lights	**18**
Exercise	exercise, exercising	**13**

The analysis revealed that the word 'sun' was mentioned by 24 children, with three learners mentioning the word 'solar', for instance, Lerato (female, 13) wrote *"I think solar energy"* and Nina (female, 12) mentioned a *"solar charger"*. References to the wind or air were made by Pearl (female, 14) who wrote "e*nergy come from air*" and Mandla (male, 14) who wrote *"we get energy frm sun and air*". The words 'carbon dioxide' were mentioned by Carol (female, 12), while 'oxygen' was referred to by 10 children, including Mondi (male, 11) and Gabriel (male, 12). The word 'water' was mentioned by 21 children, with some writing about water in relation to plants and to physical energy for instance, *"plants get energy from sun and water"* (Lerato, female, 13); "i*f you ... drink water you will have energy"* (Tshidi, female, 12); *"you must drink water to get energy"* (Thabo, male 12); *"Energy come from water"* (Zama, female, 13) and *"energy you get water"* (Sipho, male, 13). Reference to physical energy was also made when the word 'exercise' was mentioned by 13 children. For example, Tshidi (female, 12) wrote "e*nergy is when you are exercising and do whatever yu want";* Mandla (male, 14) wrote "e*nergy comes when you exercise"* and Thabo (male, 12) wrote "y*ou must exercise to get energy".* Some of the children showed understanding of physical energy resulting from food consumption, for example Thabo (male, 12) wrote *"yu must eat health food to get energy"*, John (male,13) wrote *"we get energy from food"* and Mandla (male, 14) wrote "w*e get energy by eat healthy food and water"*. The word 'power' was also highlighted by John (male, 12), Nqo (male, 13) and Siseko (male, 13) who wrote

about energy giving people power. These references to food show understanding of chemical energy.

The analysis further revealed that other children associated energy to heat, light and electricity, for example, Pamela (female, 13) wrote "*light and heat",* Siphe (female, 13) wrote *"electricity and light"*, and Joy (female, 13) wrote "e*nergy comes from heat*. Jabu (male, 13) was the only child who wrote about fire. The word 'electricity' was mentioned by 25 children, making it the most common word used by children to show their understanding of energy. Tau (male, 13) and Manga (male, 12), for example, wrote about saving electricity and Namhla (female, 13) wrote: *"how we use electricy and why we use electricity*", whereas Aphiwe (female, 12) thinks about *"the things that using electricity".* The words 'paraffin' and 'fuel' were each mentioned once while coal was mentioned three times. The word 'ability' was referenced by Ndumiso (male, 12) who wrote *"I thought it was the ability to do work"* and Pretty (female, 12) who wrote "*the ability to do everything and the ability to move"*. Movement was mentioned by Langa (female, 12) who wrote *"Energy is movement"* and Nqo (male, 13) who wrote "*The things that using movement*". The children also mentioned words such as 'soccer', 'sound' and 'gym'. Such references show understanding of kinetic energy. In addition to their understanding of the concept of energy, some of the children showed some understanding of where electricity comes from as illustrated by the following statement:

Researcher	*Do you know where electricity comes from?*
Group	*Yes*
Researcher	*Where does it come from?*
Jane	*From the power stations*
Thato	*And towers*
Researcher	*The tower, yes*
Mandla	*And poles*
Researcher	*Okay, so it comes from the power station to the towers to the poles then to the house right?*
Group	*Yes.*
Researcher	*And where do the power stations get the electricity from?*
Manga	*From coal,*
Nina	*Eskom,*
Thato	*Water.*

The children in Khayelitsha also demonstrated some basic understanding of the differences between renewable and non-renewable energy:

Manga	*Renewable energy can be developed again and non-renewable energy if you use it you can't get it back again.*
Researcher	*So non-renewable energy if you use it you can't get it again. Okay, so where did you learn about that?*
Group	*At school.*
Researcher	*At school. So how many of you remember that lesson? What grade where you in when you did that?*
Manga	*It was Grade 6.*
Researcher	*Okay, so it was last year.*
Group	*Yes.*

Similar findings were reported by Aguirre-Bielschowsky (2014), found that children had some understanding of the transmission of electricity, and Toth et al. (2013: 40) who found that some of the children in their study could identify different sources of energy.The survey also found that of the 90 respondents, 90% identified that all life on earth depends on the sun, a finding similar to Boylan (2008: 1) who reported that 83% Australian children agreed that the Sun is the source of energy for all life on Earth. The children in Khayelitsha also displayed insight of national and local energy issues. (See Appendix 7 for more survey questions). For example, 72% identified coal as the main source of energy in the country, 83% identified electricity theft as a serious problem in the country and 69% knew that burning coal inside the house makes people sick. Further elaboration of these issues in the focus group revealed that the children in this study were well informed of the ways in which energy problems affect communities and people's lives. Some of the children highlighted health problems caused by burning coal inside closed spaces, for example, Thando (female, 13) said *"coal releases smoke and you can get sick, cough and TB if they inhale the smoke"* and others knew that nuclear energy is produced in the country. Further exploration in the focus group discussion supported the notion that the children have some understanding of the environmental and health drawbacks of continued use of coal as revealed below:

Researcher	*So do you think we should continue using coal?*
Group	*No.*
Researcher	*Why?*
Siseko	*Because it causes air pollution.*
Researcher	*It causes air pollution and what else?*
Group	*Inaudible.*
Researcher	*And it can make us…sorry?*
Group	*Die.*
Researcher	*Okay. In what ways? How does it make us die?*
Group	*Inaudible…(coughing)*
Researcher	*So it gives us coughing, what else?*
Group	*Inaudible (It damages the lungs) and participants shout out TB*

Researcher	*It damages the lungs and give us TB.*
Group	*Shouting out TB. Tib Tib.*
Researcher	*It gives us TB. Tib. Oh (group laughs)*
Group	*Tuberculosis.*

These findings confirm that the children in this study were cognisant of energy-related social and health problems. They support Sethusha (2006), who found that primary school children in South Africa showed more knowledge of pollution and conservation issues in and around their local community. It is, therefore, likely that the children in South Africa are knowledgeable on social and environment problems because these issues are prevalent in their communities and discussed at school as was expressed by the educator during the interview when she said, "*We tell them here. We teach them about that and the dangers of illegals connections to them".* These findings, however, differ from Toth et al. (2014) and Aguirre-Bielschowsky (2014) who reported that social issues related to energy production were rarely discussed by the children in the UK and New Zealand respectively. With a few exceptions, a few children in Aguirre-Bielschowsky could highlight social problems caused by distributions challenges, and one child who knew of limited energy access in Africa.

Although the discussion thus far shows that children in Khayelitsha have considerable insight and understanding of socio-economic, environmental and health related issues, the results also showed that the children had lower scores on abstract and technical topics. For instance, when asked what is produced when a light bulb is switched on, 8.5% (7 of 82 children) chose light and heat. These findings contradict Boylan, (2008: 1), who found that 75% of the children (Grade 3 to 6) identified both light and heat as by-products of burning wood. This finding supports Aguirre-Bielschowsky (2014) and Boudet et al. (2014), who reported that the children in their studies showed limited understanding of technical topics. In addition, of the 90 respondents, fewer than 25% identified hydro-electricity (22.2%) and solar energy (23.3%) as renewable energy sources, while 22.2%, 17% and 25.6% identified coal, natural gas and nuclear as non-renewable sources of energy respectively. This finding is, however, in accordance with that of Boylan (2008), who reported that children struggled to differentiate between renewable and non-renewable energy sources. The cause for the lower scores on these topics is beyond the scope of the study; however, it is likely such topics are complex to understand and therefore take a longer time to grasp. Also considering that the children were in Grade 6 at the time of the study, it is likely that such topics will be covered in depth as they continue their education.

4.3.2 **Relationship between knowledge and behaviour variables/correlates**

The statistical tests (chi-square) seem to suggest that there significant relationships between knowledge and energy saving. (Refer to Appendix 8 for results on statistical tests – significant results highlighted). The analysis shows significant relationshps between knowledge of renewable and non-renewable energy and energy saving and no significant relationships with other knowledge topics[16]. The chi-test results show that i) (χ^2 =7.291 df 2 p=.026) children who could not identify hydro-electricity as renewable energy were more likely to report removing appliances from the wall plug, and ii) those who could not identify natural gas as non-renewable energy were more likely to report switching off appliances after using them (χ^2 =6.328 df 2 p=.042) and turning off lights (χ^2=6.618 df 2 p=.037). (see Table 4.5).

Table 4-5: Relationships between knowledge and behaviour

Hydro-electricity is Renewable	I remove appliances from the wall plug after using them	Natural Gas is Non-Renewable	I switch off the TV/Radio/Computer when I have finished using it	Natural Gas is Non-Renewable	I turn the lights off when I am the last person to leave a room
Yes	Always 35%	Yes	Always 12.85%	Yes	Always 46.67%
	Sometimes 50%		Sometimes 34.29%		Sometimes 46.67%
	Never 15%		Never 52.86%		Never 6.67%
No	Always 68.12%	No	Always 40%	No	Always 77.46%
	Sometimes 8.09%		Sometimes 26.67%		Sometimes 16.90%
	Never 5.8%		Never 33.33%		Never 5.64%

Table 4.5 shows that children who were unable to differentiate between renewable and non-renewable sources of energy were more likely to switch off lights and appliances and remove appliances from the wall plugs. These findings suggest that knowledge (in this case RE) does not necessarily result in energy-saving activities because children without knowledge continued to perform the appropriate and desired actions. This finding is supportive of Ajzen (1991), Kollmus and Agyeman (2002), and Wilson and Dowaltabadi, (2007) among others, who posit that knowledge does not lead to behaviour change. This finding is important because it implies that the relationship between knowledge and behaviour is more nuanced, that other factors may influence children's energy saving behaviour.

[16] There is a weak relationship between knowledge of light producing heat and light and wearing warm clothes. As such it is difficult to make an accurate analysis of energy transitions and energy saving.

Regarding gender/sex differences, the chi-square tests showed no significant relationships between the children's sex and their knowledge as the p values were greater than 0.05 with. This finding differs from Boylan (2008) and Chen, Liu and Chen (2015), who found that male students performed better than female students on knowledge dimensions. Where attitudes are concerned, one significant relationship was found. Figure 4.1 implies that while the same number of males and females recognised the importance of saving energy, male children were more likely to provide a neutral response, while female learners were more likely to disagree with the statement (χ^2=7.445 df 2 p=.024).

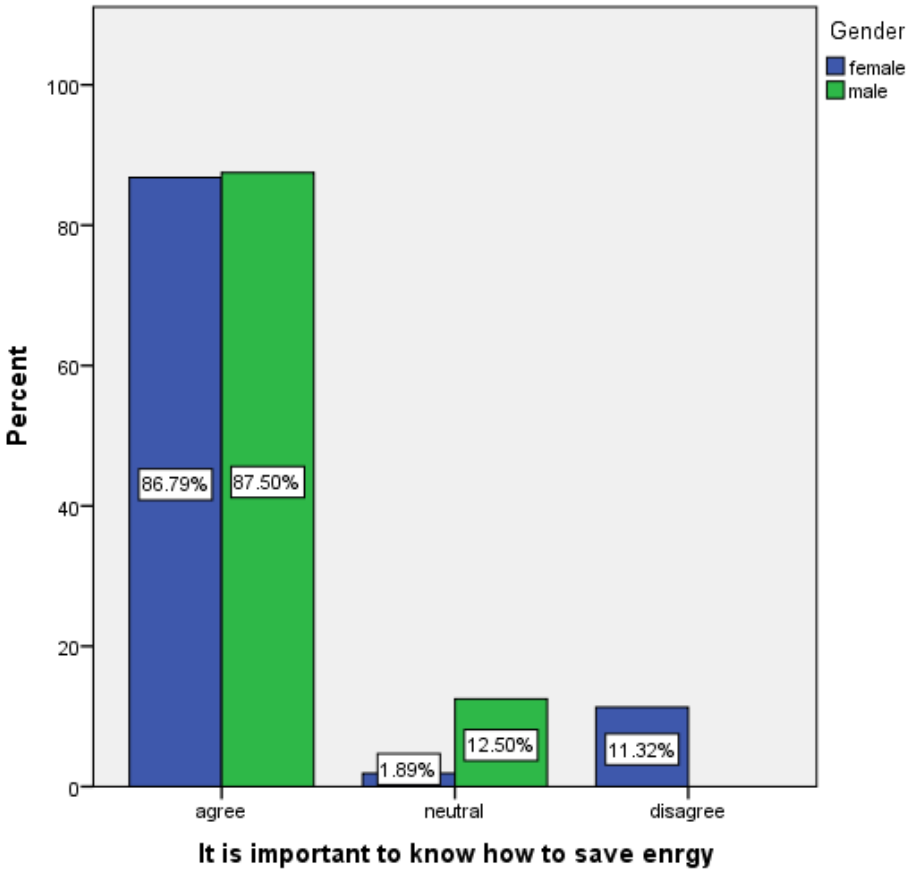

Figure 4-1: Gender/It is important to know how to save energy (n=88)

This finding further seems contradicts DeWaters and Powers (2011: 1706), who found that female children in the USA displayed greater positive attitudes towards the environment and energy issues than males. Moreover, while no the study found statistically significant relationship between gender and energy saving behaviour the diaries show that that more girls reported ironing and cooking activities compared to boys. Also, one girl gave an example of how she saves energy when she is cooking. This finding is consistent with the behaviour of girls in New Zealand (Aguirre-Bielschowsky, 2014).

4.3.3 **Motivation to save energy/electricity**

The diaries show that the majority (54.8% of 42) of the children highlighted financial/monetary reasons for saving energy. For instance, Thuli (female, 13), Zama (female, 13) and Lethi (female, 14) highlighted the need to save money, while Jane (female, 13) highlighted the high cost of electricity when she wrote *"to save money, because the electricity is so expensive".* Jabu (male, 13) shared similar sentiments as he wrote *"to save money because the electricity price is getting higher and higher"* as did Pamela (female, 13) when she wrote *"to save money because electricity is very cost more money"*. The concern over unaffordable electricity was further expressed in the group discussion as the children highlighted that *"... nowadays electricity is very expensive so sometimes you cannot afford that".* In addition to the high cost of electricity, Phuma (male, 12) expressed limited financial resources at home when he wrote *"my mother can't stand to waist money on electricity or else she will run out of money ... I did not want my mother to always buy electricity"*. This view was also expressed by Tshidi (female, 13) who wrote *"because of the electricity is to expensive ... there's no money in my home".* Gabriel (male, 12) on a similar note highlighted the need to purchase other household goods when he wrote "*If you save money you will buy anything you want" and "I can eat the food*" as did Sipho (male, 13) who wrote *"to save money because if you save money, that money you save you must buy food or rent water".* Moreover, these findings are consistent with studies by Solopova (2008: 95); Toth et al. (2013: 41) and Aguirre-Bielschowsky (2014), who found that children in Russia, New Zealand and the UK are motivated to save energy for financial reasons, the need to purchase other basic needs. The children's concern for their parents and families also showed that the children in Khayelitsha have altruistic motivations for saving energy as they aim to alleviate financial pressures at home. This is consistent with Solopova (2008), who found altruistic attitudes among Russian children, and supports Sethusha (2006), who reported that primary school children in South Africa felt a sense of responsibility for reducing pollution at school, at home and on the streets.

Analysis of the diaries also showed that 17 out of 42 children cited environmental reasons for saving energy and four learners provided a rational behind this motivation. For instance, Phuma (male, 12) wrote "*If I do not switch the heater off, my house will burn and it will affect the environment* and Stella (Male, 12) wrote *"'cause if I don't save energy it will be so much harmful to environment, I must protect environment and save electricity".* Pearl

(female, 14) and Lethi (female, 14) also expressed the desire to protect their immediate surroundings when they wrote *"when am saving energy I protect the environment in my community"* and *"to protect the environment and our community"* respectively. These findings are consistent with the few existing studies including those by Aguirre-Bielschowsky (2014) and Solopova (2008), who found environmental concerns to be the second most common reason for saving energy after financial reason among children in New Zealand and Russia. Children in the study also discussed safety reason. For instance, Mondi (male, 11) and Phuma (male, 12) wrote about preventing fires from damaging property when they said *"Because if your home is burning you must have energy to pass clothes away from heating" (*Mondi*)* and *"... I did not want to burn my house with the fire from the heater" (*Phuma*).* These findings are consistent with Fell and Chiu (2014) and Aguirre-Bielschowsky (2014) who found that some children performed energy-saving behaviours to prevent electric shocks and to prevent destruction of property. The results also suggest that children may have interpreted environment to mean their surroundings. For instance, Pearl (female, 14) and Lethi (female, 14) wrote *"when am saving energy I protect the environment in my community"* and *"to protect the environment and our community"* respectively. Similar sentiments were shared by Hloni (male, 13) who wrote *"so that your neighbour can come to you and ask for electricity*" and Ntombi (female, 13) who said *"I say the environment because when there is load shedding and then our phones won't be charged and when the criminals come to our house we cannot phone the police because our phones have low battery".* These results show that some of the children in this study have altruistic motives behind their environment reasons as they show concern for their neighbours, their community and society at large. This finding therefore supports Solopova (2008) who discovered altruistic motivation among children's desire to protect the environment.

The results of the focus group discussion also revealed that children save energy to prevent getting disconnected, a theme that was also evident in the diaries and picked up by Stella (female, 12) when she wrote *"It because if we do not save energy will run out of energy and it expensive to buy"* and Namhla (female, 13) who wrote *"... because when you light the light bulb, stove, kettle, microwave and radio in some time the electricity going to be finished to the electrical box".* The children also expressed the desire to *reduce the* likelihood of load shedding in their communities for instance, Nicki (female, 13) wrote *"because of if I did not turn off the electricity are going to fail and load"* and in the focus group discussion the children highlighted that they have experienced load shedding and knew what it is

The fear of electricity disconnection and experiencing blackout is consistent with Aguirre-Bielschowsky (2014), as children in New Zealand expressed concern of running out of electricity. However, the South African context differs from New Zealand as load shedding was a frequent occurrence in 2008 and 2014/2015 (SEA,2015). In addition to these issues, Stella (female, 12) expressed her concern for limited access to energy in the country and neighbouring countries when she wrote *"It is because it is important to save energy so that everyone could get in South Africa even out of countries not only in SA".* A summary of the children's motivation for saving energy is captured in Table 4.6.

