UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Denkleiers • Leading Minds • Dikgopolo tša Dihlalefi

GORDON INSTITUTE
OF BUSINESS SCIENCE
University of Pretoria

South African consumer attitudes towards domestic solar power systems

Siân Adams
11094576

A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration.

01 August 2011

Abstract

The success of the South African policy to reduce carbon emissions and incorporate solar energy production into the national energy mix is partly dependent on the ability to persuade householders to become more energy efficient, and to encourage installation of domestic solar systems. Solar power is an innovation in South Africa and the current policy of stimulating the market with subsidies for solar water heaters is not resulting in widespread adoption. The high upfront costs have been a barrier in the past but as more suppliers offer financing options, there has been a gradual increase in purchasing but not at the rate required to save the 578 MW of electricity over the next few years.

This research report takes the form of a survey of two consumer groups ("early adopters" and "early majority" adopters in South Africa, with the aim of:

- Investigating consumer attitudes towards characteristics of solar systems,
- Utilising the diffusion of Innovations theory to understand the attributes which affect the consumer decision making process, and
- Isolating the characteristics that are preventing a pragmatic "early majority" from adopting the technology.

The results show that overall, while the "early majority" demonstrate a positive perception of the environmental characteristics of solar power, its financial, operational and aesthetic characteristics are limiting adoption. Differences existing between the two groups show support for the concept of the 'chasm' between adopter categories identified by Moore. The study concludes that if consumers cannot identify the relative advantage of solar power over their current source of power supplied readily and cheaply through the national grid, it is unlikely that wide-scale adoption will follow.

Keywords: Solar power, diffusion of Innovation, consumer perceptions

Declaration

I declare that this research project is my own work.

This report is being submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Siân Adams

01 August 2011

Acknowledgements

I would like to thank my husband for his unwavering support and patience. You have been my rock when I felt weak and my knight in shining armour when I was weary. Thank you for the countless cups of coffee you made me, which I never drank and I promise that I will be at your side for every event in the future.

A special thank you to my mother for all the emergency coffee meetings, you were my lifeline and a sounding board when I needed it most. Daddy, thank you for all your prayers, knowing I had a prayer warrior watching out for me gave me so much comfort. Bethy, thank you for all your drama, it made an interesting contrast to the hours of reading.

I would also like to express my gratitude to my extended family for their constant encouragement and overwhelming belief in my abilities.

To my father-in-law, Jon, thank you for your patience and guidance throughout this entire MBA process. I look forward to building our family business to exceptional new heights.

Siân Adams

01 August 2011

Glossary of terms

Energy Efficiency:	Measures taken to reduce the demand for energy.
Eskom:	South African state-owned electricity utility.
Gigawatt hour (GWh):	Unit of electricity measure that is equal to one billion Watt hours.
Greenhouse Gases: (GHG):	Gases that are trapped in the Earth's atmosphere.
kW:	Unity of electricity measure that is equal to one thousand Watt hours
Kyoto Protocol:	is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions
NERSA:	National Energy Regulator of South Africa
NWSHP:	The National Solar Water Heating Programme, which has a medium-term target of installing one million SAH by 2014. The long-term target is to install five million SWHs by 2020
OECD:	The Organisation for Economic Co-operation and Development
Payback period:	Time taken to recover the capital costs from the electricity savings
Power Conservation Programme:	The energy rationing programme requires energy consumers to reduce their consumption to achieve an overall savings target of between 10 - 15% over time. This target allows for a moderate growth of approximately 3.6% in electricity consumption.

Renewable Energy:	Energy created from renewable sources such as sun, wind, biomass, hydro (water), geo thermal and other naturally occurring phenomena which are not depleted by use
SESSA:	Sustainable Energy Society Southern Africa, a voluntary association of suppliers of sustainable energy solutions.
Solar Water Heater: (SWH)	Thermal solar heating units that directly or indirectly heat water.

Contents

List of Figures

List of Tables

List of Appendices

Chapter 1

1. INTRODUCTION

This research study aims to provide new insights into the adoption of solar power technologies in the South African context. The South African government has set targets through its National Solar Water Heating Program (NSWHP) to install one million solar water heaters (SWH) by 2104; and a long-term goal of five million units by 2020. The program has seen a slow take-up since its initial launch in November 2008 and by December 2010 only 30 974 systems had been installed. This circumstance has arisen despite the rebates offered to reduce the high up-front capital cost of this energy efficient technology.