Table 4-6 Children's motivation for saving energy

	Themes	**Categories**
1	Monetary/Financial	It is expensive
2	Environmental	To protect the environment
3	I was told to do so /Educational	Parent As part of school/home work
4	Other reasons (societal)	Limited access to energy Fear of running out of electricity To prevent load shedding

4.3.4 **Attitudes to energy and the environment**

The children in Khayelitsha displayed positive attitude towards energy saving as 86% of the 88 children agreed that it is important to know how to save energy. This finding exceeds that by Ntona et al. (2015) and Boudet et al. (2014), who reported that slightly over 70% of the children in their studies acknowledged the importance of saving energy. The results also show that children who recognised the importance of knowing how to save energy were more likely to report that they perform energy-saving activities (see Table 4.7)

Table 4-7:Relationship between attitudes to energy saving and energy saving activities

It is important to know how to save energy (n=88)					
I turn the lights off when I am the last person to leave a room (n=88)		**Agree (%)**	**Neutral (%)**	**Disagree (%)**	**Total (%)**
	always	63,64	2,27	4,55	70,45
	sometimes	17,05	1,145	3,41	21,59
	Never	3,41	2,27	0,00	5,68
I leave the TV/Radio/ Computer on when I have finished using it (n=87)		**Agree**	**neutral**	**Disagree**	**Total**
	always	16,09	0,00	2,30	18,39
	sometimes	25,29	3,45	2,30	31,03
	never	42,53	2,30	3,45	48,28
I remove appliances from the plug when I am done using them (n=89)		**agree**	**neutral**	**Disagree**	**Total**
	always	51,69	4,49	3,37	59,55
	sometimes	28,09	0,00	2,25	30,34
	never	4,49	1,12	2,25	7,87
I wear warm clothes when I am feeling cold instead of using a heater (n=88)		**agree**	**neutral**	**Disagree**	**Total**
	always	37,50	1,14	3,41	42,05
	sometimes	35,23	3,41	3,41	42,05
	never	11,36	1,14	1,14	13,64

Table 4.7 shows that these children were more likely to switch off appliances after using them, switch off lights, remove appliances from the wall plug and wear warm clothes instead of using a heat when it is cold. This finding is important because it implies that children who value energy saving are more likely to save energy and that attitude may influence energy saving activities. The chi square test results depicted in Figure 4.2 (χ^2 13.722 df2 p=0.001) show that 78.33% children who could identify coal as the main source of energy in SA were more likely to acknowledge that they have a role to play in saving at home and at school, suggesting that knowledge may influence children's energy saving attitudes. See Appendix 8 for statistical test results.

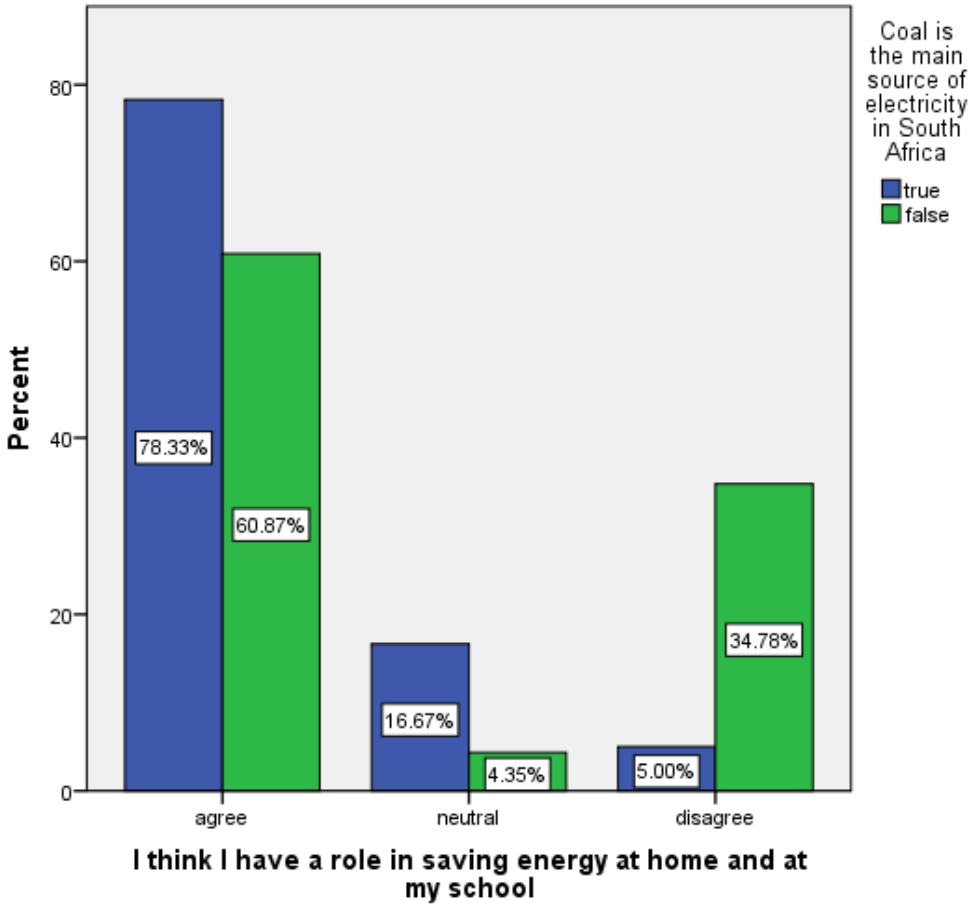

Figure 4-2: Coal main source in the country/ I think I have a role in saving energy at home and at my school (n=86)

This assertion is further supported by chi-square results that show that i) (χ^2=6.304 df 2 p=0.043) children who could identify hydro-electricity as renewable energy, and ii) (χ^2=7.015 df 2 p=0.030) those who could identify coal and non-renewable energy were more likely to agree with the "statement caring for the environment is necessary for our survival on earth". Table 4.8 shows that children who had knowledge of energy sources were more likely to display positive attitudes towards the environment and energy saving while those without the knowledge were more likely to display neutral attitudes.

Table 4-8: Relationship between knowledge and attitude

Hydro-electricity is Renewable Energy	Caring for the environment is necessary for our survival on earth	Coal is Non-Renewable Energy	Caring for the environment is necessary for our survival on earth
Yes	Agree 55%	Yes	Agree 47.37%
	Neutral 15%		Neutral 15.79%
	Disagree 30%		Disagree 36.84%
No	Agree 38.24%	No	Agree 40.30%
	Neutral 45.59%		Neutral 44.78%
	Disagree 16.18%		Disagree 14.93%

The findings are consistent with Ajzen (1991) and Newhouse (1991) who posit that the information or knowledge influences a person's beliefs and are therefore closely related to attitudes. Where attitudes to the environment are concerned the thesis found that 35% of the 90 children agreed that using fossils fuels were bad for the environment while 24.4% were neutral and 40.7% disagreed; 48% acknowledged that climate change affects global weather patterns and when asked if caring for the environment was necessary for our survival on earth, 42% agreed, 38.6% were neutral and 19.3% disagreed. Figure 4.3 showed that 76.32% of the 90 children who agreed that climate change impacts global weather patterns were more likely to agree with the statement that energy saving is everyone's responsibility.

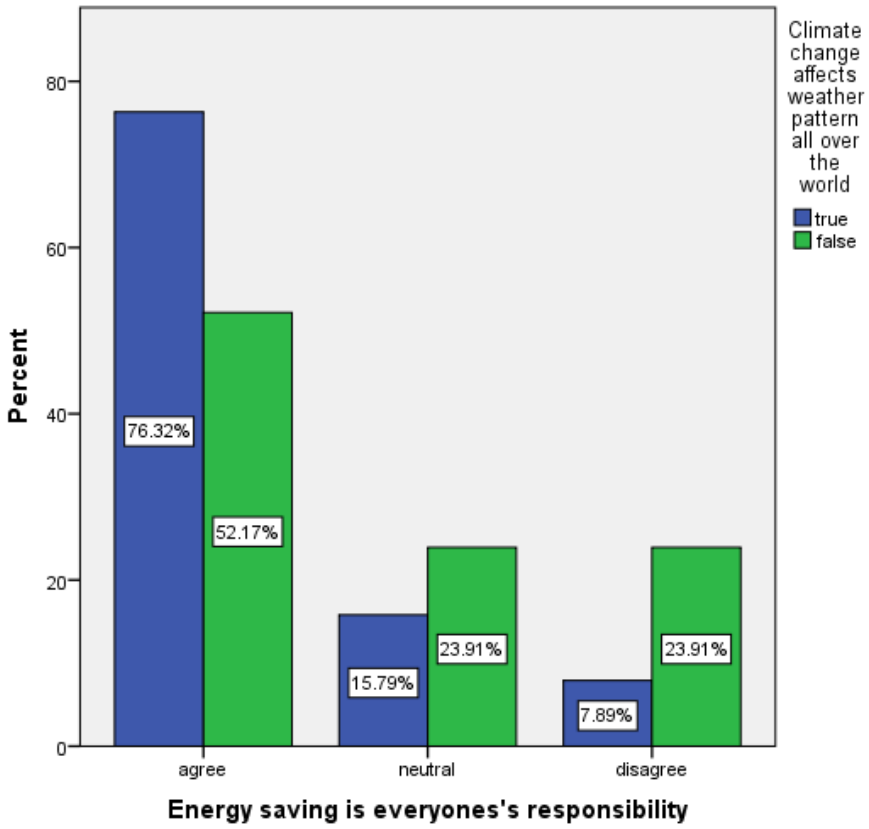

Figure 4-3: Climate change affects weather patterns all over the world/Energy saving is everyone's responsibility (n=88)

This finding provides some indication that children who had an appreciation of adverse impacts the climate change are more likely to believe that everyone must play their role in energy saving, even if the significance of the relationship is weak (χ^2 =.804 df 2 p=.055). However, Figure .4.4 shows that 76.47% of the children who disagreed with the necessity of caring for the environment were more likely to indicate that they save energy for environmental reason (χ^2=8.244 df 2 p=.016).

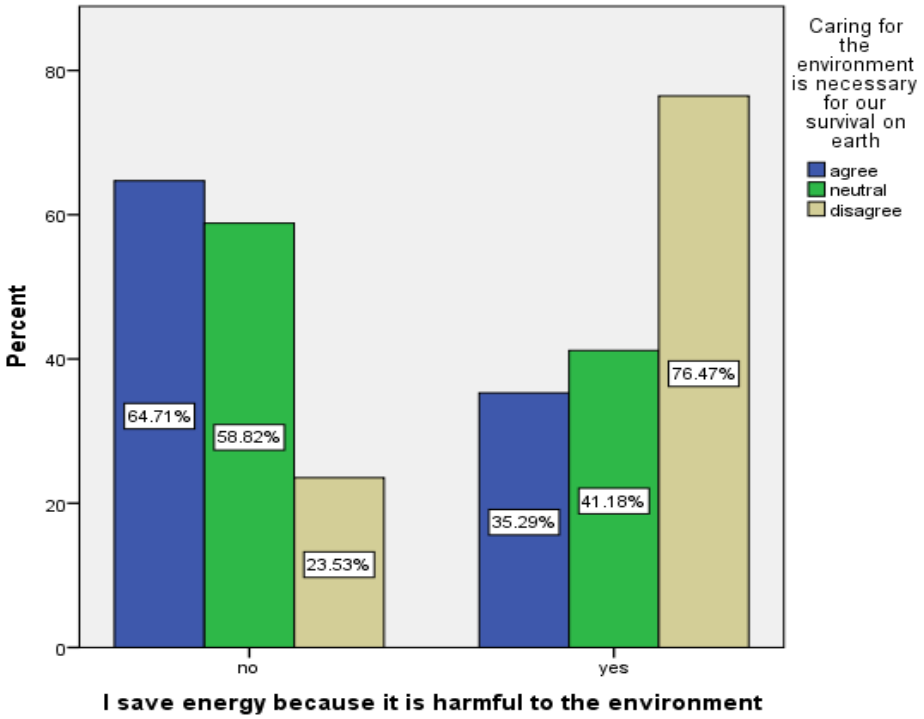

Figure 4-4:Caring for the environment is necessary for our survival on earth/I save energy because it is harmful to the environment (n=87)

This finding seems to be a contradiction, as one would have expected a positive relationship between such variables based on energy models such as TPB and energy literacy influence behaviour. Yet, keeping in mind that children are introduced to linkages between environmental and energy concepts in Grade 6, these findings may point to the likelihood that children are still learning to make sense of the linkages. Moreover, Chi-square results (χ^2 13.964 df4 p=0.007) illustrated in Figure 4.5 show that children who recognised the health challenges caused by indoor coal use were more likely to have a neutral attitude (agree-40.68%; neutral-37.29%) towards caring for the environment for our survival on earth, while the children who had a neutral response (61.54%) toward indoor use of coal were more likely to agree with the necessity of caring for the environment.

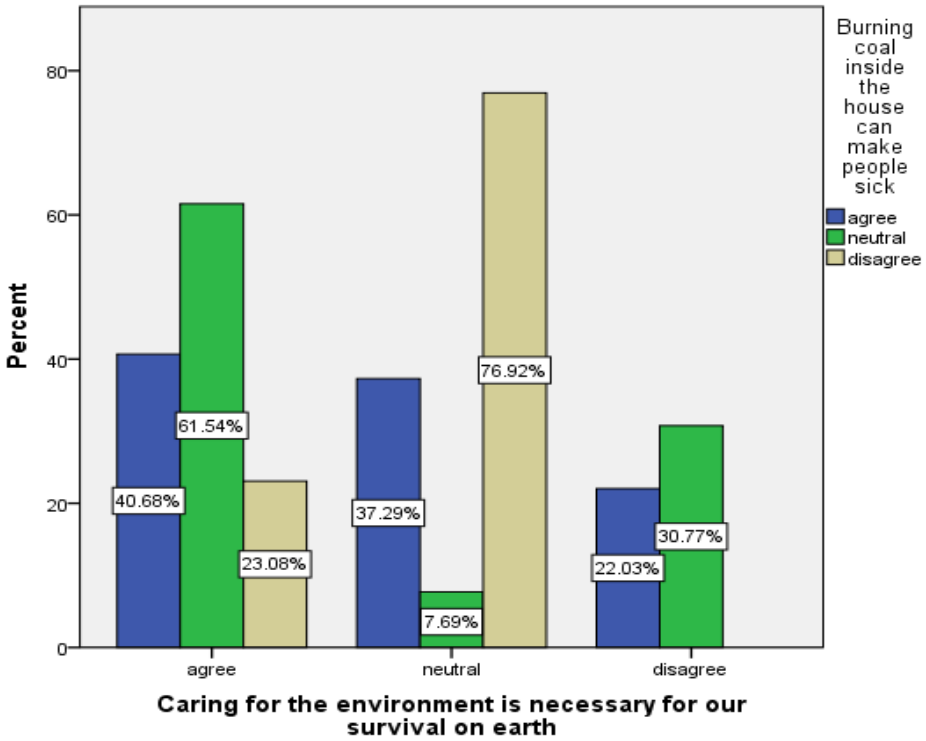

Figure 4-5:Burning coal inside the house can make people sick/Caring for the environment is necessary for our survival on earth (n=86)

This result suggests two things. On one hand, it could indicate that the children in this study may have found the question "caring for the environment is necessary for our survival of the earth" difficult to answer hence they opted to provide a neutral response. Although the survey was piloted, this finding shows the need for such questions to be more precise. On the other hand, these findings differ markedly from Ntona et al (2015) who reported 61.54% of the children (aged 12 to 13 years) in Greece acknowledged the necessity to gradually move away from fossil fuels while 20.48% had neutral attitudes on this issue. Slightly over 70% of the children in Ntona et al., (2015) acknowledged saving energy as essential to protecting human health and the environment and recognised the need for humanity to have harmonious coexistence with the natural environment. The results of this study, however, indicate that slightly less than 50% of the children in this study agreed with the need to move away from fossil fuels, showed understanding of climate change and the need to coexist with the environment. As mentioned earlier, it is likely that such a finding may point to the limited attention given to linking environment and energy in the National Science and Technology Curriculum. Therefore, it is likely that in Grade 7 and higher grades, children will be exposed to greater information on how to link environment and energy concepts. According to Newhouse's (1991) assertion that information and knowledge influence beliefs, it is therefore

possible that the children's attitudes towards the environment may change with further energy and environmental education. In addition, it is possible that the children in Khayelitsha are still developing their views and attitudes towards the environment or that they hold alternative views simultaneously, such as humanities right to use the environment for survival, similar to children in Zimbabwe. This assertion is likely keeping in mind that the educator highlighted that opportunities for children to care for the environment in the township are limited due to limited space, growing informal settlements and poor service delivery. Yet, evidence is this is week considering that only educator was interviewed. Understanding such issues is important and a possible area for future researchers.

4.3.5 Locus of control and environmental awareness

In addition to exploring children's knowledge and attitudes, this study investigated other cognitive factors. Firstly, regarding environmental awareness, the results showed that 50.6% of the 88 respondents believe that their energy use impacts on the environment. These findings suggest that about half of the Grade 7s in this particular school are aware of that their energy consumption affects the environment. In addition, Table 4. 9 shows that children who acknowledged the impact of their energy use on the environment were more likely to report that they switch appliances after using them, switch off lights, remove appliances from the wall plugs and wear warm clothes instead of using a heat when it is cold.

Table 4-9: Relationship between environmental awareness and energy saving activities

My energy use impacts on the environment (n=87)					
I don't leave the TV/Radio/Computer on when I have finished using (n=87)		**Agree (%)**	**Neutral (%)**	**Disagree (%)**	**Total (%)**
	always	5,75	6,90	5,75	18,39
	sometimes	19,54	10,34	1,15	31,03
	never	22,99	11,49	13,79	48,28
I remove appliances from the plug when I am done using them (n=89)		**Agree (%)**	**Neutral (%)**	**Disagree (%)**	**Total**
	always	25,84	16,85	15,73	58,43
	sometimes	20,22	6,74	3,37	30,34
	never	2,25	4,49	1,12	7,87
I wear warm clothes when I am feeling cold instead of using a heater (n=88)		**agree**	**neutral**	**disagree**	**Total**
	always	20,45	9,09	12,50	42,05
	sometimes	19,32	15,91	6,82	42,05
	never	9,09	3,41	1,14	13,64
I turn the lights off when I am the last person to leave a room (n=88)		**agree**	**neutral**	**disagree**	**Total**
	always	36,36	19,32	14,77	70,45
	sometimes	10,23	6,82	4,55	21,59
	never	2,27	2,27	1,14	5,68

This finding suggests that the children who believed that they contribute to environmental problems were more likely to perform activities that reduce their energy use – a finding consistent with Solopova (2008) and Fell and Chui (2014).

Secondly, regarding locus of control, the results show that 52.3% of the 88 children believe that they can bring about change to environmental problems. This finding suggests that just a little over half of the children have an internal locus of control, that is they believe that they can bring about any changes to current environmental problems. These findings are similar to those by DeWaters and Powers (2011), who found that on average about 50% of the children in the USA were cognizant of the impact of their energy use. Aguirre-Bielschowsky (2014) also reported that many of the children New Zealand thought their actions have positive financial benefits. Keeping in mind that similar results (50%,50%) were found for environmental awareness and locus control, it may indicate that children who acknowledge that personal energy use impacts on the environment are likely to believe that their actions can bring about changes to environmental problems. However, statistical tests suggest that internal locus of control (belief that personal actions can result in change) does not necessarily lead to energy saving (see Table 4.10).

Table 4-10: Relationship between locus of control and energy saving activities

I cannot bring change to environ problems because other people make all the decision					
I remove appliances from the plug when I am done using them it (n=88)		**Agree (%)**	**Neutral (%)**	**Disagree (%)**	**Total**
	Always	34,09	15,91	10,23	60,23
	sometimes	13,64	6,82	10,23	30,68
	Never	3,41	3,41	1,14	7,95
I wear warm clothes when I am feeling cold instead of using a heater (n=89)		**Agree (%)**	**Neutral (%)**	**Disagree (%)**	**Total**
	Always	26,97	7,87	6,74	41,57
	sometimes	17,98	14,61	10,11	42,70
	Never	5,62	3,37	4,49	13,48
Total		26,97	7,87	6,74	41,57

The results show that a significant number of children who feel incapable of bringing about changes reported that they always remove appliances from the wall plug and always wear warm clothes. These findings on environmental awareness and locus of control suggest two things, that energy-saving activities may to be influenced by ill-feelings of environmental harm caused by personal actions and less likely to be influenced by confidence that personal actions will bring about change. This finding is consistent with Solopova (2008), who

indicates that in the absence of adequate knowledge and commitment children are likely to act out of fear or guilt. suggest that other factors contribute to energy saving. The study also found that 63.5% of the 85 children believe that energy saving is everyone's responsibility and 74.4% of 86 children felt that they have a role in saving energy at home and at school. These findings imply that a relatively large portion of the children seem to believe that effective energy saving can be achieved by themselves together with other stakeholders. This is consistent with Ntona et al. (2015), who found that a significant percentage of the respondents believed that energy saving required intervention from themselves and the government.

4.3.6 **Subjective norms and-encouragement**

The study found 96.5% of 86 children reported that their friends always (50%) and sometimes (46.5%) find it important to save energy. Moreover, 76.5% of 85 children indicated that they always (22.4%) and sometimes (54.1%) receive encouragement to save energy from their friends. The results showed that 74.42% of 89 children whose friends valued energy saving were more likely to indicate that they always remove appliances from the plug when they are done using. This finding suggests that the views and opinions of peers may influence children to save energy. This finding seems to contradict Toth et al. (2013) who found energy saving was perceived as 'uncool' by children in the UK while it supports Boudet et al. (2014), who found that over 50% of children in the USA reported that close friends find energy saving to be important. Further analysis of encouragement from the children's perspectives shows that 95.3% of the 85 children reported that their families always (81.2%) and sometimes (14.1%) find it important to save energy. Also, 88.5% of 87 children reported that they always (59.8%) and sometimes (28.7%) receive encouragement to save energy from their family. These finding supports Boudet et al. (2014), who found that the majority (69.6%) of the children in their study reported that their families view saving energy as important. These findings seem to indicate that children in the Khayelitsha study are not only aware that their parents value energy saving, but they also feel encouraged to save energy by parents. However, aanalysis of reports of encouragement at home revealed that even though parents encourage their children to limit the amount of TV they watch. However, such changes are not readily accepted by the children as evidenced by the following dialogue:

Researcher	*Okay, what else do your parents say about electricity? What do they say about saving electricity at least?*
Phuma	*They say you must not watch TV until its 12 o'clock but TV does not waste that much electricity.*
Researcher	*Okay now how many of you agree with what he is saying that TV does not waste a lot of electricity. … Okay, so it's quite a few of you.*

This finding is consistent with Fell and Chui (2014), who found that the children expressed reluctance towards limiting the time they spent watching TV or playing their video's because they believed that it did not use a lot of energy.

4.4 Conclusion

This chapter has presented the children's self-reported energy use and energy-saving activities. The study found that children in Khayelitsha are aware of their energy use when they are cooking, space and water heating, switching on lights, switching on appliances and technologies, charging cell phones /laptops and as well ironing. The children also reported well publicised energy saving practise such as switching off appliances, reducing their energy consumption and removing appliances for the wall plug. Contrary to existing studies, the children in Khayelitsha, reported saving wood and gas by putting out an open fire and by closing gas cylinders respectively. Moreover, the children reported cooking for their families with some cooking during weekdays. These results show that children in Khayelitsha have access to have access to several energy dependent appliances at home such as stoves, heaters, musical instruments, lights and TVs and they multiple sources of energy of which they reported electricity as their main fuel. Children in Khayelitsha with limited access to space heaters reported the use of alternative appliances, in the case it was a portable wood burner known as a imbawula. Children without access to geysers reported using a kettle for heating bathwater, a finding not reported in existing literature.

This chapter also shows that children in Khayelitsha have a broad understanding of the concept of energy and the have positive attitudes towards energy saving. The study however found that children struggle to relate environmental and energy concepts, likely because such linkages are given little attention in the Intermediary Phase National Science and Technology curriculum. The results show no statistically significant relationships between gender and knowledge dimensions and gender and energy saving behaviour. However, analysis of the

diaries revealed that more girls reported ironing and cooking activities compared to boys. The study found that children are motivated to save energy for several reasons of which financial reason were the most cited followed by environmental concern. Moreover, for some children, energy use may be accompanied by guilt as children referred to themselves as energy wasters. Consistent with existing literature, the results suggest that the children have altruistic values as the main motive behind their energy saving is the desire to help others (to help their families save money and to prevent fires and pollution in their community). The study also found that subjective norms were also important in influencing energy activities. To illustrate, the results show that children who had friends who valued energy saving were more likely to indicate that they always remove plugs from the wall socket. Lastly, the study found that children in Khayelitsha were more likely to perform energy saving activities if they believed that their actions contributed to environmental problems (environmental awareness). However, children who felt that they could bring about change to environmental problems were less likely to save energy (internal locus of control). These findings highlight that energy saving in more nuanced and other factors influence behaviour.

5 External & Contextual Factors influencing energy saving

The previous chapter has described the children's energy activities and provided insight into the personal factors that play a role in influencing their energy activities. This chapter presents and discusses external and contextual factors. Section 5.1 explores the influence of the source of information and behaviour setting as well as the influence of the parental demographics and household factors. Section 5.2 explores the influence of community level and national level factors and their influence on children's energy saving activities. As indicated in the previous chapter, it is important to keep in mind that the conceptual framework illustrated in Chapter 2 shows that all the factors (personal, external and contectual) interact with each other.

5.1 External Factors

5.1.1 Sources of information and behaviour setting

The results show that children in Khayelitsha gain their information from multiple sources including parents, the school/teachers, peers/friends, the community, aunts, uncles, grandparents, siblings, the internet, magazines and environmental/energy clubs. Parents, especially mothers, were reported to be the main source of information for saving energy. Father, uncles, aunts and siblings were mentioned to a lesser extent. Teachers were the second most cited source. Closely related to this, the children indicated that they also learn from school books, as expressed in the focus group discussion excerpt below:

Phuma	*I also said to protect the environment because when we use electricity a lot, the electricity companies will have to use coal a lot but coal is not environmentally friendly.*
Researcher	*What does that mean?*
Phuma	*It means that it is corrosive to the environment*
Researcher	*Where did you guys learn about that?*
Thando	*: In class.*
Siseko	*: In science.*
Researcher	*So you learnt that in class.*
Mandla	*In our text books.*
Researcher	*Okay, ,in your textbooks.*

These findings suggest that the home is the most significant setting followed by the school and support findings studies by Boudet et al. (2013), Toth et al. (2013) and Aguirre-Bielschowsky (2014). The children in Khayelitsha also reported learning how to save

electricity by following messages on the TV and radio. This finding highlights the importance of media platforms in encouraging energy saving.

5.1.2 **Family factors**

The home environment is important for several reasons. Firstly, most of the energy-saving activities were performed at home and the children reported learning about energy saving from parents. This signifies that the home is a vital environment that possibly shapes and reinforces children's energy knowledge, attitudes and activities. This is consistent with Boudet et al. (2014), who argued that children often take note of and copy energy- saving behaviour from parents. The results further show that 61% of the 41 parents reported that they always remove appliances from the wall plug and 52.5% reported that they always switch the light off when a room is empty. These actions are also performed by children, although at a higher number, for instance switching off lights was performed by over 70% of the children while removing appliances from wall plugs was reported by 60.7% of the children. The high percentages might be a result of these activities being a responsibility for the children at home. Other energy-saving techniques reported by the parents involve the use of energy-efficient technologies: 69.2% of the parents reported using energy-saving light bulbs; 60.5% reported the use of energy-efficient microwaves, and 33.3% reported using energy-efficient heaters. These findings are consistent with the DoE (2013), who found that switching off lights, the use of energy-saving lights and switching off appliances were the most common energy-saving practices among South African adults. The results of this study also seem to imply that a considerable percentage of the parents have an ambiguous attitude towards EE appliances and alternative fuels. For instance, the majority – that is 42.5% (n=40) of the parents – indicated that they were not sure about purchasing EE appliances while only 22.5% (n=40) would consider doing so. Moreover, 60.5% (n=38) of the respondents indicated that they were either unsure, unlikely and would never use solar-powered appliances while 40% (n=40) felt the same way about using gas to cook. The results further show that 65.1% of 43 parents indicated that they would want to use more energy appliances to improve their living conditions and 69.8% of 43 parents also indicated that they would increase energy use to improve their living conditions. This finding suggests that the majority of the parents in this study had aspirations of improving their quality of life and comfort, therefore it is a norm. Based on the energy cultures framework, these results may also highlight that the parents in this study experience some internal conflict, as they would want

to use more energy to improve their living conditions and at the same time want to reduce their energy expenditure.

Where knowledge is concerned, the results show that 71,4% of 42 parents acknowledged a lack of energy access in the country, 81% agreed that humans should respect the environment and 64.3% acknowledged that changing the environment causes problem. These findings show that the parents in this study were aware of environmental problems caused by human consumption and the lack of energy access in the country. Regarding the relationships between parent and child variables, chi-square tests did not find any significant relationships between parent's educational level and the children's energy knowledge, attitude or behaviour. Nor did it find any significant relationships between households' monthly expenditure and other variables such as energy saving activities. The test, however, found a significant relationship between parents' attitudes and children's attitudes. The results (χ^2=8787 df 2 p=.012) show that parents who disagreed with the need for humans to respect the environment were more likely to have children who denied that climate change impacts global weather patterns. The results also show that parents who acknowledged the need for humans to respect the environment were more likely to have children who rejected this (58.06%), rather than children who accept (41.94%) that climate change impact global weather patterns. The statistical test also showed that parents who acknowledged the necessity of protecting the environment were more likely to have children who denied (44%) environmental dangers of using fossil fuels than children who acknowledged (36%) the statement (χ^2=9.621 df 4 p=0.047). These findings seem to suggest that there is a disconnect between parents' environmental attitude and children's environmental attitude and knowledge. This might be a result of several issues such as: i) children are still learning to understand environmental concepts and connect them to energy concepts, ii) either the parents and the children in Khayelitsha do not necessarily discuss environmental topics amongst themselves, or iii) the parents do not connect the environment to climate change, or iv) that the children do not share similar views of the environments with their parents. Further exploration of these issues in future research is recommended.

Where attitude is concerned, the results indicate that parents who had a positive attitude to the environment were more likely to discuss energy saving with the families. For instance, 65.52% of 41 parents who acknowledged that humans should respect the environment were

more likely to indicate that they always talk to their families about saving energy (χ^2=16.071 df 4 p=0.003), while 50% who provided neutral responses to the statement were more likely to never talk to their children about energy saving. In addition to these findings, the statistical tests also showed that 86.21% of 41 parents who acknowledged the need for humans to respect the environment were more likely to indicate that they always encourage their children to save energy (χ^2 10.911 df 4 p=0.028). These findings therefore seem to support Aguirre-Bielschowsky (2014) who found that parents with strong environmental values where more likely to talk to their families about electricity consumption. Regarding household communication and motivation to save energy, the results further show that 97.6% of the 41 parents reported that they always (80.5%) and sometimes (17.1%) encourage their children to save energy. 90.2% also indicated that they always (56.1%) and sometimes (34.1%) talk to their families about energy saving. Interestingly, exploration of household communication in the focus group discussion and the diaries revealed that household 'talk' focuses on the financial issues. The high costs of energy and their parents' frustration over buying electricity was revealed in the following dialogue:

Researcher:	*Okay,what about to your parents and to the people you live with. What do they say about electricity or energy?*
Melissa:	*They just buy, buy, buy.*
Researcher:	*They just buy all the time?*
Manga:	*They say you must stop wasting electricity because it is expensive.*
Jane:	*They buy electricity so that they cannot buy it again that's what they say.*
Researcher:	*They say they don't want to buy it again?*
Jane:	*Yes. They say so.*
Researcher:	*How do they say that?*
Mandla:	*They say you must switch off the lights in the kitchen and in the bedroom.*

This finding was supported by the survey as it showed the majority (83.3%) of the parents reported financial reasons as their main reason for reducing energy consumption. Qondi's (female, 13) and Phuma's (male, 12) parents highlighted challenges of the high cost of electricity while the need to saving money was expressed by Hlubi's (female, 14) parent who wrote *"it create chance to save money"* and Adzi's (male, 14) parent who wrote *"to save money because if you use energy wise u can't spend a lot of energy".* These findings are consistent with Aguirre Bielschowsky (2014: 94), who reported that monetary concerns were the most cited response among the parents in her study. Moreover, this study shows that both parents and children in Khayelitsha cite financial reasons as a main reason for saving energy.

These findings suggest that most the parents and children in this study discuss energy saving. This finding contradicts existing studies on this topic, in particular, Boudet et al. (2014) and Fell and Chiu (2014) who found little evidence of energy being discussed in the American and UK homes.

The results also show that 72.1% of the 43 parents have environmental reasons for saving energy. This is not surprising considering that parents have positive attitudes towards the environment – a topic that will be discussed in Chapter 5. This finding is consistent with Aguirre-Bielschowsky (2014) who found that environmental concern to be the second most cited reason for saving electricity among the parents in her sample. This finding suggests that children are likely to be exposed to pro-environmental attitudes and behaviours both at home and at school. The results also show that some of the parents shared similar motivations for saving energy. For instance, Karabo's (female, 12) parent highlighting the problem of load shedding wrote "If we save energy there is a low chance of us experiencing load shedding", sentiments that were shared by Jabu's parent (To avoid load shedding) and Phuma (male, 12) parents (Prevent load shedding). Energy access issues were expressed by Gabriel's parents who wrote "it is important to save energy because not all of us have it"

Although the responses from the educator do not provide sufficient evidence because it is from one respondent, the responses highlight several issues that might hinder or encourage children's attempt at saving energy. A potential barrier to children's energy saving is that parents might always be willing to adopt energy-saving techniques recommended by their children, for example, the educator highlighted that the children report that parents do not want to use a flask to store hot milk and water for tea, especially if it helps with their level of comfort and quality of life. However, the notion that parents are not always willing to accept all energy-saving techniques suggested by their children is reported by Garabuau-Moussaoui (2011), who found that some adults in France stop paying too much attention to their energy costs so that they can attain a certain level of comfort. The challenge from this barrier is that providing energy-saving suggestions may possibly lead to conflict between children and their parents and if this happens, children may try to avoid any conflict by not offering new energy-saving techniques. This perspective is consistent with Fell and Chiu (2014), who found that there is a possibility for disputes between parents and children in the UK, if one party felt that the other was using more energy than agreed upon, and Garabuau-Moussaoui et

al., (2011) who reported that teenagers in France show reluctance to save energy if it would lead to disagreements with their parents. This topic was not explored further in this study; hence exploration of this topic is important and is recommended for future studies.The educator also indicated that previous attempts by the school to engage with parents and for parents to become more involved in their children's learning problem have been difficult, saying: *"Unfortunately our parents do not come to school as often as we would love. And when they come they are tired ... but if maybe they were always willing to come to school because sometimes we drag them to attend the school meetings"*. Despite these challenges, the educator highlighted that in some cases *"parents listen to their children but it's very few it's not much"* and that this has resulted in the adoption of good practices in both the children and their parents. The educator suggested that there is potential for knowledge transfer from the children to the parents when she said *"... if the same approach if we use it for energy..."* She further implied that knowledge transfer could improve communities as members adopt energy-saving activities when she said *"because if they can make use of their children and listen to their teachings, then I'm sure that our communities would be better…".* This following section explores community factors.

Where material culture is concerned the results presented and discussed in Chapter 3 and the Chapter 4 provide insight into household material culture. To review, household factors such as type of appliances and energy sources determine the behaviour of children. The children boil bath water using a kettle because they do not have geysers and one child in this study was able to save biomass used for cooking by putting out a fire. Moreover, although electricity is the main source of cooking and lighting fuel, some of the children live in households were paraffin and wood are food for cooking and candles and paraffin are used for lighting. These findings are consistent with behaviours reported by StatsSA (2015) and they show how the behaviour of some low-income households is shaped by the type of resources they have.

5.2 Contextual Factor

The results reveal that the children highlighted that community members were another source of information on energy issues as shown in the following conversation:

Researcher	*So, someone said that they save electricity because they know that some people in South Africa do not have electricity. Is that true?*
Siseko	*Yes..(*inaudible*) …… that there will be no electricity for about 4 years.*
Researcher	*Oh Really. Where did you hear that from?*
Siseko	*From the community.*
Researcher	*Is that what they talk about.*

However, the educator expressed concern that community member may have misconceptions and biases about energy-saving technologies and fuels might trickle down to children. The educator therefore emphasised the importance of educating children on energy; environmental issues was expressed by the educator when she said, *"I feel that because they are exposed to these things these teachings about energy at an early age when they become of age they will buy sensible …"*. She further suggested that their education would lead to good citizenship as children adopt positive energy practices: *"That's why I am of the feeling that the children that we are teaching currently will be better citizens because they've been exposed to these teachings throughout".* These ideals seem to have been accepted by the children as a reason for saving energy, for example Namhla (female, 14) said *"… I am the student and I have to know to save electricity and energy I am old".* In this statement, Namhla highlights the importance knowing how to save energy as a student and a maturing person. However, further probing of energy education revealed that there are several factors at national level that hinder children's education and may indirectly influence their knowledge, attitudes and behaviours. In the interview, the educator highlighted that the school suffers from limited capacity. As such, teachers do not have enough time to organise excursions and field trips to conservation parks and power stations, given that the DoE requires educators to submit their travel documents six to eight weeks in advance. The importance of excursions as a part of energy education was highlighted by the educator when she said: "… *we are not specialists and our schools are not well resourced … sometimes they need to go out and see the real things so that it can be really meaningful to them."* This view of providing children with opportunities to go on field trips and to participate in practical activities is supported by Aguirre-Bielschowsky (2014) in New Zealand and Fell and Chui (2014) in the UK. The educator also highlighted the limited resources within the school when she said:

Researcher	*Do you think that right now for primary school learners anything can be done to improve the curriculum or the way in which it is taught?*

Educator	*The way it is taught, because in terms of resources we are still struggling because we don't have labs. Because sometimes we want to demonstrate something using the equipment, for instance…*
Researcher	*So that's the one thing that you would want. And who would you want that assistance from?*
Educator	*Eskom, because it is their baby. Because the Department of Education is going to tell you budget cuts ….*

This dialogue also suggests that this particular school has been negatively affected by budget cuts within the Department of Education. Although the educator implied that Eskom should be proactive in energy education endeavours, she had indicated earlier in the interview that the school has also been negatively impacted by budget cuts within the utility when she said *"They would call us and say we have got this so, are you interested and…in fact, I once asked them and they said they have got budget cuts"*. According to the educator, budget cuts within Eskom have caused limited interaction between the utility and the children and they have also restricted the opportunities offered to the school to go on excursions. The lack of resources and lack of cohesion is problematic and has been reported by Newborough et al. (1991), of schools in the UK, and Wassung (2010) of schools in South Africa. Children are prevented from leaving and receiving instruction from outside sources. For example, Phuma (male, 12) indicated that he had been encouraged to save energy through participating in the research study when he wrote "*a lady (Shanon Lusinga) at my school advised me to save energy".*

When exploring the lack of resources within the school, it is equally important to keep in mind the context in which the school is located. In restating the historical and geographical factors of the study area as highlighted in Chapter 3, Khayelitsha is a low-income community, that is poorly services and schools are poorly resourced (Seekings, 2013; Clarke, 2015). It is therefore likely that budget cuts by government and other stakeholders has had adverse impacts on this particular school and it ability to effectively teach children about energy and energy saving.