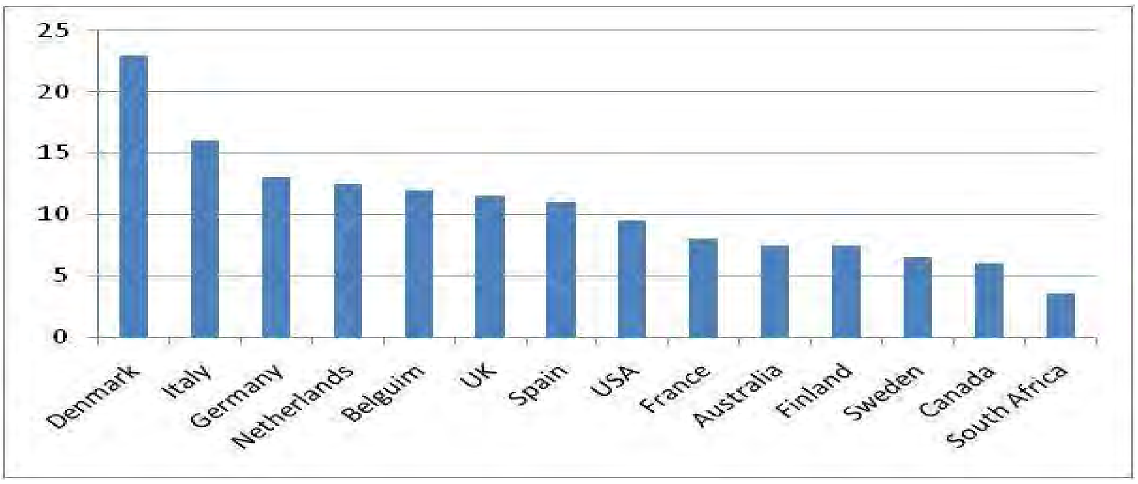
Success in the domestic sector would seem to be dependent on private householders adopting the technology. Consequently, this study evaluates domestic consumer attitudes towards solar system characteristics. The diffusion of innovations theory was used to identify the barriers affecting the adoption process of solar systems in the South African context.

1.1. BACKGROUND INTO THE RESEARCH PROBLEM

1.1.1. South Africa’s energy heritage

South Africa has always been known globally as the provider of one of the cheapest rates of electricity in the world, as shown by Figure 1: South Africa electricity costs. South Africa’s abundant coal reserve as well as a massive over-investment in power stations during the 1980’s, combined with low coal prices during this same period resulted in South Africa being one of the lowest cost producers in the world (Chalmers, 2006).

Figure 1: South Africa electricity costs



Source: Eskom, 2008

South Africa has an energy intense economy which is higher than some developed nations such as the United States and OECD. This wasteful use of energy has contributed to making the country the 13th highest carbon polluter in the world. There are two major contributors to this statistic: the first is a result of the cheap abundant coal resource available locally (Department of Minerals and Energy, 2008 a). The second is the fact that Eskom provides 95% of the country's energy needs and this utility's primary energy source is coal. A significant percentage (74%) of the energy mix is provided by the burning of fossil fuels and this is the primary source of carbon dioxide.

Historically, the low price of electricity had not catered for future investment in power plant refurbishment and maintenance. As a result of lack of investment into new generation capacity in the late 1990's, a national power emergency was declared in early 2008 when the national power utility did not have sufficient capacity to meet the power demands of the country (DME, 2008 b).

Currently, South Africa not only faces a rise in electricity tariffs to refurbish and build new capacity, it also has to incorporate the challenge of climate change and Kyoto Protocol parameters; all of which a specific impact on a future energy mix. This has come at a cost to the South African consumer who will experience a higher cost of living based on the new tariff increases approved by NERSA. For instance, domestic households can expect an increase in electricity tariffs of 24.8% in 2010/2011, 25.8% in 2011/201 and an increase of 25.4% in 2012/213.

Countries across the world have had to review their primary sources of energy as well as energy consumption patterns in all sectors, in the light of heightened climate change and diminishing fossil fuel supplies. In order to mitigate climate change, all carbon dioxide producing fuels need to be minimised. This change in energy mix has become the driving force towards the uptake of renewable energy. Technological advancements have led to the creation of energy generation technologies which are non-exhaustive energy sources and have no carbon dioxide (CO_2) emissions. Renewable energy can play a fundamental role in tackling environmental degradation and energy security.

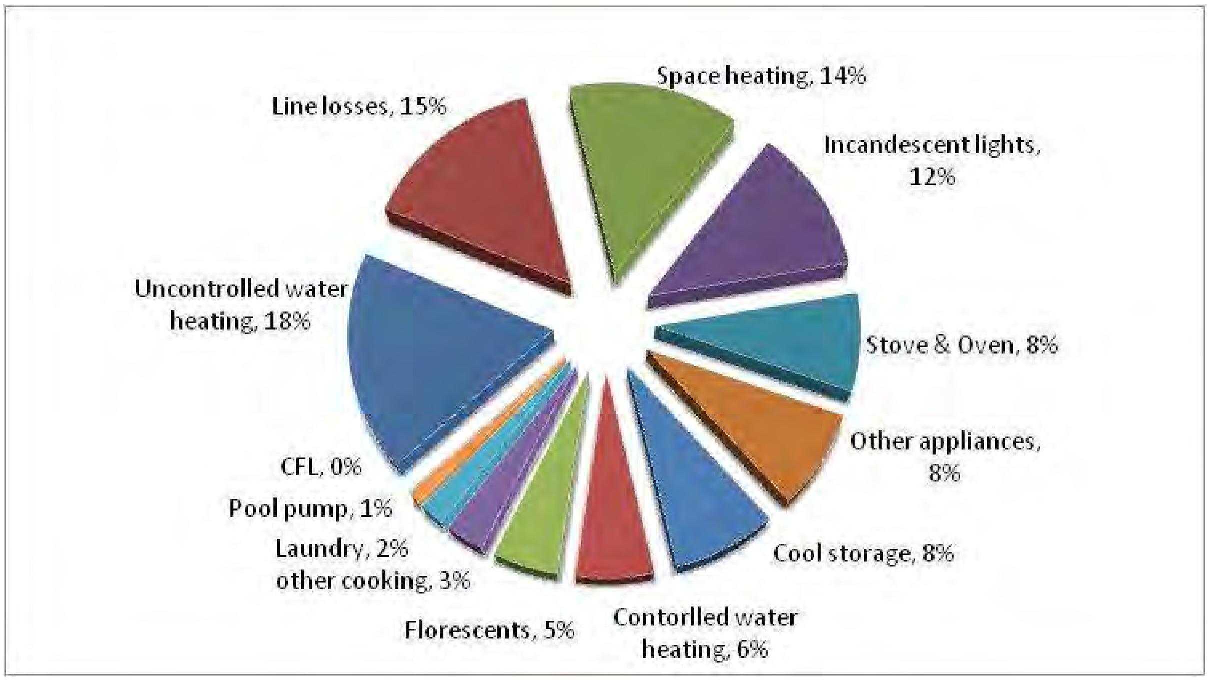
As the country has come under pressure to meet the conflicting demands to improve the quality of life of its population and simultaneously conform environmentally, by limiting emissions associated with power generation, more attention has been focused on energy conservation and efficiency as a means to achieve these goals.