5.3 Conclusion

This chapter reveals that the home and school environment are important in instilling and reinforcing positive energy-saving activities. Moreover, parents (especially mothers) and educators/books were cited as significant sources of information. The results also show a bi-directional relationship within the home because on one hand i) children seem to copy energy

saving activities such as switching off lights and removing plugs from the wall socket and ii) parents with positive attitudes towards the environment were more likely to talk to their family about the cost of energy hence both children and parents cited finances as the main reason for saving energy. On the other hand, the results also show that there is potential for children transfer energy saving techniques they learnt at school to home. A potential barrier was highlighted by the educator who indicated that this relationship may be accompanied by conflict if it interferes with parent's comfort, thereby, resulting in children's reluctance to offer suggestions on energy saving. Although the school was cited as the the second important setting for learning, the lack of resources and limited capacity at the school may be to be a serious barrier to effective learning as children are unable to go on excursions and they do not have the necessary equipment such as labs within the school, resources that were identified as important by their teacher. The educator also highlighted another potential barrier in parents are not always willing to participate in school activities that promote energy saving. The lack of agreement between the home and the school environment may indirectly confuse the children as act as a barrier to the children's energy activities. Regarding contextual factors, it has been argued that it is important to consider the historical factors that have contributed deprivation experienced by the school in Khayelitsha. Equally important are the current problems such as budget cuts within the DoE and Eskom that may have a negative effect on the school's ability to take purchase resources and teach children.

6 Conclusion and Recommendations

Having reviewed the existing literature, a gap was identified showing that little is known about children's energy activities in South Africa and the factors influencing such activities. A case study and mixed methods approaches were adopted to collect data from the children, parents and educator participating in the survey. This final chapter will show how the research results have answered the research questions outlined in Chapter 1 and provide the conclusions for this research. In addition, it will provide recommendations alongside the identification of areas for future research.

This research study was carried out in Khayelitsha, Cape Town to answer six questions. The first question of this study was *"how do children in grade 7 conceptualise energy?"*. The study found that the children have a broad understanding of the concept as they related the concept to the natural world and different types of energy, such as thermal, kinetic, chemical and physical. This broad understanding carried through to the way in which children use and save energy, as some of the children reported using and saving physical energy alongside its thermal applications. Two key aspects on children's energy knowledge were identified. Firstly, children's in Khayelitsha had insight into how people and communities are affected by fossil fuels, limited access to energy and the high cost of electricity, but they struggled to show understanding of the energy-environment nexus and other technical aspects, likely a reflection on the content they have covered. Secondly, children learn about energy and energy saving from multiple sources, of which parents, educators and the TV seem to play a significant role.

The second question was *"In what ways, do grade 7 learners in Khayelitsha use energy?"*. The study found that children perform several activities that require the use of energy. Most the children reported cooking, switching on lights, ironing their clothes, boiling water in a kettle to bath/wash, charging cell phones, while fewer reported charging laptops, using the washing machine. Important contributions from this thesis are that children between the ages of 11 to 15 years use kettles for bathwater, iron their clothes and sometimes assume the responsibility of cooking for their families.

The third question was *"What techniques do grade 7 learners in Khayelitsha employ to save energy?"*. The study found that children tend to save energy by switching off light and appliances, removing appliances from the wall plug and restricting the amount of energy they

use. A contribution from this thesis is that children in South Africa save gas by turning off the gas cylinders and save wood by putting out a fire.

The fourth question was *"What factors influence child energy saving behaviours among grade 7 learners in Khayelitsha?"*. The study found that these activities are influenced by multiple factors. These were presented in a conceptual framework in Chapter 2 as personal factors (grade/age, gender, knowledge, attitude, motivation, locus of control, environmental awareness, subjective norms), external factors (source of information, behaviour setting, parental factors, household factors) and contextual factors (the state of energy in South Africa, national energy and climate policy, energy education, the relationship between the school and stakeholder, and national and community attitudes and behaviours). This framework does not explore these factors in a sequential order rather shows that all the factors interact with each other.

The fifth question was *"What reasons do children have for saving energy?"*. The study found that children had financial, environmental, instruction and safety reasons for saving energy. However, the main motive behind their actions was to listen to parents and teachers and help their families and communities. This implies that children in Khayelitsha have altruistic values behind their energy saving.

The sixth question of this study *"How can the existing frameworks and theories help improve our understanding of children's energy saving activities in Khayelitsha?"*. The study found that the Theory of Planned Behaviour, the Model of Pro-Environmental Behaviour, the concept of Energy Literacy, the Energy Cultures Framework, the Bio-Ecological System Theory and Theory of Cognitive Development provide insight in the personal, external, and contextual factors that may influence children's energy saving activities.

Considering the results of this research study, policy recommendations are:

- Energy programmes aimed at affecting children's energy behaviour could include a focus on parents given the key role they play in influencing children energy activities.
- Stakeholders such as the DoE, Eskom and NGOs could increase their efforts to engage with school in improvised communities to improve their access to resources and ability to go on excursions.
- There could be efforts to improve communication and interaction between the parents and the school because they seem to be two significant behaviour settings. This may

overcome some of the feelings of guilt that children have when they use energy at home and to address their reluctance to recommend new energy saving technologies.

- It is also recommended that energy and environmental programmes could minimise the guilt children have by helping them recognise that they are already engaging in energy-saving activities.

There are some limitations to these this. Firstly, the study only focused on Grade 7 children in one school. Future research could focus on several schools in townships or compare a township school with another school in a more affluent area. Secondly, given low levels of education in Khayelitsha, it is assumed that parents might not have felt confident to answer the survey; hence future researchers could use other methods such as interviews or focus group discussions. Thirdly, although the survey was piloted with some of the children, it is possible that some questions may be difficult for the children to grasp. It is therefore recommended that future studies spend more time piloting research instruments. There were also time and resources limitations to this study; it is therefore recommended that future studies use more interactive research methods with the children, such as cameras and arts and craft sessions. This will provide further insight into children's energy and environment attitudes.

References

Aguirre-Bielschowsky, I. 2014. Electricity saving behaviours and energy literacy of New Zealand children. Ph.D. University of Otago. Available: https://ourarchive.otago.ac.nz/bitstream/handle/10523/4685/AguirreBielschowskyIkerne2014PhD.pdf?sequence=3&isAllowed=y; [2015, October 10].

Aguirre-Bielschowsky, I., Lawson, R., Stephenson, J. & Todd, S. 2015. Energy literacy and agency of New Zealand children. Environmental Education Research. :1-23. DOI:10.1080/13504622.2015.1054267.

Ajzen, I. 1991. The Theory of Planned Behavior. Organizational Behavior and Human Decision Processes. 50(2): 179-211. DOI: http://dx.doi.org/10.1016/0749-5978(91)90020-T.

Ajzen, I. 2002. Perceived behavioral control, Self-Efficacy, locus of control, and the theory of planned Behavior1. Journal of Applied Social Psychology. 32(4):665-683. DOI: 10.1111/j.1559-1816.2002.tb00236.x.

Baker, L., Burton, J., Godinho, C. & Trollip, H. 2015. The political economy of decarbonisation: Exploring the dynamics of South Africa's electricity sector. Energy Reserch Centre. Univsirty of Cape Town. Available: http://deepdecarbonization.org/wp-content/uploads/2015/11/DDPP-Political-Economy-261115-FINAL-for-printing.pdf [2015, June 12].

Barnes, B. R. 2014. Behavioural change, indoor air pollution and child respiratory health in developing countries: A review. International Journal of Environmental Research and Public Health. 11(5): 4607-4618. DOI: 10.3390/ijerph110504607.

Batchelor, S. & Smith, J. 2014. Renewable energy and decentralization (READ): Tools for improving decentralised governance of energy. (Project EP/L002469/1, 2013-2015 Working Paper 5). Available: http://thereadproject.co.uk/wp-content/uploads/2014/04/Tools-for-Improving-Decentralised-Governance-of-Energy-Working-Paper-5-v29072014.pdf [2016, November 5].

Bekker, B., Eberhard, A., Gaunt, T., & Marquard, A. 2008. South Africa's rapid electrification programme: Policy, institutional, planning, financing and technical innovations. Energy Policy, 36(8), 3125-3137. doi:10.1016/j.enpol.2008.04.014.

Boeve-de Pauw, J. & Van Petegem, P. 2012. Cultural differences in the environmental worldview of children. International Electronic Journal of Environmental Education. 2(1):1-11. Available: http://dergipark.ulakbim.gov.tr/iejeegreen/article/view/1087000041/1087000025 [2015, August 5].

Boudet, H., Ardoin, N.M., Flora, J., Armel, K.C., Desai, M. & Robinson, T.N. 2014. Energy behaviours of northern California Girl Scouts and their families. Energy Policy. 73:439-449. DOI: http://dx.doi.org/10.1016/j.enpol.2014.05.044.

Boylan, C. 2008. Exploring Elementary Students' Understanding of Energy and Climate Change. International Electronic Journal of Elementary Education. 1(1):1-15. Available: http://files.eric.ed.gov/fulltext/EJ1052050.pdf [2015, October 6].

Burton, J. & Winkler, H. 2014. South Africa's planned coal infrastructure expansion: drivers, dynamics and impacts on greenhouse gas emissions. Energy Research Centre. University of Cape Town. Available: http://www.erc.uct.ac.za/Research/publications/14-Burton-Winkler-Coal_expansion.pdf [2015, September 1].

Clarke, J. 2015. Briefing Document 1: The township – an overview. Schools Improvement Initiative. University of Cape Town. Available: http://www.sii.uct.ac.za/siipii-symposium-held-cosat-khayelitsha-22-august-2015 [2016, August 12].

Chacko, C. 1998. An understanding of environmental concepts and issues among grade 10-12 students from urban and rural schools. Southern African Journal of Environmental Education. 18:54-61. Available: http://www.ajol.info/index.php/sajee/article/view/137414/126975 [2016, October 12].

City of Cape Town. 2013. 2011 Census Suburb Khayelitsha. Available: https://www.capetown.gov.za/en/stats/2011CensusSuburbs/2011_Census_CT_Suburb_Khayelitsha_Profile.pdf [2015, October 18].

Chen, K., Liu, S. & Chen, P. 2015. Assessing Multidimensional Energy Literacy of Secondary Students Using Contextualized Assessment. International Journal of Environmental and Science Education. 10(2):201-218. DOI:10.12973/ijese.2015.241a.

Chen, M. 2016. Extending the theory of planned behavior model to explain people's energy savings and carbon reduction behavioral intentions to mitigate climate change in Taiwan–moral obligation matters. Journal of Cleaner Production. 112:1746-1753. DOI: http://dx.doi.org/10.1016/j.jclepro.2015.07.043.

CNBCAFRICA. 2014. Effects of load shedding on SA economy. CNBCAFRICA News. December, 9. 2014. [Video file] Available: http://www.cnbcafrica.com/video/?bctid=3931287178001 [2015, August 10].

Conner, M. & Armitage, C.J. 1998. Extending the theory of planned behavior: A review and avenues for further research. Journal of Applied Social Psychology. 28(15):1429-1464. DOI: 10.1111/j.1559-1816. 1998.tb01685.x.

Cohen, L., Manion, L. & Morrison, K. 2007. Research methods in education. Rev. 6th ed. New York, USA: Routledge. Available: https://islmblogblog.files.wordpress.com/2016/05/rme-edu-helpline-blogspot-com.pdf [2016, March 16].

Creswell, J., W 2009. Research Design: Qualitative, quantitative and mixed methods approaches. Rev. 3rd ed. Los Angeles: Sage Publication.

Croad, T. 2014. New Zealand's energy strategy and policy resilience. Proceedings of United Kingdom Political Studies Association (UKPSA) Conference. 2015. Available: https://www.psa.ac.uk/sites/default/files/conference/papers/2015/New%20Zealand's%20Energy%20Strategies%20and%20Policy%20Resilience%20-%20UKPSA%202015%20Conference.pdf [2016, June 19].

Department of Basic Education. 2009. Curriculum and Assessment Policy document. Grades 4-6. Natural Sciences and Technology. Available: http://www.education.gov.za/LinkClick.aspx?fileticket=IzbFrpzoQ44%3d&tabid=572&portalid=0&mid=1568 [2015, November 8].

Department of Education. 2014. Report on the annual national assessment of 2014: grades 1 to 6 & 9. Available: http://www.saqa.org.za/docs/rep_annual/2014/REPORT%20ON%20THE%20ANA%20OF%202014.pdf [2015, November 8].

Department of Energy. 2012. A Survey of Energy Related Behaviour and Perceptions in South Africa: The Residential Sector. Available: http://www.energy.gov.za/files/media/Pub/DoE-2012-Survey-of-EnergyRelated-Behaviour-and-Perception-in-SA.pdf [2015, October 18].

Department of Energy. 2013. A Survey of Energy Related Behaviour and Perceptions in South Africa: The Residential Sector. Available: http://www.energy.gov.za/files/media/Pub/DoE-2013-Survey-of-EnergyRelated-Behaviour-and-Perception-in-SA.pdf [2015, October 18].

Department of Energy-United States of America. 2011. Energy literacy: Essential principles and fundamental concepts for energy education. Available: http://www1.eere.energy.gov/education/pdfs/energy_literacy_1_0_high_res.pdf [2015, November 8].

Department of Environmental Affairs. 2011. National Climate Change Response White Paper. Available: http://www.gov.za/sites/www.gov.za/files/national_climatechange_response_whitepaper_0.pdf [2015, October 18].

Department of Minerals and Energy. 2005. Energy Efficiency Strategy of the Republic of South Africa. Available: https://www.gov.za/sites/www.gov.za/files/energy%20efficiency_strategy_05_1.pdf [2015, November 8].

De Vos, A.S., Strydom, H., Fouche, C.B., Delport, C.S.L. 2011. Research at Grass Roots, for the social sciences and human service professions. Rev. 4th ed. Pretoria: Van Schaik Publishers.

DeWaters, J., Powers, S.E. & Graham, M. 2007. Developing an energy literacy scale. Proceedings of ASEE Annual Conference and Exposition, 2007. Citeseer. Available:

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.619.3399&rep=rep1&type=pdf [2015, August 20].

DeWaters, J. & Powers, S. 2008. Energy literacy among middle and high school youth. Proceedings of Frontiers in Education (FIE) Conference 2008. 38th Annual. IEEE. Available: http://128.153.5.187/highschool/k12/pdf/FIE08_EnergyLiteracy.pdf [2015, August 20].

DeWaters, J.E. & Powers, S.E.2011. Improving energy literacy among middle school youth with project-based learning pedagogies. Proceedings of Frontiers in Education Conference (FIE), 2011. 12-15 October. DOI 1.10.1109/FIE.2011.6142961.

Dietz, T., Gardner, G.T., Gilligan, J., Stern, P.C. & Vandenbergh, M.P. 2009. Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. Proceedings of the National Academy of Sciences of the United States of America. 106(44):18452-18456. DOI:10.1073/pnas.0908738106.

Dominelli, L. & Holloway, M. 2008. Ethics and governance in social work research in the UK. British Journal of Social Work. 38(5): 1009-1024. Available: http://bjsw.oxfordjournals.org/content/38/5/1009.full.pdf+html [2015, March 20].

Eitel, K.B., Hougham, J., Laninga, T., Fizzell, G., Schon, J. & Hendrickson, D. 2015. Teacher Professional Development for Energy Literacy: A Comparison of Two Approaches. The Journal of Sustainable Education. 8:1-24. Available: http://www.jsedimensions.org/wordpress/content/teacher-professional-development-for-energy-literacy-a-comparison-of-two-approaches_2015_01/ [2016, December 3].

Ekström, K.M. 2007. Parental consumer learning or 'keeping up with the children'. Journal of Consumer Behaviour. 6(4):203-217. DOI: 10.1002/cb.215.

Federal Ministry for Economic Cooperation and Development (BMZ), 2014. Sustainable Energy for Development. (Brochure 1/2014e). Available https://www.bmz.de/en/publications/topics/energy/Materialie235_Information_Brochure_1_2014.pdf [2016, March 15].

Fell, M.J. & Chiu, L.F. 2014. Children, parents and home energy use: Exploring motivations and limits to energy demand reduction. Energy Policy. 65:351-358. DOI: http://dx.doi.org/10.1016/j.enpol.2013.10.003.

Garabuau-Moussaoui, I. 2009. Behaviours, transmissions, generations: why is energy efficiency not enough? Proceedings of ECEEE Summer study proceedings 2009. Available: http://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2009/Panel_1/1.054/paper [2016, July 12].

Garabuau-Moussaoui, I. 2011. Energy-related logics of action throughout the ages in France: historical milestones, stages of life and intergenerational transmissions. Energy Efficiency, 4(4): 493-509. DOI: 10.1007/s12053-011-9124-8.

Gaunt, C.T. 2005. Meeting electrification's social objectives in South Africa, and implications for developing countries. Energy Policy. 33(10):1309-1317. DOI: http://dx.doi.org/10.1016/j.enpol.2003.12.007

Guba, E.G. & Lincoln, Y. S. 2008. Paradigmatic controversies, contradictions and emerging confluences. In the landscape of qualitative research. N. K. Denzin & Y. S. Lincoln. Eds Los Angeles. Sage Publication. 255-287.

Hall. 2016. Housing and Services-Access to electricity. Available: https://www.childrencount.org.za/indicator.php?id=3&indicator=43 [2017, October 20].

Hall, K., Meintjes, H., & Sambu, W. 2014. Demography of South Africa's children. In South African child gauge 2014. Eds. Hall, K., Meintjes, H., & Sambu, W.,Mathews, et al. 90-93. Cape Town. UCT. Available: http://www.ci.org.za/depts/ci/pubs/pdf/general/gauge2014/ChildGauge2014_childrencount_demography.pdf [2015, May 12].

Härkönen, U. 2007. The Bronfenbrenner ecological systems theory of human development. Proceeding of International Conference Person. Colour. Nature. Music 2007. 17-21 October. Available: https://pdfs.semanticscholar.org/87f8/0fb75870d7044b5e94bf7261677763d39322.pdf [2016, November 10].

Hook, D. 2009. Bronfenbrenner's ecological theory of development. In developmental psychology. J Watts, K, Cookcroft & N. Duncan. Eds. Cape Town: UCT Press. 501-513.

International Energy Agency.2014. World Energy Outlook. Available: https://www.iea.org/publications/freepublications/publication/WEO2014.pdf [2016, March 5].

International Energy Agency. 2015. World Energy Outlook. Executive summary. Available: https://www.iea.org/Textbase/npsum/WEO2015SUM.pdf [2015, July 8].