1.1.2. Domestic energy consumers

The search for a solution to the energy shortage starts with reviewing the energy usage per sector. Half of the electricity consumed is used by the industrial sector, with the residential and mining sectors taking about 18% each and agriculture using only 4% (Nortje, 2005).

Figure 2: Maximum demand in the residential sector shows which electricity loads are responsible for the highest demand within the residential sector.

Figure 2: Maximum demand in the residential sector



Source: Nortje, 2005

As it can be seen from the graph above, the largest savings can be made in these three areas:

- Uncontrolled water heating 18%
- Space heating 14%
- Incandescent lighting 12%

There are approximately nine million households in South Africa using electricity (STATS SA, 2010). The largest single load in a residence is the hot water geyser and this can be up to 40% of the household electricity usage. Solar water heating has proven to be one of the cheapest renewable technologies and has been readily adopted world-wide. South African households can assist in alleviating the dependence on fossil fuels by investing in SWH technologies. In this country, domestic hot water is heated by electric geysers and current statistics show that more than 4.2 million electric geysers are installed in South Africa. This provides significant scope for implementation of solar geysers in South Africa (Eskom, 2010).

Another consideration is that the South African climate provides optimal irradiation levels for energy production from the sun: for example, Europe receives only 2.5 kWh/m^2 solar radiation while South Africa receives 6.5 kWh/m^2 solar radiation. This is one of the highest levels in the world and a clear indication that solar energy is an abundant energy source of renewable energy in this country. In fact, South African consumers can achieve higher efficiencies from the technology than consumers in Europe, where the solar water heater market is well established. Solar energy becomes an obvious choice when seeking alternatives for applications in the local context.

Due to the rising cost of energy in South Africa, consumers have had to relook at their energy profile and usage patterns. With the high levels of irradiation in the country, and the high demand for water in domestic sectors, solar water heaters have become an obvious choice for consumers. However, as of 2003 only 1.3% of South Africa's solar energy market was used for solar heating despite it being a proven technology and a cheap alternative to other water heating methods in the long term.

In 2008, the state-owned energy utility Eskom launched the NSWHP to support the large-scale introduction of solar water heaters. This program aimed to reduce electricity demand, offset rising electricity prices, help meet the renewable energy target of 10 000GWh by 2013, contribute to the country's Long-Term Mitigation Strategies for climate change, grow a 'green' business sector, create sustainable livelihoods and, to diversify the energy mix (Afrane-Okese, 2009). However, despite the benefits of electricity saving, the rebate to offer to reduce the upfront capital cost and also the higher efficiency rate of the technology due to higher irradiation levels, the adoption of solar water heaters has been slow in the South African context.

This situation ultimately affects the policy targets set out by the *White Paper of Renewable Energy* (DME, 2003). An increased application of SWH has the potential to reduce the country's carbon emissions, thereby helping the country to meet both international climate change and energy reduction demands, specifically during peak periods. This would have the combined benefit of increasing energy efficiency and reducing the strain on national energy resources (Hardie, 2011).

1.2. DEFINING THE RESEARCH PROBLEM

To date, as the literature review highlights energy research has not sought to understand the attitudes of householders to the new solar power technologies either with regard to their attitudes to the technology or their decision making processes when adopting the technology. If the attitude of householders could be understood, this could facilitate the achievement of targets set for the current policy of increasing the use of SWH technologies.

1.3. RESEARCH QUESTION

What are domestic consumer attitudes in South Africa towards solar systems?

1.3.1. Subordinate questions

1. Do the “early majority” have a sufficiently positive attitude towards solar systems to indicate that adoption will follow in the near future?
2. Is there a difference existing in attitude between adopters that would influence marketing activity?
3. Is it possible to identify characteristics of solar power that may be creating the adoption ‘chasm’ as defined by Moore (2002)?