Ishak, M.H., Iman, A.H.M. & Sapri, M. 2012. Theoretical postulation of energy consumption behaviour assessment in Malaysian higher education institutions. Procedia-Social and Behavioral Sciences. 65:891-896. DOI: http://dx.doi.org/10.1016/j.sbspro.2012.11.216.

IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp. Available: https://www.ipcc.ch/report/ar4/wg1/ [2015, August 20].

Kandpal, T. & Garg, H. 1999. Energy education. Applied Energy. 64(1):71-78. DOI: http://dx.doi.org/10.1016/S0306-2619(99)00076-8.

Keirstead, J. 2006. Evaluating the applicability of integrated domestic energy consumption frameworks in the UK. Energy Policy. 34(17):3065-3077. DOI: 10.1016/j.enpol.2005.06.004.

Kohler, M. 2017. An Empirical Analysis of Energy Efficiency in South Africa. Unpublished Report. School of Accounting Economics & Finance. University of Kwa-Zulu Natal.

Kollmuss, A. & Agyeman, J. 2002. Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? Environmental Education Research. 8(3):239-260. DOI: http://dx.doi.org/10.1080/13504620220145401.

Krishnan, V.2010. Early child development: A conceptual model. Proceedings of Early Childhood Council Annual Conference 2010, “Valuing Care”. 7-9 May 2010. Christchurch, New Zealand. Available: https://www.ualberta.ca/-/media/ualberta/faculties-and-programs/centres-institutes/community-university-partnership/research/ecmap-reports/ecd-conceptualmodel.pdf [2016, November 10].

Moezzi, M. & Lutzenhiser, L.2010. What’s missing in theories of the residential energy user. ACEEE Summer Study on Energy Efficiency in Buildings. Available: https://www.pdx.edu/cus/sites/www.pdx.edu.cus/files/Moezzi%20%26%20Lutzenhiser%20(2010)%20Whats%20Missing%20In%20Theories%20of%20the%20Residential%20Energy%20User_0.pdf [2016, November 19].

Morrow. V. 2008. Ethical dilemmas in research with children and young people about their social environments. Children's Geographies. 6(1): 49-61. DOI:

National Heatlh Act, No 61 of 2003, as amended. 2004. Available: http://www.chr.up.ac.za/undp/domestic/docs/legislation_55.pdf [2016, August 18].

Newborough, M., Getvoldsen, P., Probert, D. & Page, P. 1991. Primary-and secondary-level energy education in the UK [Abstract]. Applied Energy. 40(2):119-156. DOI: http://dx.doi.org/10.1016/0306-2619(91)90018-S

Newhouse, N. 1991. Implications of attitude and behavior research for environmental conservation. The Journal of Environmental Education. 22(1):26-32. DOI: http://dx.doi.org/10.1080/00958964.1990.9943043.

Ntona, E., Arabatzis, G. & Kyriakopoulos, G.L. 2015. Energy saving: Views and attitudes of students in secondary education. Renewable and Sustainable Energy Reviews. 46:1-15. DOI: http://dx.doi.org/10.1016/j.rser.2015.02.033.

Olufemi, A.C., Mji, A. & Mukhola, M.S. 2014. Assessment of secondary school students’ awareness, knowledge and attitudes to environmental pollution issues in the mining regions of South Africa: implications for instruction and learning. Environmental Education Research. 22(1):43-61. DOI: http://dx.doi.org/10.1080/13504622.2014.984162.

Pachauri, R.K., Allen, M.R., Barros, V.R., Broome, J., Cramer, W., Christ, R., Church, J.A., Clarke, L. et al. 2014. Climate change 2014: synthesis report. Contribution of Working Groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change. IPCC. Available: https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_Front_matters.pdf [2015, October 12].

Palys, T. 2008. Purposive sampling. In The sage encyclopedia of qualitative research methods. L. M. Given. Ed. Los Angeles: Sage Publications. 697-698.

Prager, K. 2012. Understanding behaviour change: How to apply theories of behaviour change to SEWeb and related public engagement activities. (SEWeb LIFE+ Project Action Number 04). Available: http://www.environment.scotland.gov.uk//media/16539/Understanding-Behaviour-Change.pdf [2016, October 12].

Punch, K. 2005. Introduction to social research: quantitative and qualitative approaches. Rev. 3rd ed. London. Sage Publication.

Rondganger, L. 2015. Spread the load (shedding). iol News. 22 May, 2015. Available: http://www.iol.co.za/dailynews/spread-the-load-shedding-1.1862119#.VltvjdIrLDc [2015, August 10].

Saunders, M. N. K., Lewis, P., & Thornhill, A. 2000. Research methods for business students. Rev. 5th ed. Harlow: Financial Times/Prentice Hall. Available: Harlow: Financial Times/Prentice Hall.

Seeking, J. Economy, society and municipal services in Khayelitsha. Centre for Social Science Research-UCT. Available: http://www.dag.org.za/images/dag-matters/2013_Economy_society_and_municipal_services_in_Khayelitsha_Jeremy_Seekings.pdf

Sethusha, M.J. 2006. How Primary School Learners Conceptualize the Environment and Environmental Education. Master's Thesis. University of Pretoria. Available: http://www.repository.up.ac.za/dspace/bitstream/handle/2263/28350/dissertation.pdf?sequence=1 [2017, January 17].

Sigelman, C.K & Rider, E.A. 2009. Life-span human development. 6th ed. Belmont, CA: Wadsworth.

Silverman, D. 2013. Doing qualitative research. Rev. 4th ed. London : Sage Publication.

Solopova, A. 2008. The Forming of Environmental Behavior among Children through Ecological Education in Russia: The Case of UNDPs Energy Efficiency Educational Program. Master's Thesis. University of Olso. Available: http://urn.nb.no/URN:NBN:no-20564 [2015, October 16].

Statistics South Africa. 2015. General household survey. 2015. Available: h http://www.statssa.gov.za/publications/P0318/P03182015.pdf [2016, October 18].

Stephenson, J., Barton, B., Carrington, G., Gnoth, D., Lawson, R. & Thorsnes, P. 2010. Energy cultures: A framework for understanding energy behaviours. Energy Policy. 38(10):6120-6129. DOI: http://dx.doi.org/10.1016/j.enpol.2010.05.069.

Stephenson, J., Barton, B., Carrington, G., Doering, A., Ford, R., Hopkins, D., Lawson, R., McCarthy, A. et al. 2015. The energy cultures framework: Exploring the role of norms, practices and material culture in shaping energy behaviour in New Zealand. Energy Research & Social Science. 7:117-123. DOI: http://dx.doi.org/10.1016/j.erss.2015.03.005.

Street, B. 2003. What's "new" in New Literacy Studies? Critical approaches to literacy in theory and practice. Current Issues in Comparative Education. 5(2):77-91. Available: https://pdfs.semanticscholar.org/d35d/71ecf9e68cd6f8b80a0be05cb2d595f73aac.pdf [2016, October 25].

Sustainable Energy Africa. 2012. Energising Urban South Africa: poverty, sustainability and future cities. Available: http://www.cityenergy.org.za/uploads/resource_75.pdf [2015 September 9].

Sweeney, J.C., Kresling, J., Webb, D., Soutar, G.N. & Mazzarol, T. 2013. Energy saving behaviours: Development of a practice-based model. Energy Policy. 61:371-381. DOI: http://dx.doi.org/10.1016/j.enpol.2013.06.121.

Symon, G. 2004. Qualitative research diairies. In Essential guide to qualitative methods in organizational research. C. Cassell & Symon, G. London. Sage Publication. 98-114.

Tait, L., Merven, B., & Senatla, M. 2013. Investigating current and future roles of paraffin in South Africa. Energy Research Centre. University of Cape Town. Available: http://webdav.uct.ac.za/depts/erc/Research/publications/13Tait-etal_Paraffin_in_SA.pdf [2015, November 24].

Tesch, R. 1990. Qualitative research: Analysis types and software. London. Routledge.

Toth, N., Little, L., Read, J.C., Fitton, D. & Horton, M. 2013. Understanding teen attitudes towards energy consumption. Journal of Environmental Psychology. 34:36-44. DOI: http://dx.doi.org/10.1016/j.jenvp.2012.12.001.

Trollip, H., Butler, A., Burton, Caetano & Godinho, C. 2014. Energy Security in South Africa. Cape Town. MAPS. Available http://www.mapsprogramme.org/wp-content/uploads/Energy-Security_in-South-Africa.pdf [2015, March 18].

Trumper, R. 2010. How Do Learners in Developed and Developing Countries Relate to Environmental Issues?. Science Education International. 21(4):217-240. Available: http://files.eric.ed.gov/fulltext/EJ907042.pdf [2014, January 7].

UNICEF. 2011. Change Through the Eyes of a Child: South African children speak about climate change. Available: https://www.unicef.org/southafrica/SAF_resources_childrensvoices.pdf [2016, January 16].

UNICEF. 2013. Sustainable development starts and ends with safe, healthy and well-educated children. Available: http://www.unicef.org/socialpolicy/files/Sustainable_Development_post_2015.pdf [2015, October 5].

UNICEF. 2015. Why sustainable energy matters to children: The critical importance of sustainable energy for children and future generations? Available: http://causetechnet.com/files/UNICEF%20Sustainable%20Energy%20for%20Children%202015_FINAL.pdf [2015, October 5].

Urban Earth. 2015. South African Carbon Snapshot 2012. Available: www.urbanearth.co.za [2015, September 9].

Walliman, N. 2011. Research methods: The basics. New York. Routledge. Available: http://www.dphu.org/uploads/attachements/books/books_2531_0.pdf [2016, July March].

Walshe, N. 2013. Exploring and developing children's understandings of sustainable development with dialogic diaries. Children's Geographies. 11(1):132-154. DOI: http://dx.doi.org/10.1080/14733285.2013.743286.

Wassung, N. 2010. Water Scarcity and Electricity Generation in South Africa. Master's Thesis. University of Stellenbosch. Available: http://scholar.sun.ac.za/handle/10019.1/18158 [2016, October 12].

White, K.M., Hyde, M.K., Walsh, S.P. & Watson, B. 2010. Mobile phone use while driving: An investigation of the beliefs influencing drivers' hands-free and hand-held mobile phone use. Transportation Research Part F: Traffic Psychology and Behaviour. 13(1):9-20. DOI: 10.1016/j.trf.2009.09.004

Wilson, C. & Dowlatabadi, H. 2007. Models of decision making and residential energy use. Annual Reviews of Environmental Resources. 32:169-203. DOI: 10.1146/annurev.energy.32.053006.141137

Winkler, H. & Marquand, A. 2009. Changing development paths: From an energy-intensive to low-carbon economy in South Africa. Climate and Development. 1(1):47-65. doi:10.3763/cdev.2009.0003.

Winkler, H. 2011. Cleaner energy cooler climate: developing sustainable energy solutions for South Africa. Available: https://open.uct.ac.za/bitstream/item/2157/Cleaner_Energy_Climate.pdf?sequence=1 [2015, September 2015].

World Bank. 2013. Inclusion Matters: The Foundation for Shared Prosperity (Advance Edition). Washington, DC: World Bank. License: Available:

http://monitoramentocedaw.com.br/wp-content/uploads/2014/03/InclusionMatters_AdvanceEdition.pdf [2015, July 7].

World Energy Council. 2016. Energy Trilemma Index: South Africa. Available: https://www.worldenergy.org/data/trilemma-index/country/south-africa/ [2017, October 20].

Yaw Amoateng, A. & Kalule-Sabiti, I. 2013. Social structure and sexual behaviour of black African adolescents in the North West Province, South Africa. South African Review of Sociology. 44(1):131-157. DOI: http://dx.doi.org/10.1080/21528586.2013.784453

Yuenyong, C. & Yuenyong, J. 2007. Grade 1 to 6 Thai Students' Existing Ideas about Energy. Science Education International. 18(4):289-298. Available: http://files.eric.ed.gov/fulltext/EJ1065883.pdf [2017, February 26].

Yin. R.K. 1994. Case study research: design and methods. Los Angeles: Sage Publication.

Yin. R.K. 2014. Case study research: design and methods. Rev. 5th ed. Los Angeles: Sage Publication.

Zografakis, N., Menegaki, A.N. & Tsagarakis, K.P. 2008. Effective education for energy efficiency. Energy Policy. 36(8):3226-3232. DOI: http://dx.doi.org/10.1016/j.enpol.2008.04.021

Appendix 1: Ethical clearance

Application for Approval of Ethics in Research (EIR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

APPLICATION FORM

Please Note:
Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form **before** collecting or analysing data. The objective of submitting this application prior to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the **EBE Ethics in Research Handbook** (available from the UCT EBE, Research Ethics website) prior to completing this application form: http://www.ebe.uct.ac.za/usr/ebe/research/ethics.pdf

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant		Click here to enter text. SHANNON LUSINGA
Department		Click here to enter text. ENERGY RESEARCH CENTRE, MECHANICAL ENGINEERING
Preferred email address of applicant		Click here to enter text. slusinga22@gmail.com
If a Student	Your Degree e.g., MSc, PhD, etc.,	Click here to enter text. MPHIL ENERGY AND DEVELOPMENT STUDIES
	Name of Supervisor (if supervised)	Click here to enter text. JISKA DE GROOT
If this is a researchcontract, indicate the source of funding/sponsorship		Click here to enter text. N/A
Project Title		Click here to enter text. ENERGY LITERACY: AN EXPLORATORY STUDY ON THE ENERGY ATTITUDE, KNOWLEDGE AND BEHAVIOURS OF CHILDREN IN CAPE TOWN

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

SIGNED BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Shanon Click here to enter text. Lusinga	S. Lusinga	27/11/2015 Click here to enter a date.

APPLICATION APPROVED BY	Full name	Signature	Date
Supervisor (where applicable)	JISKA REINARDA DE GROOT Click here to enter text.		27/11/2015 Click here to enter a date.
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section1; and for all Undergraduateresearch (Including Honours)	AMOS MADHLOPA Click here to enter text.		27/11/2015 Click here to enter a date.
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.	G Sithole Click here to enter text.		14/12/2015 Click here to enter a date.

Western Cape Government
Education

Directorate: Research

Audrey.wyngaard@westerncape.gov.za
tel: +27 021 467 9272
Fax: 0865902282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20160204-7369
ENQUIRIES: Dr A T Wyngaard

Miss Shanon Lusinga
Amalinda House UCT
25 Cecil Road
Rosebank
7700

Dear Miss Shanon Lusinga

RESEARCH PROPOSAL: ENERGY LITERACY: AN EXPLORATORY STUDY ON ENERGY KNOWLEDGE, ATTITUDES AND BEHAVIOURS OF CHILDREN IN KHAYELITSHA, CAPE TOWN

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **08 February 2016 till 24 June 2016**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 05 February 2016

Appendix 2: Information sheets and consent forms

An exploratory study on energy consumption activities, energy saving activities and the factors that influence energy saving among children in Khayelitsha, Cape Town.

Information sheet and consent form: Participating Institution

Please, would you participate in a research study on children and energy? My name is Shanon Lusinga, and I am a Masters student at the Energy Research Centre, University of Cape Town. This sheet contains information explaining the study. Please read this information carefully before deciding whether to participate. If you agree to participate, please complete your details below and then sign and date this document. I would appreciate your full participation through the research process, and it will be of great value in understanding how children relate to energy. However, in case you decide not to participate or decided to stop your participation during the process there will be no disadvantage to you. Thank you for considering taking part in this research study.

What is the purpose of the research study?

This research seeks to understand the way in which children understand energy, the ways in which they use and save energy and the factors influencing these behaviours. We are interested in this information because children are an important group of energy users and the tomorrow's decision-makers. Yet, there is limited information on their energy behaviours. By acquiring this information, we hope to inform future energy policy and energy programmes.

Who are the requested participants?

We work with children in grade 7, their science teacher and their parents. The children are the main respondents as the research focuses on them. Interviews with teachers are necessary to provide the researcher with information on what children learn in school about energy. We will ask parents a few questions to help gain a better understanding of the energy sources children have at home. For your participation, the researcher will make the research findings available to the school upon completion of the thesis at no cost.

How will the data that is collected be used?

The data collected will largely inform the researchers' Master thesis and all participants will remain anonymous. Only the researcher and the supervisor be privileged to this information. The identity of the institution and the participants will not be revealed throughout the research process. The thesis will be made available via the University of Cape Town library. The findings from this study may be published in a journal article also.

Is there any harm from participation?

This study poses minimal risk to the participants. The study is to be conducted within the institutions premises and, therefore, may only expose the participants to the risks found in their normal environment. If any sensitive information is exposed, authorities will be informed and the matter will be reported to the relevant parties.

What is required from the participants?

Children:

Energy diaries: Children will be asked to participate in a journaling exercise, which involves the use of energy diaries. These diaries have been structured by the researcher and require students to record activities showing how they use and save energy and their motivation for saving energy. The children will be given seven days to complete this task. This is enough time for children to become comfortable with the task and to record a range of energy behaviours. The children will be provided with the necessary materials. Your institution and the children will not incur any costs.

Survey: The children will be asked to take part in a short survey which will take no more than 40 minutes. The purpose of the survey is to get insight into their knowledge of energy and environmental issues, attitudes towards energy saving and the environments and energy saving habits. The survey will be completed at school to minimise interruption to the children's schedule.

Focus group discussion: Children will also be asked to participate in a focus group discussion. This will involve children and the researcher discussing and reflecting on the themes captured in the diary entries. These discussions will take 45 minutes to 60 minutes. The group activities will be recorded using an audio recorder. The precise nature of the questions is dependent on the responses from the other activity and, therefore, have not been determined

Teachers:

Interviews: Teachers involved in energy education will be asked to participate in the study. The purpose of engaging with the educator is to understand the influence of the energy curriculum and the school resources on children education. The interview will take approximately 45 minutes.

Parents:

Survey: The parents of participating children will be asked to take part in a short survey. The purpose of the survey is to get a basic understanding of the type of energy sources that are used in the home. Parents will be asked to identify the type of energy source for cooking, heating, lighting and for operating electrical appliances such as TVs or fridge's. The survey also aims to gain insight into the parent's attitudes towards energy saving and the environment.

If you have any questions regarding the research, please send an email to Shanon Lusinga at lsnsha001@myuct.ac.za (Student researcher) and Jiska de Groot at jiska.degroot@uct.ac.za (Supervisor) or call 021 650 4311.

PLEASE REFER TO THE TEAR OFF SECTION BELOW

I have read the information sheet and I understand that my participation is voluntary and that I am free to withdraw from the research at any stage. I understand that the institution and the participants will not be identified in the research report and that researcher will have attempted to avoid any harm or risk to the institution and the participants.

Under these circumstances, I agree to participate in this research.

Name: …….…….

Signature: ……

Position: …….....

Date: ……..……

An exploratory study on energy consumption activities, energy saving activities and the factors that influence energy saving among children in Khayelitsha, Cape Town.
Information sheet: Parents/Guardians

My name is Shanon Lusinga, I am studying towards my Master's degree in Energy and Development Studies at the University of Cape. I am conducting a research study that is trying to understand how children use energy, their attitudes towards energy and what they know about energy. I will work with children in Grade 7, their teachers and their parents.