1.4. SCOPE

This research study focused on the adoption of solar power technologies by the South African domestic sector, most particularly the attitudes of householders to solar power technologies as opposed to the supply or distribution of solar systems. The research aimed to understand the issues that seem to prevent the adoption of solar power technologies by householders. This study draws on literature to consumer behaviour and diffusion of innovations.

Key assumptions made for the purposes of this thesis:

- The term 'householders' is interchangeable with 'consumers' as the main body of the behavioural literature has been centred on consumers.

- The study initially considered the consumer attitudes towards solar water heaters (SWH) and solar photovoltaic (PV) technologies although they are separately established technologies. The results of the "early adopter" questionnaire revealed that there were only a few solar (PV) adopters within the respondent group. It was decided that the low response rate would affect the validity and reliability of the data, therefore the study only focused on the attitudes towards solar water heaters.

- The term 'solar system' is interchangeable with 'solar water heater' (SWH) as the main body of the technology literature has been centred on solar technologies suitable for urban environments.

- These technologies are assumed to be innovative technologies as they are new in relation to large scale distributions of electric geysers in the market place in South Africa.

Chapter 2

2. LITERATURE REVIEW

This chapter highlights the program South Africa has in place to promote the adoption of SWHs as well as the different challenges faced by the country in creating a higher demand in comparison with other countries with similar initiatives that promote solar technology diffusion. Previous research and emerging trends regarding solar technologies within urban environments and the possible barriers causing a slow rate of adoption of the innovation – will also be discussed. The *Diffusion of Innovation Theory* and Moore's (2002) *"chasm" theory* are applied to understand disruptive technologies and reveal the possible reasons for the slow rate of adoption of solar technologies.

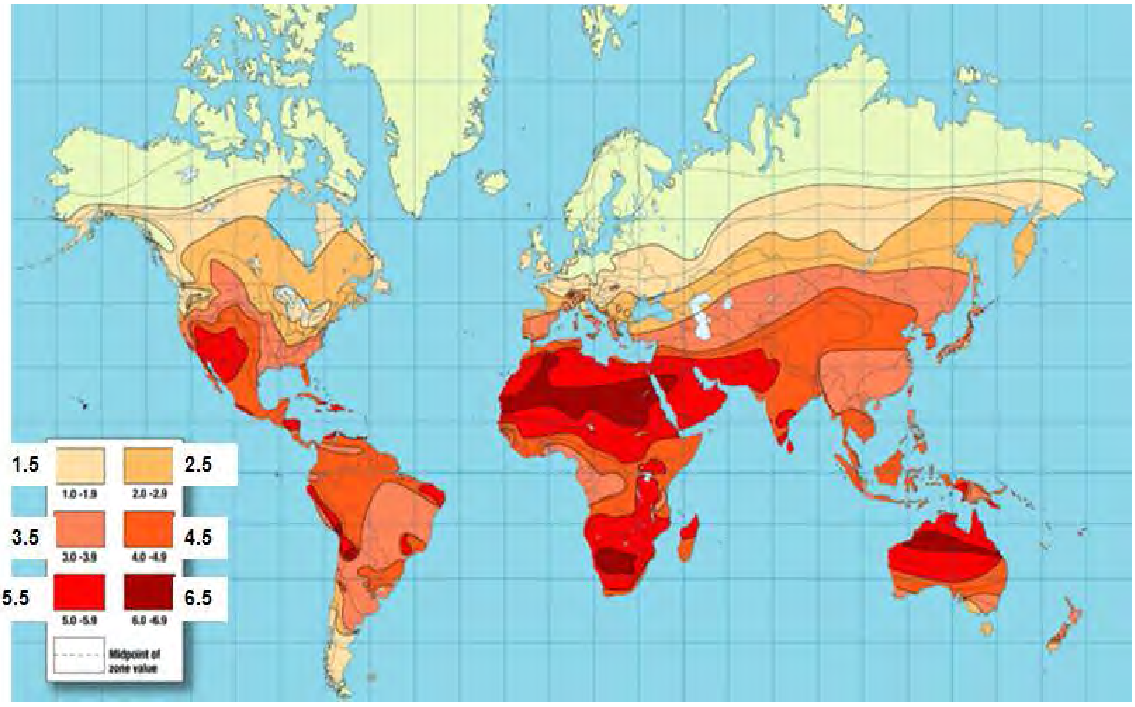
2.1. DEFINING SOLAR SYSTEMS

There are two types of solar technology: "Photovoltaic" (PV) systems which convert light energy to electricity and "Solar Water Heating" (SWH) systems which utilises solar thermal energy to heat water. Domestic solar power systems provide a proven source of energy and using clean technology that has no emissions in operation (Luque, 2001). These systems can be readily used in urban environments as they require no additional land use, they offer the household the opportunity to reduce their existing electricity bill (Afrane-Okese, 2009) and to make a statement about their environmental belief (BRECSU, 2001).

2.1.1. Solar technologies in the South African context

South Africa's solar resources are amongst the highest in the world as can be seen in Figure 3: Solar insolation map of World. The key on the left-hand side indicates that the areas in red have the highest solar radiation levels.

Figure 3: Solar insolation map of World



Source: DME, 2003

South Africa's average daily solar radiation varies between 4.5 and 6.5 kWh/m^2 (DME, 2003). An important metric when comparing the production capability of a solar system is the energy produced per kW. This yield per kW is directly proportional to the solar insolation received at a system location. These higher yields for the same costs per kW are a significant consideration as they result in increased savings on the higher energy production and therefore ultimately reduce the payback period of the upfront costs.