Whenever researchers work with children, we communicate with the parents/guardians to ask them for permission. After you have read about the research study in this information sheet and if you agree to have your child participate, I will then ask your daughter/son for their agreement as well. Both of you must agree individually before I start the research. Please read this information sheet carefully. Your interest in this research is greatly appreciated.

What is voluntary research participation?

Participation in this research is voluntary, and I would appreciate their full participation throughout the research process. However, even though we would like your child to participate, please note that your child is not required to participate and you are free to remove your child from this study at any time.

What is the purpose of the research study?

This research aims to understand the ways in which children use and save energy. It aims to find out if children's knowledge or attitudes towards energy have any impact on how they use energy. We are interested in this information because children are an important group of energy users but we know very little about how they use or think about energy. Importantly, by acquiring this information we hope to inform future energy policy and energy programmes, to better match their needs. This research also acts as an educational exercise that will allow children to judge their energy knowledge and to become more aware of how they use and save energy.

What is required from the children?

To gain information from the children, the researcher will use energy diaries, group discussions and a survey. The group activity will be recorded using an audio recorder. This will allow the researcher to remember everything that is said without making mistakes.
The energy diaries involve children recording their energy behaviours over seven (7) days. During these days, we ask your child to record their energy behaviours every day. The children will be provided with the necessary materials.

Your child may also be asked to participate in a small group discussion during school hours, in which your child will talk about their experiences of completing the survey and the diary activity with children in an informal setting. These discussions will also take 45 minutes to 60 minutes. This research will be carried out within the school and, therefore, poses minimal risk to the children. If any sensitive information is exposed or a child is placed in any harmful situation as a result of participating in this research, the right authorities will be informed and the matter will be reported to the relevant parties.

Important notes

The data collected will largely inform the researchers' Master thesis and all participants will remain anonymous. The thesis will be made available via the University of Cape Town library. You may request a copy of the thesis if you wish to view it, which will be provided to you at no cost. The findings from this study may be published in a journal article also. The identity of the institution and the participants will not be revealed throughout the research process.

If you have any questions regarding the research, please send an email to Shanon Lusinga at lsnsha001@myuct.ac.za (Student researcher) and Jiska de Groot at jiska.degroot@uct.ac.za (Supervisor) or call 021 650 4311.

PLEASE COMPLETE THE CONSENT FORM ATTACHED AND RETURN TO THE SCHOOL.

Consent form- Parents/Guardian

I have read the information sheets attached to this consent form and I fully understand that:

1. My child's participation is voluntary and she/he does not have to participate.
2. That my child's name will not be used.
3. I am free to withdraw my child from the study at any time.
4. A voice recorder will be used by the researcher during the group activities.
5. The data that is collected will only be analysed by the researcher and her supervisor.
6. The finding from the study will be captured in a research report that will be used for university work. The report may be published in a journal and will be made available through the university of Cape Town library.

☐ I agree to my children participating in this research

☐ My child will not be participating in this research

Name of Parent/Guardian: …….

Name of child: ……..…….

Signature: ……..……

Contact details: …….…….

Date: ……..……

What is required from parents/ guardians?

As a parent/guardian of a participating child, could you kindly assist by participating in a survey? These questions will help us understand the different types of resources children have at home and how parents influence children attitudes and behaviour. This information will be a great help in understanding your child's responses and views.

PLEASE NOTE: Your participation as a parent/guardian is also voluntary. Any personal information gathered as part of the research process will only be reviewed by the researcher and those assisting. If you choose not to complete the section below it will be at no disadvantage to you or your child. I appreciate your assistance in this research.

If you have any questions regarding the research, please send an email to Shanon Lusinga at lsnsha001@myuct.ac.za (Student researcher) and Jiska de Groot at jiska.degroot@uct.ac.za (Supervisor) or call 021 650 4311.

☐ I agree to participate in this research

OR

☐ I will not be participating in this research

_____ _____

Name Date

An exploratory study on energy consumption activities, energy saving activities and the factors that influence energy saving among children in Khayelitsha, Cape Town.

Information Sheet-Children

Dear student, please would you help me with a research study that is trying to understand the energy knowledge, attitudes and behaviours of students in grade 7? Please read this information sheet carefully and then fill in the bottom part of this sheet. Thank you for helping me with my study!

Who am I?

My name is Shanon Lusinga, I am studying towards my Master's degree in Energy and Development Studies at the University of Cape. I am conducting a research study that is trying to understand how you (as students in grade 7) use energy, what you think about it, and what you know about energy. To do this, I need your help as your views on energy are really important!

What is voluntary research participation?

I would appreciate your full participation throughout the research process. It will not take too much of your time and you might have fun participating. You should know that participation in this research is voluntary. This means that if you really do not want to participate, you don't have to. Also, if you do not participate there will be no negative consequences. Also, you can leave this study at any time if you do not want to participate anymore.

What is the purpose of your participation?

This study is very important as it will allow me (and people that make decisions about energy) to learn from you how you understand energy. I hope to use the information I get from children to improve energy education for children in the future. Also as pupils in grade 7, this exercise will help you recognise if you understand energy and are practising what you have been taught in class.

What is involved in participation?

1. You will be given an energy diary that you will use over seven (7) days to write all the activities that you believe involve the use of energy and saving of energy. You will be asked to record the type of energy activity you perform, and the location of the activity. There is also a section for you to write down your reasons for saving energy and any comments you may have regarding performing the activity. This is daily task but it will only take a few minutes each day.
2. You will also be asked to participate in a survey. The questions explore your understanding of energy, your attitudes towards the environment and energy saving and your energy saving habits.
3. Also, you will be asked to take part in a group conversation with other children in which we will talk about your diaries and the survey. In the discussion, you will be able to find out what the other students think about energy and how they use it. The group activity will also take place at the school and will be also run for 45 minutes to 60 minutes.

How will the information I provide be used?

The information I collect from you I will use to write a report for my university studies, so, as a student yourself, you will help me with my studies! You will be able to find the report in the University of Cape Town's library, and it may appear in a journal. If you would like to get a copy, I would be very happy to send you one. Please note that we will not use your real names, or that of your school in the study to protect your identity.

Important notes

Please be aware that an audio recorder will be used during group discussion.

If you have any questions regarding the research, please send an email to Shanon Lusinga at lsnsha001@myuct.ac.za (Student researcher) and Jiska de Groot at jiska.degroot@uct.ac.za (Supervisor)

Thank you for your help, and I look forward to talking to you!

PLEASE COMPLETE THE CONSENT FORM ATTACHED AND RETURN TO THE SCHOOL.

Consent Form-Children

I have been told about the study and I understand what it is about. I have also read the information sheet attached to this consent form and I fully understand what it says.

I know that:

1. Participation is voluntary and I do not have to participate.
2. My name will not be used.
3. I am free to withdraw from the study at any time.
4. A audio recorder will be used by the researcher during the group discussion.
5. The data that is collected will only be analysed by the researcher and her supervisor.
6. The findings from the study will be captured in a research report that will be used for university work. The report may be published in a journal and will be made available through the university library.

☐ I agree to take part in the study

OR

☐ I will not be taking part in the study

_____ _____

Name Date

Appendix 3: Child energy consumption activities related to cooking

Use of the stove and preparing meals[17]

Child	Statement
Jordaan-Male, 13	"I make porride by stove"; "I switch off the light on a sove"
Ntombi- Female, 13	"I boiled water fo porridge"; "I switch on the stove and I cook"
Mondi-Male, 11	"I boiled water and chook movite"; "I switch stove on for cooking"; "I boiled water and chook bacon and eggs"
Siphiwe-Male, 12	"I bolied water to make porridge"
Pearl- Female, 12	"I do porridge for my selve"
Sophia- Female, 13	"I go to the kitchen and boil water";
Sipho-Male 13	"I cooking the food in to stove"
Thandi- Female 12	"I boiled water and cook some porridge"
Namhla- Female 13	"1 warm milk and water for tea"; "I warm my cornflakes with stove", "I warm my water with the kettle"
Pamela- Female 13	"I cook with stove"; "I cook my pap at morning"; "I cook with stove"
Tshidi- Female 12	"I coo for me to eat lunch"; I light kettle to boil water so that I can make breakfast for me"
Nqo-Male, 13	"I boiled milk in stove"; "I boiled milk in stove, "I fried egg from the stove"; "I cooked supper"
Jane- Female, 13	"I cook food for the evening in the stove when am finish I remove the plug"
Mary, Female 13	"I boiled eggs at the stove" "I boiled water and fired an egg".
Nicki, Female 13	"I light the stove and boil the egg and a bacon and the frest"
Beauty, Female 12	"made me some tea" "friend an bacon", "cooked breakfast", "fried an burger"
Thuli, Female 13	"I boiled water and fired an egg"
Prisca, Female 14	"I boiled the eggs"
Precious, Female 12	I boiled water and fried an egg" "I cook food"
Mellisa, Female 11	"I make a tea with kettle, I cooked eggs, I boiled water and fried eggs, I fried eggs and tomato to make sandwich"

[17] A total of 37 children reported food related energy activities. Appendix 29 children reported the use of the stove and preparing meals listed on this page and the 8 are included in the use of the microwave and in cooking for others…. yellow highlight is used.

Grace, Female 12	“I use the stove t make my food” “I make myself food to eat”
Lesedi, Female 13	“I friend egg and rushen to eat,
Thato, Male 13	“I cooked some eggs” “I cook some sausage” “I cooked some breakfast”
Brighton, Male 12	“I cook the bread” “I make tea I am hungry”
Rene, Female 14	“I cook”
Lethi, Female 14	“I fired eggs” “I plug the kettle, I used the microwave to make breakfast”
Thandi, Female 12	“I cook eggs and eat”
Stella, Female 12	“I boiled water and fried an egg and fish fingers”
Nina, Female 12	“I boiled and fired eggs”
Tami, Female 12	“I cook pap”

Use of the microwave

Child	**Statement**
Jabu-Male, 13	“I reheat my food by microwave”
Namhla- Female, 13	“I warm my teacher food with the microwave”
Nqo-Male, 13	“I use microwave from my warm food”
Pamela- Female, 13	“I switched the microwave on”
Siphe- Female, 13	“I used microwave”
Melissa- Female, 11	“I used microwave”
Nicki- Female, 13	“I put my food in the microwave”
Victoria- Female, 12	“I used the microwave”
Dingaan, Male, 12	“I use the microwave
Phuma-Male, 12	“I used the microwave”
Jane- Female, 13	“I warm my food to the microwave”; “take the teachers food to the microwave”
Stella- Female, 12	“I used the microwave,”
Nina- Female, 12	“I use the microwave”
Sipho-Male, 13	“I used the microwave”
Lesedi- Female, 13	“I make food warm for my teacher in microwave”

Lethi, Female 14	I used the microwave to make breakfast”

Making tea for mother

Child	Statement
Tani- Female, 14	“I make tea for mother”
Hloni- Male, 13	“I make for my mom some et”
Tshidi- Female, 12	“I make tea for my mother”

Making tea for teacher

Child	Statement
Pearl- Female, 12	“I go and make tea for my teacher”
Qondi- Female, 13	“I make a tea for my teacher”

Making breakfast for self

Child	Statement
Hloni- Male, 13	“I make for myself something to eat,”
Ntombi- Female, 13	“I do my breakfast”,
Stella- Female, 12	“I make breakfast”
Jane- Female, 13	“I boil water for breakfast” “I boil water to make coffee”
Jabu- Male, 13	“I boile water for tea”;
Phuma- Male, 12	“I boiled water for tea”

Cooking for others

Child	Statement
Jordaan- Male, 13	“I cook for the whole people in the house”.
Hloni- Male, 13	“I cook something for my family
Beauty- Female, 12	“cook supper,”
Rene- Female, 12	“I cooked supper”
Qondi- Female, 13	“I cook supper”
Prisca- Female, 14	“I cooked supper”
Siphe- Female,13	“I cooked supper, I cook food”
Melissa- Female, 11	“I cooked my supper”

Zinzi- Female, 12	“I turn on stove so that I can cook supper”
Zama- Female, 13	“I switched the microwave on, I cook food to eat for super”
Tshidi- Female, 12	“I light a stove to cook pap or breakfast for everyone” “I cook supper for everyone”
Lethi- Female, 14	“I switched stove on I cooked supper”
Nqo- Male, 13	“I cooked supper”
Namhla- Female, 13	“I cook supper to eat”
Stella- Female, 12	“I cooked supper then we eat”
Thuli- Female, 13	“I cook supper”
Jane- Female, 13	“I cook food for the evening in the stove when am finish I remove the plug
Phuma, male 12	“I cooked supper”; “I cooked lunch”

Appendix 4: Heating activities

Space heating (15)

Child	Statement
Jordaan-Male, 13	"I turn on heater"
Pearl- Female, 12	"I light the heater on"
Martin-Male, 15	"I turned the heater on"
Thuli- Female, 13	"I turned the heater on"
Precious- Female, 12	"I switch on the heath"
Sophia- Female, 13	"I switched on the heat in my room
Melissa- Female, 11	"I turn the heater on"
Grace- Female, 12	"I make food and turn the hita to make myself warm"
Tshidi- Female, 12	"I light heater because it was cold" "I make imbawula so that we can be warm and inside the house I light a heater"
Brighton-Male, 12	"I switch the hiter on"
Rene- Female, 14	"I plug the heater" "I make heater on"
Lethi Female, 12	"I turned the heater on" (paraffin)
Namhla- Female, 13	"I turned the heater on"
Stella- Female, 12	"I turn on the heater" (gas)
Phuma- Male, 12	"I burned the heater-paraffin" "I used fire to warm myself up"

Water heating: Geyser use (11)

Child	Statement
Mary- Female, 13	"I switched of the geyser"
Tani- Female, 14	"My alarm woke me up at 6.oo I switched the gizery on"
John- Male, 13	"I swetched off the geyser"
Ntombi- Female, 13	"Gser on"
Pearl- Female, 12	"I switched the geyser on"
Martin- Male, 15	"I switched the geyser on"
Thuli- Female, 13	"I switched geyser on";

Siphe- Female, 13	“I switched the geyser on”
Melissa- Female, 11	“I switched the geyser on”
Sipho- Male, 13	I used the geyser off,
Lethi- Female, 14	“I switched the geyser on”;
Nqo- Male, 13	“I boiled water in the geyser”;
Nina- Female, 12	“I switch on my geyser”
Stella- Female, 12	“I switch on my geyser”;

Water heating: Boiling water (22)

Child	**Statement**
Jordaan- Male, 13	“I boil water to wash my body”; “I boil water after rinsing it, Then I boil water for dishes”
John- Male, 13	“I boild the water i watsh my watshing”
Hloni- Male, 13	“I boiled water to wash my face” “I wash my brother and sister”
Mondi- Male, 11	“I boiled water to wash”; “I plug kettle on for washing dishes”
Siphiwe- Male, 12	“I boiled water to wash my body”
Pearl- Female, 12	“I boiled water and wash”
Precious- Female, 12	“I boil water I wash my body”
Sophia- Female, 13	“I was boiling the water of kitchen I washed my body and dressed my cothers”
Melissa- Female, 11	“I boiling water with kettle when I done to boiling water I switch off the kettle I switch on the heater when I wash myself”
Grace- Female, 12	“And I turn of the light and boil my wart to wash”, “Woke up and boil water so that I can wash my body”; “I boiled water to wash”
Pamela- Female, 13	“I boil water for wash my body”
Lesedi- Female, 13	“I boiled water and I was myself, I choose the clothers to wear”; “I boiled water to wash dishes I boiled water to wash myself I boiled water to wash my body”
Zama- Female, 12	“I wash my body and use the kettle”
Busi- Female, 12	“I boiled water, I switched off the stove when I finished boiling water, I wash my school clothes, I take the baf and wash my clothes”
Sandra- Female, 12	“I boiled water to wash my body”
Tshidi- Female, 12	“When I was washing my body”; “I use kettle to boil water so that I can wash my little brother”

Rene- Female, 14	"When I wake up I pour the in the kettle and I plug after water I pour water I pour the water and I wash after was I comb my hair I brush my hair teeth I eat breakfast I take money"
Thandi- Female, 12	"I boiled water and wash dishes"
Namhla- Female,13	"I warm my water to the kettle to wash"
Stella- Female, 12	"I boiled water to wash"
Jane- Female, 13	"I wake up boil water so that I can wash"; "I boil the water and wash the dishes I remove the plug when the water is boiled"
Gabriel-Male, 12	"I boiled water to wash"

Laundry: Washing Machine

Child	**Statement**
Lesedi- Female, 13	'I switched washing machine on"; "I switched washing machine off when I finished wash"
Zama- Female, 13	"I wash my clother in washing machine"; "I wash my school uniform in washing machine"

Ironing

Child	**Statement**
Mary- Female, 13	"I ironed my clothes"
Jordaan-Male, 13	"Then I iron my clothes"
Ntombi- Female, 13	"I ironed my clothes"
Pearl- Female, 12	"I ironed my clothes"
Qondi- Female, 13	"Ironed my school uniform"
Martin-Male, 15	"I ironed my clothes"
Thuli- Female, 13	"I ironed my clothes"
Precious- Female, 12	"I iron my clothes"
Siphe- Female, 13	"I ironed my clothes"
Sophia- Female, 13	"I ironed my clother and I go switch off"
Melissa- Female, 11	"I iron my clothes I removed the iron and a dry"
Lesedi- Female, 13	"I ironed my school clothers, I ironed my school wear"
Sipho-Male, 13	"I ironed my clothes of my school
Zama-Female, 13	"I ironed my clothes

Sandra- Female, 12	“I ironed my clothes”
Thato-Male, 13	“I ironed my clothes”
Rene- Female, 14	“I iron my uniform”; “I iron my clothes I polish my shoes”
Lethi- Female, 14	“I ironed my school uniform”; “I switched the iron off when I had finished”
Namhla- Female, 13	“I ironed my clothes I remove the iron”; “I iron my clothes and remove when I am done”
Stella- Female, 12	“I ironed my cloths”
Jane- Female, 13	“I iron my clothes I remove the iron when am finish, I iron my clothes I remove the iron to the socket wall”
Tami- Female, 12	“I iron my clothe I removed the iron from the wall plug”

Hair drying

Child	Statement
Martin, Male, 15	“I used the blow dryer”
Thuli- Female, 13	“I removed the iron and hair dryer from wall plug”
Siphe- Female, 13	“I used the blow dryer”
Zama-Female, 13	“I removed the iron and hairdryer from the wall plug”
Tshidi- Female, 12	“I used the blow dryer”
Lethi- Female, 14	“I used the dryer hair, I switched the hair dryer when I had finished”

Appendix 5: Other energy consumption activities

Switching on the lights at school

Child	Statements
Mary- Female, 13	"I switched the class room on"
Pearl- Female, 12	"I turn the class lights (on)"
Siphe- Female, 13	"I swetched the classroom lights on"
Mellisa- Female, 11	"switched on the light of classroom";
Pamela- Female, 13	"I switched on class room lights",
Lesedi- Female, 13-	"I switched on classroom light"
Tshidi- Female, 12-	"I switched at the classroom light"
Stella- Female, 12-	"I switched on the light on the classroom,
Jane- Female, 13-	"I switch on the classroom lights"

Plugging in video games

Child	Statement
Mary- Female, 13	"I plugged my play station"
Mondi- Male, 11	"I play my play station"
Pearl- Female, 12	"I play my video games"
Mellisa- Female, 11	"I removed my video games"
Lesedi- Female, 13-	"I switched on –TV t play music"
Thato- Female, 14	"I play my play station"
Namhla- Female, 14	"I plugged my place station game to play";
Stella- Female, 12	"I switch on the TV game"

Switching on the TV

Child	Statement
Jordaan-Male, 13	"I light the TV"
John-Male, 13	"I watch the TV"
Hloni-Male 13	"I wach TV, I wach TV with my brother"
Nicki- Female 13	"I switched on television"
Mondi, Male, 11	"I wasch TV"

Pearl- Female, 12	“I switch the TV I turn the TV (on)”
Prisca- Female, 12	“I switched the TV on”
Thuli- Female, 13	“I switch the TV on”
Siphe- Female, 13	“I watch TV when I am taind, I watch TV with my friends”; “I wash TV when I am taid to play outside”, “I watch TV after that I read my books”
Mellisa- Female, 11-	“I switched the TV on”
Grace- Female, 12-	“I make myself food and I switch on my TV”, “Come from home and turn on the TV”
Pamela- Female, 13	“I switched on the TV”
Lesedi- Female, 13	“I switched on the TV”, “I switched on my - TV music”
Sipho-Male, 13	“I switched the TV on”
Zama- Female, 13	“I watched TV and I switched it off”;
Busi- Female, 13	“I wake up again and switch on the TV and watch”
Sandra- Female, 12	“I switch the TV on”
Tshidi- Female, 12	“I switched the TV on”
Rene- Female, 14	“I eat food and I watch the TV”
Lethi- Female, 14	“I switched the TV on”
Nqo-Male, 13	“I switched the TV on”
Jabu-Male, 13	“I switched on the TV”
Namhla- Female, 14	“I watch TV, I watch Sofia the first on TV, I leave the TV on”
Victoria- Female, 13	“I switched TV on”
Stella- Female, 12	“I switched on the TV”
Nina- Female, 12	“I switch the TV on”
Phuma-Male, 13-	“I switched the TV on”
Tami- Female, 12	“I switch on the TV”

Switching on the radio

Child	**Statement**
Mondi-Male, 11-	“I listen radio”;

Pearl- Female, 12-	“I turn my radio on”;
Grace- Female 12-	“I listen radio;
Lesedi- Female 13-	“I charge the radio, I switched my radio-on”
Jabu-Male 13	“I switched on the radio”
Phuma-Male 12 -	“I swiched music on Electricity (Radio)”; “I played the radio”

Charging-cellphone

Child	**Statement**
Hloni-Male, 13-	“Plagge my cellphone”; “I plagge my mum cellphone
Ntombi- Female, 13	“My cell phone charge it”
Mondi-Male, 13	“I charge my cell phone”
Pearl- Female, 12	“I charge my cell phone”
Prisca- Female, 12	“I charge my cell phone”
Thuli- Female, 13-	“I charged my cell phone”
Siphe- Female, 13	“I charge my cell phone”
Sophia- Female, 13	“I charger my cell phone”
Mellisa- Female, 11	“I charged my cell phone”
Grace- Female, 12	“I charge my cell phone”
Pamela- Female, 13	“I charge my cell phone”
Sipho-Male, 13	“I charged my cell phone”
Sandra- Female, 12	“I changed my cell phone-solar”
Tshidi- Female, 12	“I charged my cell phone”
Thato- Female, 14	“I charge my cell phone”
Brighton-Male, 12	“I charge my cell phone”
Rene- Female, 14	“I light on and I charge my cellphone”
Lethi- Female, 14	“I charge my cell phone”
Nqo-Male, 13	“I charge my cell phone”
Namhla- Female, 14	I charge my cellphone
Victoria- Female, 13	I charge my cellphone
Stella- Female, 12	“I charger my cell phone”
Nina- Female, 12	“I charger my cell phone”

Jane- Female, 13	“I take my cell phone to the charge”
Phuma-Male, 13	“I recharged my cellphone, I charged fathers cellphone I took fathers cellphone out of the charge”
Thandi-Female, 12	“My cellphone alarm woke me up ”

Charging-laptop

Child	**Statement**
Mary- Female, 13	“I charge my laptop:’ “I plugged in my laptop”
Sophia- Female, 13-	“I charger my laptop”
Mellisa- Female, 11	“I plugged in my laptop”
Sipho-Male, 13	“I charged my computer”/“I removed my laptop from charger on /
Nqo-Male, 13	“I switched off sister laptop, charge my laptop”

School Setting- computer use

Child	**Statement**
Pearl- Female, 12	I go and use the computer lab

School Setting-Charging laptop and cellphone for teacher

Child	**Statement**
Pearl- Female, 12	“I plug my teacher laptop (on)”
Mellisa- Female, 11	“I removed the plugged teachers laptop, I plugged teachers”
Lesedi- Female, 13	“I charge my cell phone, I remove teachers’ cell phone (I charge my radio and my cell phone-solar)”
Stella- Female, 12	“I remove teacher’s laptop from wall charger” “I removed teacher cell from charger”
Jane- Female, 13	“I plug the laptop, I remove the the plug”; “I switch on the classrom lights I plug my laptop Remove the laptop”.

Appendix 6: Energy saving activities

Switching off lights at home

Child	Statement
Mary- Female ,13	"I switched the lights off,"; "I switched off the room"
Ntombi- Female, 13	"Stewtch of the light"
Nicki, Female, 13	"I turn off the kitchen light"
Mondi-Male, 11	"I switch lights off", "I switch my room lights on"
Beauty- Female, 12	"Switch off the light"; "I switch off the light when I am up to bed"
Pearl- Female, 12	"I switch off the light off"; "I switch my mother's room light on"
Martin-Male, 15	"I switched the bedroom light off"
Thuli- Female, 13	"I switch the lights in the house off"
Precious- Female, 12	"I swith off the light"
Siphe- Female, 13	"I switched my lights off"; "I swethed the lights in the house off"; "I go to bad early to and I switched off all lights"
Sophia- Female, 13	"I switch off all the light at my home"
Melissa, Female, 11	"I switched off my bedroom light off"; "I switched the light in the house off";
Grace- Female, 12	"I turn on my bedroom light turn off the light"; "Swetch of the light to sleep"; "I switch my room lights off"
Pamela, Female, 13	"I switched off the house light"; "I switched off the room light"
Lesedi- Female, 13	"I switched off kitchen lights when I finish at kitchen"; "I switched off all the lights"
Zama-Female, 13	"I switched off the house light"; "I switched off the room light"
Sandra- Female, 12	"I switch the bedroom lights off"
Tshidi- Female, 12	"I switch of lights"
Thato-Male, 13	"I switched off the light bulbs"
Brighton-Male, 12	"I switch all lights off"
Lethi- Female, 14	"I switched the lights in the house off"; "I switched the lights in kitchen off"; "I turned the bedroom light off"
Nqo-Male, 13	"I switched of my room light"; "I switched off the house light"
Jabu-Male, 13	"I switched off my room's light"
Thandi- Female, 12	"I must switch off lights when I go to sleep and or if the there is no

	one at home. I learn to save electricity energy by doing this things"
Namhla- Female, 13	"I switch the light off"
Victoria, Female, 13	"I switched the light off in whole house"
Stella- Female, 12	"I switched off the lights"; "I switched off the lights in the kitchen and bedroom even outside"
Nina- Female, 12	"I switch off light in my own"
Jane- Female, 13	"I switch off the light"
Phuma-Male 12	"I switched the lights off"
Tami- Female, 12	"I switch off the light"

Switching off lights at school

Child	**Statement**
Martin-Male, 15	"I switched the classroom lights off when I was leaving"
Melissa, Female, 11	"I switched off the classroom lights"
Pamela- Female, 13	"I switched off the classroom light
Lesedi- Female, 13	"I switched off the lights when I leave class"
Lethi- Female, 14	"I switched the classroom lights off"
Stella- Female, 12	"I switched off the class room light"
Jane- Female, 13	"When am leaving I switch off the light class"
Phuma-Male, 12	"I switched the lights in my class of"

Switching off the stove (27)

Child	**Statement**
Mary- Female, 13	"I switched off the stove whe i finished, I switche the gas off"
Jordaan-Male, 13	"actually I do to save energy is switch off the light TV ceaser the stove"
Nicki- Female, 13	"I switched off the stove when i finished cook the supper"
Mondi-Male, 11	"I switch stove off when I finish"; "I switch of the stove of when I finish"
Gabriel- Male,12	"I switch the stove off because I want to save energy"

Beauty- Female 12	“I switch off the stove when I am done using it”
Pearl- Female, 12	“I switch the stove off when I had finished cooking”
Martin-Male 15	“I switched off the stove when I finished cooking”
Thuli- Female 13	“I switched off the stove when I finished cooking”
Precious- Female 12	“I switch off the stove when I fineshed egg”
Siphe- Female 13	“I switched off the stove”
Melissa- Female, 11	“When I done with stove switch it off”
Grace- Female 12	“I switch stove on for choking meals”; “I switch stove off when i finish”
Pamela- Female 13	“I switch off my stove when I am finished my pop”; “I switched off the stove”
Lesedi- Female 13	“I switched off the stove when I finished cooking”; “I switched off-stove when I finished cooking”
Sipho-Male, 13	“I switched off the stove when I finished cooking”
Zama-Female 13	“I switched off the stove when I finished cooking”; “I switch off the stove when I finish cooking”
Busi- Female, 12	“I switched off the stove when I finished boiling water”
Sandra- Female, 12	“I switch of the stove when I finished”
Brighton-Male 12	“I switch stove off”
Lethi- Female 14	“I switched the stove off when I had finished”; “I switched the stove of when I finished cooking”; “The activities that I do to save energy is Electricity and gas stove”
Nqo-Male 13	“I switched off the stove”
Thandi- Female 12	“I switched off the stove when I finished cooking”
Namhla- Female 13	“I switched off the stove when I am done”
Victoria-Female, 13	“I switch off the TV, light and the stove”
Stella- Female 12	“I switched the lights off the stove”; “I switched the stove off when I am done using it”
Nina- Female, 12	“I switch off the stove when I finish do my egg”
Tami- Female 12	“I switch off the stove when I am done cooking”

Switching off video game

Child	**Statement**

Mellisa- Female, 11	“I removed my video games”
Lesedi- Female 13	“I switche off all music game”
Thato-Male 13	“I switched off the play station”
Namhla- Female 13	“I switched the play station off when I am done”

Switching off the TV

Child	**Statement**
Jordaan-Male, 13	“actually I do to save energy is switch off the light, TV”
John-Male, 13	“I switched the TV off”
Nicki- Female, 13	“I turn off the TV”
Mondi-Male, 11	“I switch TV off”
Siphiwe-Male, 13	“Switch off TV’s”
Pearl- Female, 12	“I switch (off) the TV”
Martin-Male 15	“I switched the TV off”
Thuli- Female 13	“I switch the TV off”
Siphe- Female, 13	“I swethed the TV off”
Sophia- Female, 13	“I switched off TV”
Mellisa- Female, 11	“I swicted the TV off”
Grace- Female, 12	“I switch TV off”
Pamela- Female, 13	“I switched off the TV”
Lesedi- Female, 13	“I switched off-the TV”
Busi- Female, 13	“I switch the TV off”
Sandra- Female, 12	“I switch the TV off”
Tshidi- Female, 12	“To switch TV …”
Lethi- Female, 14	“I switched the TV off”
Nqo-Male, 13	“I switched off the TV”
Jabu-Male, 13	“I switched off the TV”
Namhla- Female, 13	“I switch the TV off when I go to sleep”
Victoria- Female, 13	“I switched the TV off”
Stella- Female, 12	“I switched off TV”

Nina- Female, 12	“I switch the TV off”
Phuma-Male, 12	“I switch radio and TV off”
Tami- Female, 12	“I switch off the TV”

Switching off the radio

Child	**Statement**
Mondi- Male, 11	“I switch radio off”
Pearl- Female, 12	“I switch (off) my radio”
Precious- Female, 12	“I remove radio”
Grace- Female, 12	“I switch radio off”
Jabu-Male, 13	“I switched off the radio”
Phuma-Male, 12	“I switched … radio off”

Switching off the geyser

Child	**Statement**
Mary- Female, 13	“I switched of the geyser”
John-Male, 13	“I swetched off the geyser”
Thuli- Female 13	“I switched geyser off”
Mellisa- Female, 11	“I swicter the geyser off”
Sipho-Male, 13	“I used the geyser off”
Lethi- Female 14	“I switched the geyser off”
Stella- Female, 12	“I switched the geyser off”
Nina- Female, 12	“I switch off the geyser”

Switching off the iron

Child	**Statement**
Sophia- Female, 13	“I ironed my clother and I go switch off”
Mellisa- Female, 11	“I swicter …off iron”
Thato-Male, 13	“I switch off the … iron”

Switching off the heater

Child	Statement
Brighton-Male, 12	“I swtch hiter off”
Stella- Female, 12	“I switched off heater”
Phuma-Male, 12	“I swiched the heater off”

Washing machine

Child	Statement
Lesedi- Female, 13	“I switched washing machine off when I finished wash”

Switching off the kettle

Child	Statement
Mondi-Male, 11	“I switch kettle off when I finish”
Beauty- Female, 12	“Switch off the urn”
Pearl- Female, 12	“I switch off the kettle when I done”
Precious- Female, 12	“I remove kettle”
Siphe- Female, 13	“I switched my kettle off”
Sophia- Female, 13	“I switched off the kettle when I finished”
Melissa- Female, 11	“I switch off the kettle”
Grace- Female, 12	“I switch off the kettle”
Pamela- Female, 13	“I switch off the kettle”
Lesedi- Female, 13	“I switched off the cattle when I finished”
Thato-Male, 13	“I switch off the kettle”
Victoria- Female, 12	“The cattle switched off”
Tami- Female, 12	“I switch off the katlle when they are boile”

Switching off microwave

Child	Statement
Nicki- Female, 13	“I turn off microwave”
Beauty- Female, 12	“Switch of the microwave”
Pamela- Female, 13	“I switched off microwave”
Lesedi- Female, 13	“I switche off microwave”

Lethi- Female, 14	“I switched off the microwave when I had finished cooking”
Jabu-Male, 13	“I switched off microwave”

Appendix 7:Gender data and child survey scores

Child Survey Questions

Question	Response Choices	No.	100%	Boys %	Girls %
What is produced when wood burns N78	electrical	4	5,1%	10%	2.2%
	Heat	18	23,1%	16.7%	28.9%
	Light	6	7,7%	10%	4.4%
	Light & Heat	46	59,0%	63.3%	57.8%
	sound	1	1,3%	-	2.2%
	movement	3	3,8%	-	4.5%
What is produced when a light bulb is switched on N82	electrical	15	18,3%	16.1%	20.8%
	heat	4	4,9%	3.2%	4.2%
	light	49	59.8%	67.7%	56.3%
	light & heat	7	8.5%	3.2%	10.4%
	sound	6	7,3%	6.5%	8.3%
	movement	1	1,2%	3.2%	-
Does all life on earth depend on the sun?	True	81	90%	91.2%	88.7%
	False	9	10%	8.8%	11.3%

Which of the following are renewable? N90	**Response Choices**	**No.**	**100%**	**Boys**	**Girls**
	Coal	27	30%	35.3%	28.3%
	Hydro-electricity	20	22,2%	29.4%	15.1%
	Natural gas	32	35,6%	17.7%	11.8%
	Nuclear	5	5,6%	8.8%	3.8%
	Solar	21	23,3%	23.5%	22.6%
	I do not know	30	33,3%	23.5%	41.4%
Which of the following are non-renewable? N88	**Response Choices**	**No.**	**100%**	**Boys**	**Girls**
	Coal	20	22,2%	26.5%	21.6%
	Hydro-electricity	26	29,5%	26.5%	33.3%
	Natural gas	15	17%	17.7%	11.8%
	Nuclear	23	25,6%	20.6%	31.4%
	Solar	14	15,6%	14.7%	17.7%
	I do not know	26	28,9%	20.6%	37.3%

Question	Response Choices	No.	100%	Boys	Girls
Coal is the main source of electricity in South Africa? N86	True	62	72,1%	78.8%	70%
	False	24	27,9%	21.2%	30%
Some people steal electricity in SA? N89	True	74	83,1%	79.4%	84.6%
	False	15	16,9%	20.6%	15.4%
Everyone in SA has enough access to energy? N88	True	52	59,1%	48.5%	65.4%
	False	36	40,9%	51.5%	34.6%
climate change affects weather pattern all over the world N88	True	42	47,7%	57.6%	38.5%
	False	46	52,3%	42.4%	61.5%
Burning coal inside the house can make people sick?	Agree	61	69,4%	66.7%	71.1%
	Neutral	13	15,3%	13.3%	15.4%
	Disagree	13	15,3%	20%	13.5%

Question	Response Choices	No.	%	Boys	Girls
Using fossil fuels is good for the environment? N87	Agree	35	40,7%	34.4%	41.2%
	Neutral	21	24,4%	34.4%	19.6%
	Disagree	30	34,9%	31.2%	39.2%
It is important to know how to save energy? N88	Agree	76	86,4%	87.50	86.79
	Neutral	5	5,6%	12.50	1.89
	Disagree	7	8%	-	11.32
caring for the environment is necessary for our survival on earthN86	Agree	37	42,1%	45.4%	40.4%
	Neutral	34	38,6%	36.4%	40.4%
	Disagree	17	19,3%	18.2%	19.2%

Question	Response Choices	No.	%	Boys	Girls
I cannot bring change to environ problems because other people make all the decision? N88	Agree	46	52,3%	65.6%	47.2%
	Neutral	23	26,1%	18.8%	30.2%
	Disagree	19	21,6%	15.6%	22.6%
my energy use impacts on the environment N87	Agree	44	50.6%	58.1%	45.3%
	Neutral	25	28.7%	25.8%	32.1%
	Disagree	18	20.7%	16.1%	22.6%
energy saving is everyone's responsibility N85	Agree	54	63.5%	70%	58.5%
	Neutral	17	20%	16.7%	22.6%
	Disagree	14	16.5%	13.3%	18.9%
I think I have a role in saving energy at home and at my school N86	Agree	64	74.4%	64.5%	81.2%
	Neutral	11	12.8%	16.1%	9.4%
	Disagree	11	12.8%	19.4%	9.4%

Question	**Response Choices**	**No.**	**%**	**Boys**	**Girls**
I turn the lights off when I am the last person to leave a room? N88	Always	64	72,7%	66.7%	76.9%
	Sometimes	19	21,6%	27.3%	17.3%
	Never	5	5,7%	6.%	5.77%
I leave the TV/Radio/Computer on when I have finished using it N87	Always	16	18,4%	15.6%	19.2%
	Sometimes	28	32,2%	40.6%	26.9%
	Never	43	49,4%	43.8%	53.9%
I remove appliances from the plug when I am done using themN89	Always	54	60,7%	55.9%	65.4%
	Sometimes	28	31,4%	35.3%	26.9%
	Never	7	7,9%	8.9%	7.7%
I wear warm clothes when I am feeling	Always	38	43,2%	45.5%	42.3%

cold instead of using a heaterN8	Sometimes	38	43,2%	45.5%	44.2%
	Never	12	13,6%	9%	13.5%