When compared with other countries around the world which have implemented SWH programs successfully, countries like the United States and countries in Europe, for instance, South Africa has a higher 24-hour global solar radiation average of 220 watts per square meter (W/m^2). This is in comparison with 150 W/m^2 for much of the United States and 100 (W/m^2) for Europe and the United Kingdom (Stats SA, 2006).

However, it is interesting to note that the reasons for the implementation of policies to promote the use of SWHs have been different across countries. For example, in the United Kingdom, polices were initiated to combat greenhouse gas emission, while in Austria tax incentives were provided to stimulate energy efficiency (Menanteau, 2005). Israel's restriction on water heating was borne from the fuel supply crisis in the 1950's and Barbados' policies were fuelled by the high energy price.

While the general consensus for promoting renewable technologies in the world has been to address the world's two interrelated energy problems of an over-reliance on fossil fuels and the need for reduction in climate change. In, South Africa, the necessity for greater energy efficiency has become more critical, in recent years, due to major electricity supply constraints. In other words, the process has not only been driven by reducing climate change but providing a solution to the high peak demand, thereby alleviating the current strain placed on the national grid.

The South African government responded to the electricity supply crisis in 2008 with the first *Energy Efficiency Strategy of 2005* review, whereby the target energy demand reduction for the residential sector was amended to 20% by 2015 (DME , 2008). The residential sector use 18% of final energy demand and electric geysers consume on average 40% – 50% of household energy. A national roll-out of domestic SWH could potentially reduce overall energy demand by 4.5% of 9,000 GWh per annum (Austin & Morris, 2005).

The first initiative aimed at the residential sector was launched through Eskom's SWH rebate program which was designed to help reduce the electricity demand from households and to simultaneously promote the awareness of energy efficiency. The Power Conservation Programme seeks to convert 925 000 electric geysers to SWH over a period of five years. The initiative is aimed at upper income households and – provides consumers with a rebate on SWH units supplied to registered installers and manufacturers. The size of the Eskom (2009) rebate is linked to thermal efficiency and – thus to the anticipated savings of the system.

Meanwhile, Eskom's in an ongoing effort to meet its own carbon reduction targets, manage the electricity supply on the national grid and assists in the orchestration of a shift in the manufacturing sector to a low carbon economy, the South African government launched the National Solar Water Heating Programme (NSWHP). As can be seen in Table 1: Summary of NSWHP, this Programme has a defined the target market which has a medium-target of installing one million SWHs by 2014. The longer term target is to install five million by the year 2020 (South African Government, 2009).

Table 1: Summary of NSWHP

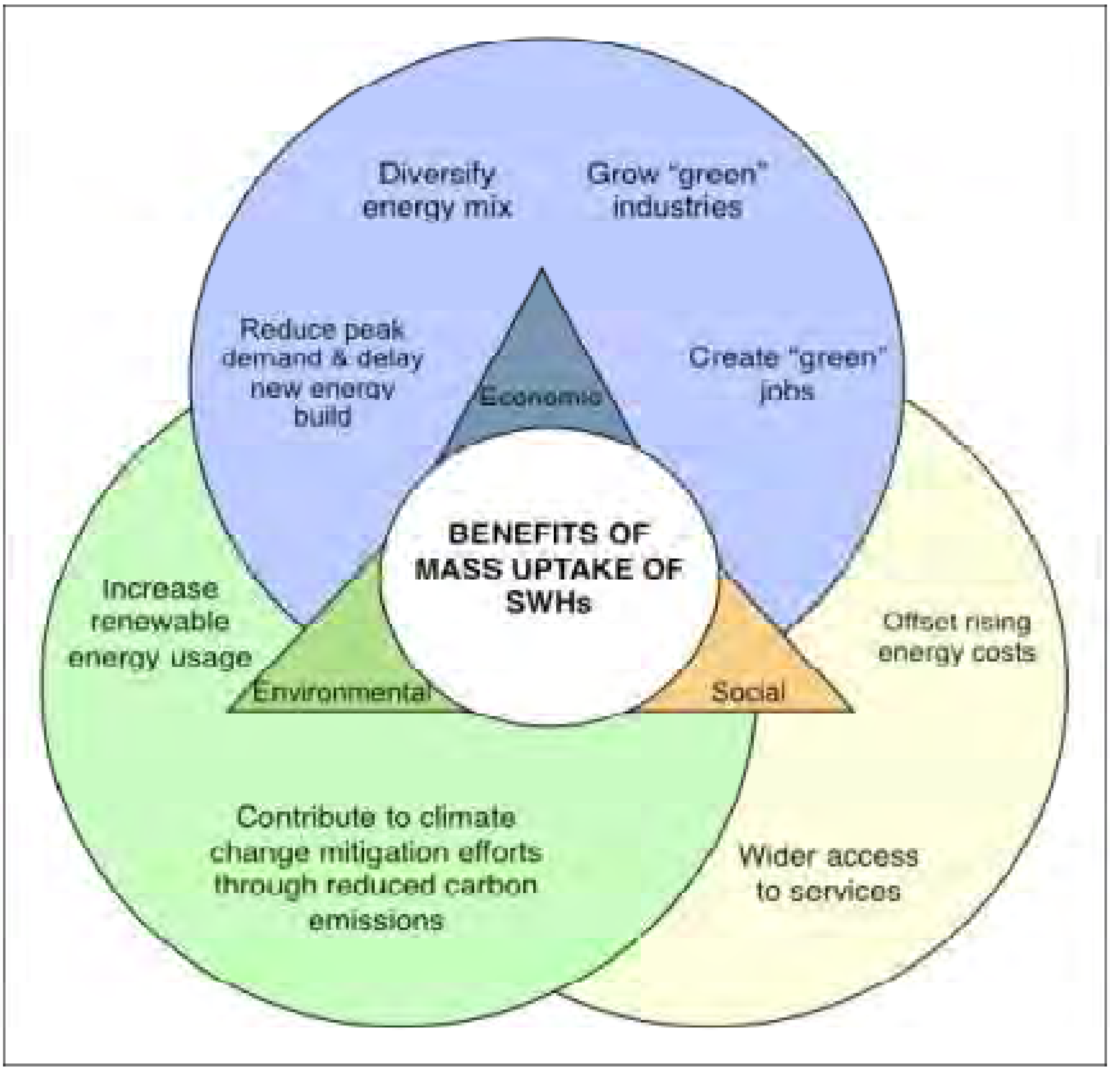
Target Market	Upper Income	Middle/low Income	Low Income (No geyser)
Income Level	> R16 000	R6 000 – R16 000	< R6 000
Market size (households)	1.2 million	3 million	6.6 million
Type of dwelling	Formal house. Main water supply.	Formal dwellings with load bearing roofs (may be part of mass developments). Mains water supply.	Broad range of house types (formal, RDP, site service, squatter). Limited mains water supply.
Current water heating	Electrified households that have access to an electric geyser.	Electrified households – a large portion have access to an electric geyser.	Some households are electrified and some not. No geyser – stove-based, wood-burning or other methods used to heat water.
Target 1 (by 2014)	210 000 installations	450 000 installations	340 000 installations
Target 2 (by 2020)	560 000 installations	1 750 000 installations	2 690 000 installations
Basic policy	Subsidies schemes, including Eskom rebates. New measures, such as insurance companies replacing electric geysers with SWHs.	A dedicated SWH entity with a national mandate to procure SWHs for a mass rollout (basic system).	A dedicated SWH entity with a national mandate to procure SWHs for a mass rollout (very basic system with or without electric backup).

Source: Afrane-Okese, 2009

The NSWHP is also conceived as contributing to South Africa's renewable energy targets as envisaged as part of its climate change mitigation strategy. South Africa's reliance in cheap fossil-fuels energy sources has not only allowed the country to become an inefficient energy user but also made it one of the top contributors globally to greenhouse gas emission. This is evident from the fact that the energy sector is the single largest contributor to GHG emissions, accounting for more than 70% of the total emissions in the country (South African Government, 2009).).

The benefits of the NSWHP are depicted in Figure 4: Benefits of mass take up of SWH.

Figure 4: Benefits of mass take up of SWH

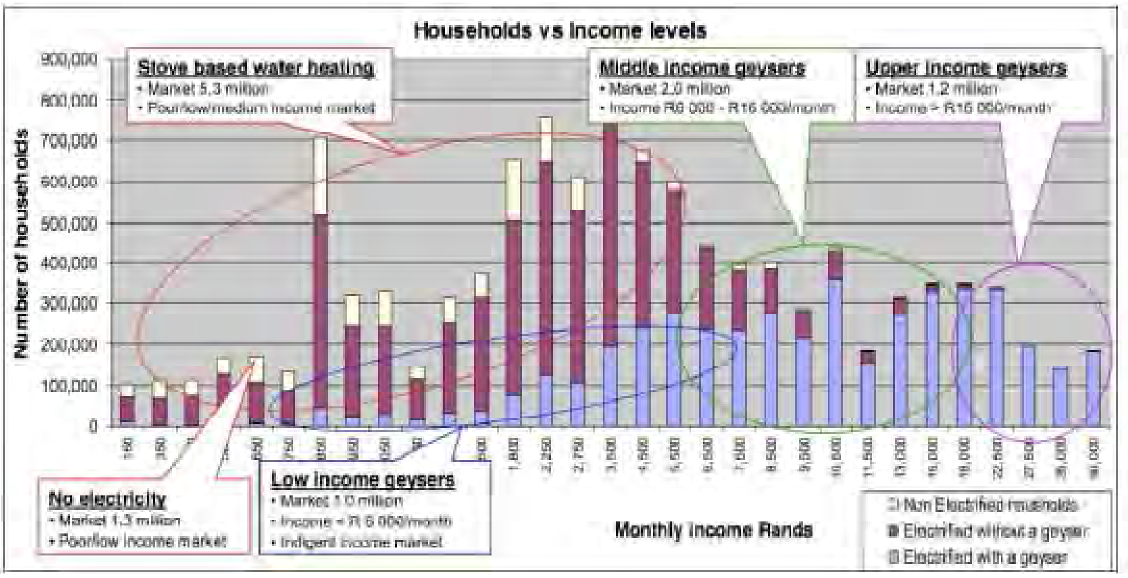


Source: (Hardie, 2011)

The implementation plan identifies three key residential markets based on household income levels and current delivery of water heating services: upper income households (where the majority have electric geysers), middle/low income households (with and without electric geysers) and low income householders - many of which do not have geysers and some of which do not have access to electricity

This division is represented graphically in Figure 5 below.