Question	Response Choices	No.	%	Boys	Girls
I talk to my family about energy and the environment? N88	Always	34	38,6%	44.1%	35.3%
	Sometimes	43	48,9%	47.1%	51%
	Never	11	12,5%	8.8%	13.7%
I talk to my friends about energy and the environment N86	Always	23	26,7%	37.5%	21.6%
	Sometimes	47	54,7%	40.6%	60.8%
	Never	16	18,6%	21.9%	17.6%
My family encourages me to save energy N87	Always	52	59,8%	45.5%	68.6%
	Sometimes	25	28,7%	39.4%	23.53%
	Never	10	11,5%	15.1%	7.8%
My friends encourage me to save energy N85	Always	19	22,4%	21.9%	22%
	Sometimes	46	54,1%	59.4%	52%
	Never	20	23,5%	18.7%	26%
My family finds it important to save energy N85	Always	69	81,2%	81.3%	82%
	Sometimes	12	14,1%	12.5%	14%
	Never	4	4,7%	6.2%	4%
My friends find it important to save energy N85	Always	43	50,0%	40.6%	54.9%
	Sometimes	40	46,5%	53.1%	43.1%
	Never	3	3,5%	6.3%	2%

Gender and child variables

Research Question	**df**	**chi-square**	χ^2
what is produced when wood burns	5	0.298	6.088
what is produced when a lightbulb is switched on	5	0.610	3.591
Does all life on earth depend on the sun	1	0.709	.139
Renewable energy -Coal	1	0.492	.473
Renewable energy -Hydro-electricity	1	0.108	2.588
Renewable energy -Natural gas	1	0.822	.051
Renewable energy -Nuclear	1	0.323	.975
Renewable energy -Solar	1	0.923	.009
Renewable energy -I don't know	1	0.085	2.964
Non-renewable energy -Coal	1	0.602	.272
Non-renewable energy -Hydro-electricity	1	0.501	.453
Non-renewable energy -Natural gas	1	0.445	.582
Non-renewable energy -Nuclear	1	0.273	1.202
Non-renewable energy -Solar	1	0.720	.128
Non-renewable energy -I don't know	1	0.102	2.669
wind can be used to produce electricity	1	0.084	2.980
coal is the main source of electricity in South Africa	1	0.375	.788
some people steal electricity in SA	1	0.534	.387
everyone in SA has enough access to energy	1	0.123	2.380
climate change affects whether pattern all over the world	1	0.085	2.970
save energy its expensive to buy	1	0.408	.683
save energy its harmful to the environment	1	0.726	.123
save energy to avoid harm and danger	1	0.330	.951
using fossil fuels is good for the environment	2	0.320	2.276
burning coal inside the house can make people sick	2	0.732	.623
caring for the environment is necessary for our survival on earth	2	0.897	.218
I cannot bring change to environ problems because other people make all the decision	2	0.252	2.756

my energy use impacts on the environment	2	0.520	1.307
it is important to know how to save energy	2	0.024	7.445
energy saving is everyone's responsibility	2	0.581	1.087
I think I have a role in saving energy at home and at my school	2	0.231	2.927
my friends find it important to save energy	2	0.328	2.230
my family finds it important to save energy	2	0.888	.237
my friends encourage me to save energy	2	0.728	.636
my family encourage me to save energy	2	0.105	4.501
I talk to my friends about energy and the environment	2	0.175	3.491
I talk to my family about energy and the environment	2	0.641	889
I turn the lights off when I am the last person to leave a room	2	0.538	1.241
I leave the TV/Radio/Computer on when I have finished using it	2	0.426	1.705
I remove appliances from the plug when I am done using them	2	0.667	.810
I wear warm clothes when I am feeling cold instead of using a heater	2	0.827	.380

Appendix 8: Statistical test

The following tables only considers variables in which significant relationships were found.

Knowledge: Energy Transitions

Research Question what is produced when wood burns	**df**	**Chi-square**	**χ^2**		**Research Question what is produced when light is switched on**	**df**	**chi-square**	**χ^2**
using fossil fuels is good for the environment	10	0.232	12.855[a]		using fossil fuels is good for the environment	10	0.480	9.559
burning coal inside the house can make people sick	10	0.825	5.886[a]		burning coal inside the house can make people sick	10	0.626	8.027
caring for the environment is necessary for our survival on earth	10	0.654	7.738		caring for the environment is necessary for our survival on earth	10	0.018	21.468
I cannot bring change to environ problems because other people make all the decision	10	0.234	12.813		I cannot bring change to environ problems because other people make all the decision	10	0.097	16.092
my energy use impacts on the environment	10	0.701	7.258		my energy use impacts on the environment	10	0.387	10.634
it is important to know how to save energy	10	0.534	8.980		it is important to know how to save energy	10	0.623	8.061
energy saving is everyone’s responsibility	10	0.744	6.801		energy saving is everyone's responsibility	10	0.136	14.889
I think I have a role in saving energy at home and at my school	10	0.053	18.109		I think I have a role in saving energy at home and at my school	10	0.351	11.079
my friends find it important to save energy	10	0.087	16.462		my friends find it important to save energy	10	0.000	48.718
my family finds it important to save energy	10	0.003	27.081		my family finds it important to save energy	10	0.000	33.533
I talk to my friends about energy and the environment	10	0.847	5.605		I talk to my friends about energy and the environment	10	0.892	4.994
I talk to my family	10	0.887	5.069		I talk to my family	10	0.415	10.295

about energy and the environment					about energy and the environment			
I turn the lights off when I am the last person to leave a room	10	0.504	9.298		I turn the lights off when I am the last person to leave a room	10	0.597	8.325
I leave the TV/Radio/Computer on when I have finished using it	10	0.172	14.011		I leave the TV/Radio/Computer on when I have finished using it	10	0.143	14.710
I remove appliances from the plug when I am done using them	10	0.403	10.434		I remove appliances from the plug when I am done using them	10	0.731	6.943
I wear warm clothes when I am feeling cold instead of using a heater	10	0.256	12.452		I wear warm clothes when I am feeling cold instead of using a heater	10	0.033	19.593

Knowledge: Renewable Energy

Research Question RE-Hydo-electricity	**df**	**chi-square**	χ^2		**Research Question RE-Solar**	**df**	**chi-square**	χ^2
using fossil fuels is good for the environment	2	0.580	1.089		using fossil fuels is good for the environment	2	0.877	.262
burning coal inside the house can make people sick	2	0.994	.011		burning coal inside the house can make people sick	2	0.644	.880
caring for the environment is necessary for our survival on earth	2	0.043	6.304		caring for the environment is necessary for our survival on earth	2	0.891	.231
I cannot bring change to environ problems because other people make all the decision	2	0.287	2.498		I cannot bring change to environ problems because other people make all the decision	2	0.698	.718
my energy use impacts on the environment	2	0.053	5.862		my energy use impacts on the environment	2	0.989	.022
it is important to know how to save energy	2	0.043	6.313		it is important to know how to save energy	2	0.415	1.758
energy saving is everyone's responsibility	2	0.285	2.508		energy saving is everyone's responsibility	2	0.658	.837
I think I have a role in saving energy at home	2	0.302	2.392		I think I have a role in saving energy at home	2	0.409	1.787

and at my school					and at my school			
my friends find it important to save energy	2	0.697	.721		my friends find it important to save energy	2	0.514	1.333
my family finds it important to save energy	2	0.372	1.979		my family finds it important to save energy	2	0.197	3.254
I talk to my friends about energy and the environment	2	0.406	1.804		I talk to my friends about energy and the environment	2	0.359	2.049
I talk to my family about energy and the environment	2	0.502	1.377		I talk to my family about energy and the environment	2	0.041	6.385
I turn the lights off when I am the last person to leave a room	2	0.443	1.630		I turn the lights off when I am the last person to leave a room	2	0.946	.110
I leave the TV/Radio/Computer on when I have finished using it	2	0.872	.274		I leave the TV/Radio/Computer on when I have finished using it	2	0.298	2.423
I remove appliances from the plug when I am done using them	2	0.026	7.291		I remove appliances from the plug when I am done using them	2	0.273	2.597
I wear warm clothes when I am feeling cold instead of using a heater	2	0.816	.406		I wear warm clothes when I am feeling cold instead of using a heater	2	0.257	2.714

Knowledge: Non-Renewable energy

Research Question Non-renewable energy Coal	**df**	**chi-square**	**χ^2**		**Research Question Non-renewable energy Natural gas**	**df**	**chi-square**	**χ^2**
using fossil fuels is good for the environment	2	0.581	1.085		using fossil fuels is good for the environment	2	0.208	3.141
burning coal inside the house can make people sick	2	0.140	3.937		burning coal inside the house can make people sick	2	0.786	.481
caring for the environment is necessary for our survival on earth	2	0.030	7.015		caring for the environment is necessary for our survival on earth	2	0.345	2.127
I cannot bring change to environ problems because other people	2	0.105	4.508		I cannot bring change to environ problems because	2	0.624	.943

make all the decision					other people make all the decision			
my energy use impacts on the environment	2	0.682	.767		my energy use impacts on the environment	2	0.499	1.389
it is important to know how to save energy	2	0.905	.199		it is important to know how to save energy	2	0.348	2.109
energy saving is everyone's responsibility	2	0.881	.253		energy saving is everyone's responsibility	2	0.620	.955
I think I have a role in saving energy at home and at my school	2	0.906	.197		I think I have a role in saving energy at home and at my school	2	0.976	.049
my friends find it important to save energy	2	0.554	1.181		my friends find it important to save energy	2	0.693	.732
my family finds it important to save energy	2	0.534	1.255		my family finds it important to save energy	2	0.191	3.312
I talk to my friends about energy and the environment	2	0.458	1.562		I talk to my friends about energy and the environment	2	0.056	5.748
I talk to my family about energy and the environment	2	0.401	1.826		I talk to my family about energy and the environment	2	0.335	2.184
I turn the lights off when I am the last person to leave a room	2	0.160	3.662		I turn the lights off when I am the last person to leave a room	2	0.037	6.618
I leave the TV/Radio/Computer on when I have finished using it	2	0.317	2.296		I leave the TV/Radio/Computer on when I have finished using it	2	0.042	6.328
I remove appliances from the plug when I am done using them	2	0.266	2.651		I remove appliances from the plug when I am done using them	2	0.711	.684
I wear warm clothes when I am feeling cold instead of using a heater	2	0.464	1.535		I wear warm clothes when I am feeling cold instead of using a heater	2	0.967	.068

Knowledge: General and context

Research Question Does life on earth	**df**	**chi-square**	χ^2		**Research Question Coal is the main**	**df**	**chi-square**	χ^2

depend on the sun					**source of energy in SA**			
using fossil fuels is good for the environment	2	0.351	2.094		using fossil fuels is good for the environment	2	0.950	.102
burning coal inside the house can make people sick	2	0.281	2.535		burning coal inside the house can make people sick	2	0.659	.834
caring for the environment is necessary for our survival on earth	2	0.421	1.732		caring for the environment is necessary for our survival on earth	2	0.087	4.884
I cannot bring change to environ problems because other people make all the decision	2	0.617	.966		I cannot bring change to environ problems because other people make all the decision	2	0.790	.471
my energy use impacts on the environment	2	0.923	.160		my energy use impacts on the environment	2	0.765	.536
it is important to know how to save energy	2	0.704	.703		it is important to know how to save energy	2	0.343	2.139
energy saving is everyone's responsibility	2	0.153	3.760		energy saving is everyone's responsibility	2	0.287	2.498
I think I have a role in saving energy at home and at my school	2	0.368	2.000		I think I have a role in saving energy at home and at my school	2	0.001	13.722
my friends find it important to save energy	2	0.069	5.350		my friends find it important to save energy	2	0.083	4.976
my family finds it important to save energy	2	0.011	9.017		my family finds it important to save energy	2	0.033	6.826
I talk to my friends about energy and the environment	2	0.743	.593		I talk to my friends about energy and the environment	2	0.657	.839
I talk to my family about energy and the environment	2	0.252	2.754		I talk to my family about energy and the environment	2	0.021	7.758
I turn the lights off when I am the last person to leave a room	2	0.132	4.048		I turn the lights off when I am the last person to leave a room	2	0.163	3.625

I leave the TV/Radio/Computer on when I have finished using it	2	0.454	1.579		I leave the TV/Radio/Computer on when I have finished using it	2	0.481	1.466
I remove appliances from the plug when I am done using them	2	0.793	.465		I remove appliances from the plug when I am done using them	2	0.141	3.918
I wear warm clothes when I am feeling cold instead of using a heater	2	0.680	.771		I wear warm clothes when I am feeling cold instead of using a heater	2	0.394	1.861

Motivation- children's attitudes

Research Question **Environment reasons for saving energy**	**df**	**chi-square**	χ^2
Using fossil fuels is good for the environment	2	0.785	.484
Burning coal inside the house can make people sick	2	0.924	.158
Caring for the environment is necessary for our survival on earth	2	0.016	8.244
I cannot bring change to environ problems because other people make all the decision	2	0.412	1.774
My energy use impacts on the environment	2	0.788	.475
It is important to know how to save energy	2	0.673	.792
Energy saving is everyone's responsibility	2	0.350	2.102
I think I have a role in saving energy at home and at my school	2	0.710	.686
My friends find it important to save energy	2	0.874	.270
My family finds it important to save energy	2	0.874	.269
I talk to my friends about energy and the environment	2	0.488	1.436
I talk to my family about energy and the environment	2	0.740	.603
I turn the lights off when I am the last person to leave a room	2	0.220	3.030
I leave the TV/Radio/Computer on when I have finished using it	2	0.245	2.816
I remove appliances from the plug when I am done using them	2	0.053	5.879
I wear warm clothes when I am feeling cold instead of using a heater	2	0.833	.366

Climate change affects weather patterns-children's attitude

Research Question	**df**	**chi-square**	χ^2
I talk to my friends about energy and the environment	2	0.423	1.722
I talk to my family about energy and the environment	2	0.807	.429
I turn the lights off when I am the last person to leave a room	2	0.947	.108
I leave the TV/Radio/Computer on when I have finished using it	2	0.693	.732
I remove appliances from the plug when I am done using them	2	0.435	1.663
I wear warm clothes when I am feeling cold instead of using a heater	2	0.439	1.646
Using fossil fuels is good for the environment	2	0.761	.546
Burning coal inside the house can make people sick	2	0.444	1.622
caring for the environment is necessary for our survival on earth	2	0.789	.474

I cannot bring change to environ problems because other people make all the decision	2	0.478	1.478
my energy use impacts on the environment	2	0.578	1.097
It is important to know how to save energy	2	0.081	5.031
energy saving is everyone's responsibility	2	0.055	5.804
I think I have a role in saving energy at home and at my school	2	0.403	1.815

Parents: humans should respect the environment-child behaviour and attitude

Research Question	**df**	**chi-square**	χ^2
Wind can be used to produce electricity	2	0.404	1.812
Coal is the main source of electricity in South Africa	2	0.130	4.085
Some people steal electricity in SA	2	0.333	2.202
Everyone in SA has enough access to energy	2	0.231	2.933
Climate change affects whether pattern all over the world	2	0.012	8.787
Save energy its expensive to buy	2	0.905	.200
Save energy its harmful to the environment	2	0.264	2.667
Save energy to avoid harm and danger	2	0.602	1.016
Using fossil fuels is good for the environment	2	0.080	8.350
Burning coal inside the house can make people sick	2	0.685	2.278
Caring for the environment is necessary for our survival on earth	2	0.810	1.593
Wind can be used to produce electricity	2	0.665	2.389

Parents: protecting the environment is a necessity-child behaviour and attitude

Research Question	**df**	**chi-square**	χ^2
Wind can be used to produce electricity	2	0.759	.550
Coal is the main source of electricity in South Africa	2	0.184	3.381
Some people steal electricity in SA	2	0.300	2.408
Everyone in SA has enough access to energy	2	0.043	6.312
Climate change affects whether pattern all over the world	2	0.405	1.809
Save energy its expensive to buy	2	0.449	1.602
Save energy its harmful to the environment	2	0.381	1.931
Save energy to avoid harm and danger	2	0.704	.703
Using fossil fuels is good for the environment	4	0.047	9.621
Burning coal inside the house can make people sick	2	0.501	3.351
Caring for the environment is necessary for our survival on earth	2	0.159	6.593
I cannot bring change to environ problems because other people make all the decision	2	0.305	4.833
I turn the lights off when I am the last person to leave a room	4	0.840	1.425
I leave the TV/Radio/Computer on when I have finished using it	4	0.597	2.771
I remove appliances from the plug when I am done using them	4	0.565	2.959
I wear warm clothes when I am feeling cold instead of using a heater	4	0.980	.425
my energy use impacts on the environment	4	0.087	8.140

Parents: humans should respect the environment-parent variable

Research Question	**df**	**chi-square**	χ^2
I try to buy EE appliances even if they are expensive	4	0.288	4.995
South African have enough access to energy	4	0.518	3.241
It's important for my household to save energy	2	0.880	.256
I pay attention to household energy expenditure	2	0.141	3.919
I would to improve energy use to improve living conditions	2	0.341	2.153
I would like to use more energy appliances	2	0.094	4.725
I would like to reduce energy to save money	2	0.290	2.474
I would like to reduce energy to protect environment	2	0.489	1.432
Happy with current energy use won't change anything	2	0.049	6.051
Happy with current energy use but want to use better	2	0.373	1.974
I remove appliances from the plug	4	0.141	6.906
I leave lights on when room is empty	4	0.452	3.673
I talk to my family abut energy saving	4	0.003	16.071
I encourage my child to save energy	4	0.028	10.911
Use gas to cook	8	0.785	4.739
Buy EE appliances	4	0.278	5.097
Buy EE microwave	8	0.155	11.917
Use solar powered appliances	8	0.511	7.237
Use EE heating systems	8	0.052	15.373
Install energy saving light bulbs	8	0.995	1.356

My friends find it important to save energy

Research Question	**df**	**chi-square**	χ^2
I turn the lights off when I am the last person to leave a room	4	0.946	.740
I leave the TV/Radio/Computer on when I have finished using it	4	0.459	3.625
I remove appliances from the plug when I am done using them	4	0.026	11.070
I wear warm clothes when I am feeling cold instead of using a heater	4	0.082	8.263

It is important to know how to save energy

Research Question	**df**	**chi-square**	χ^2
I turn the lights off when I am the last person to leave a room	4	0.009	13.402
I leave the TV/Radio/Computer on when I have finished using it	4	0.590	2.818
I remove appliances from the plug when I am done using them	4	0.107	7.608
I wear warm clothes when I am feeling cold instead of using a heater	4	0.885	1.157

I cannot bring change to environ problems because other people make all the decision

Research Question	**df**	**chi-square**	χ^2
I turn the lights off when I am the last person to leave a room	4	0.203	5.954
I leave the TV/Radio/Computer on when I have finished using it	4	0.010	13.353
I remove appliances from the plug when I am done using them	4	0.418	3.911
I wear warm clothes when I am feeling cold instead of using a heater	4	0.273	5.139