Figure 5: Households in South Africa and their current water heating methods



Source: (Afrane-Okese, 2009)

In terms of this division, it is expected that current SWH suppliers service the upper income target market, with the support of a subsidy. The middle and lower income markets would benefit from mass rollout schemes of basic SWH units supplied by municipalities and paid off via the saving from the consumer's lower electricity bills. The low income and currently under-services communities would receive highly subsidised or free basic SWH with or without electrical back-up (Afrane-Okese, 2009). In addition, to facilitate widespread adoption of SWHs, government intends to amend the National Building regulations to make the use of SWH's mandatory in all new buildings and renovated buildings.

This energy saving will translate into an overall saving to consumers in the form of lower energy costs. According to Holm (2005), the installation of a solar water heating alternative has the potential to save up to 70% of the cost of running an electric geyser, translating into a 21-35% saving of the total household electricity costs (DME, 2009).

Despite the potential savings and the subsidy to reduce the up-front cost of the solar systems, the first year of Eskom's rebate scheme saw low market demand, with less than 1000 installations via the scheme in 2008 (South African Government, 2009). In an effort to stimulate demand, the Eskom rebates were increased by 50%-120% in January 2010. While increased rebate reduced the payback period for the systems, consumers would however, still cover the initial upfront cost for the total system and only then claim back the rebate. Eskom guaranteed that once a complete rebate application had been lodged, funds would be transferred to the consumer within an eight-week period (Eskom, 2010).

Clearly, in order for the NSWHP to be successful and have a higher rate of adoption, private domestic householders would need to adopt the technology. The aim of this study is to investigate possible barriers which may be hindering the adoption of SWH by domestic households across South Africa. These barriers are identified by measuring the attitude of domestic consumers towards SWH attributes.

A limitation to this study is that although government has provided for SWH technologies in its current policies, no legislation has been passed on incentives to promote the growth of solar PV. Consequently, this study will not focus on the perceptions of solar PV systems which remain an under-developed market that can benefit from research in the future.

2.2. THE REASONS FOR SOLAR TECHNOLOGY ADOPTION

Solar systems have been defined as economic (Book, 1999), affordable (Berger, 2001), compatible with other technologies (Knusden, 2002), able to reduce pollution (Luque, 2001), technically reliable (Cabraal et al, 1998) and capable of producing savings (Holm, 2005).

Solar power is considered attractive at a national policy level because it can reduce national carbon emissions; create sustainable new livelihoods (Timilisina, 2002), reduce electricity demand, help grow a "green" business sector, provide wider access to modern, affordable services to all households; offset rising electricity prices; help to meet the renewable energy target of 10 000 GWh by 2013; and help diversify the energy mix (Afrane-Okese, 2009).

Solar systems can raise awareness of householders' energy consumption by means of a monitoring system. This type of behavioural change is advantageous to the adoption of solar as it increase the compatibility of the systems with the households' current energy consumption trends (Faiers, 2009).

However, despite the positive characteristics, solar systems remain unattractive to individual householders as a home improvement (Timilsina et al, 2000) and incompatible with personal priorities (Berger, 2001). There are further hindrances to widespread adoption in the form of issues with the long pay-back periods, high capital costs and a lack of confidence in the long-term performance (Muller, 2009; Timilsina et al, 2000; Hardie, 2010).

Nevertheless, even if the costs reduced and information was made more widely available, it is not clear whether adoption levels would increase. Several international studies done on the price elasticity of electricity have shown that it is inelastic. Filippini (1999) found that users in Switzerland were price inelastic and therefore from an energy policy point of view the results imply that there is little room for discouraging residential electricity consumption using price increases. This is particularly relevant in the South African context because not only is a subsidy being offered to reduce the initial high capital cost but it is anticipated that the increase in electricity tariffs will eventually force domestic consumers to search for a cheaper alternative power source in the long term.

Solar electricity is considered to be more expensive to produce than conventional electricity, because of the high up-front costs and the long period it takes to produce enough electricity to recoup the financial benefits. However, over time the increases in production capacities and improvements, to be made through research and development, will result in cost reductions. Among the renewable energies, solar is the one with the highest long-term potential, and some experts predict it will be the cheapest option for electricity generation in the mid and long term. In the coming decades, solar electricity from the roof may be more attractive in terms of price than electricity from the wall socket offered by utilities (EPIA, 2008).

2.3. THE BARRIERS TO SOLAR TECHNOLOGY ADOPTION

The literature concerning the adoption of domestic solar power systems is limited and paints a pessimistic picture for a higher take-up in future. It is a mature technology that is being pushed by policy but, so far has failed to be adopted as it is expensive (Energy Research Centre, 2010). Investigations in the past, into the adoption of energy efficiency and renewable energy technologies, confirmed that the barriers to adoption of renewable technologies are mostly financial, as well as some practical issues regarding installation and general levels of knowledge (Caird *et al*, 2008; Faiers, 2006; Labay & Kinnear, 1981). Rogers (1995) also found that if an innovation has been developed in order to prevent something occurring (reduced energy consumption), its rate of adoption will be slow because the advantages take a long time to be realised.

Hardie (2010) details the barriers to the natural growth of the SWH industry, as being the low market demand, which translates into a high investment risk for suppliers and due to this uncertainty industry participants only invest in the short-term. This does not lead to an increase in long-term benefits, such as competition, better choice, better quality and lower prices.

2.3.1. High cost of SWHs and competition from the incumbent technology

The up-front cost of SWH systems can be significant when compared to conventional technologies (Milton &Kaufman, 2005). The average price of a SWH is R16, 000 after the rebate has been taken into account, however this does not include the installation charge which is approximately R4, 000 (Hardie, 2010). The average rebate comes in at approximately 35% of the cost of the unit or 28% of the totals cost to the consumer (including installation) at R5, 600. If this cost is compared to the cost of the incumbent technology, the cost of a conventional electric geyser is between R3, 000 and R6, 000. It is significantly cheaper which can have a dampening effect on demand.

2.3.2. Low energy cost

Low energy costs represent a significant barrier to investment in renewable energy technologies (Hardie, 2010). SWH technology diffusion will be slow where the capital cost of the technology is high and the energy costs are low. As mentioned in the previous section, South Africa is known to be the lowest cost producer of electricity in the world. This will remain the case even though there will be increases in the electricity tariff over the next three years.

2.3.3. Lack of awareness

Hardie (2010) documented that the low level of awareness of the benefits of SWH and general environmental issues can have a significant impact on the demand for the technology. Kaplan showed that the adoption of renewable energy systems requires extensive research by a householder therefore marketing to increase familiarity with the technology is beneficial. Householders need information such as descriptions of the technology, methods of operation and their overall performance with regards to energy savings and environmental benefits (Berger, 2001; Vollink et al, 2002).

2.3.4. Lack of quality of SWH

To begin with solar thermal markets often operate in unregulated markets. This can often cause confusion and distrust amongst consumers as there are no guidelines for performance standards that the consumer can identify with or contact for further information. Where countries have no minimum quality standards related to SWH this is considered a barrier to adoption because the quality can be variable and energy savings (and thus the pay-payback period) are not guaranteed. The SWH industry did not have any standard regulations before the launch of the NSWHP. Currently, suppliers must meet a minimum standards set by the South African Bureau of Standards. Although this is seen as mechanism to increase consumers reliance in the technology thereby reducing purchase dissonances , suppliers see this process as a hindrance to the supply of SWH because the testing can take as long as six months.

2.3.5. Lack of established suppliers and skills shortage

The number of SWH suppliers in South Africa increased over-night with the announcement of Eskom's rebate program to stimulate the diffusion of the technology into the market. This has resulted in the majority of suppliers being in the early stages of growth, Hardie's (2010) research showed that 73% of South Africa's SWH suppliers are less than five years old. This makes these businesses vulnerable to the risks and growth constraints experienced by small business. There is a 70%-80% failure rate of SMMEs in South Africa according to (Ferreira, 2010; Strydom and Niewenhuizen, 2010). Consumers want to know that if they buy a product that the company will exist by the time they need to a maintenance service.

Due to the infancy of the industry players this has resulted in a lack of experienced labour to install systems to the highest professional standards. Poor quality installations will lead to poor system performance and post-purchase dissonance especially if the SWH perform to a lower quality than the incumbent technology.

2.3.6. Lack of traiability

Different providers offer various systems, varying in size, price and returns. As of February 2010, there were a total of 136 different systems to offer in South Africa (Hardie, 2001). The operational choice becomes a complex one when the final decision has to be made without the opportunity to test the systems (Jager, 2005). This lack of trialability was confirmed in Labay & Kinnear (1981) study.

However despite the criticisms of domestic level SWH technologies, some households are adopting the technology, it is estimated that there are currently about 4.2 million electric geysers in the country and only 76 873 installed solar water heating units (Eskom, 2010).

2.4. THE INNOVATION ADOPTION DECISION

To better understand consumer behaviour when considering the adoption of a new technology, the type of innovation and the decision making process followed by the consumer is considered in this next section.

An innovation is defined as an idea, practice or object that is perceived as new to an individual or another unit of adoption (Rogers, 1995). Being new does not capture the essences of innovation; it is also something novel and different. Technology innovations are considered to be *discontinuous innovations* because they require us to change our current mode of behaviour, in contrast to *continuous innovations* which allow for the eventual upgrading of products that do not require a change in behaviour. This is explained by the theory of disruptive innovation. Christensen (1997) found that most companies focus their strategies on ‘sustaining technologies’ rather than disruptive ones. Sustaining innovations occur when a company essentially offers more of the same to its existing customers: better, faster, bigger. Sustaining innovations might be incremental or radical, but always involve improvements to products and services along the dimensions that are valued by existing customers .

Disruptive innovations generally underperform established products in the mainstream markets, and may act as a weak substitute for the existing product in the eye of its mainstream customers (Christensen, 1997). This is the case with the current incumbent technology of electric geysers; consumers prefer the traditional technology which provides the same outcome of heating water which is cheaper in comparison to a SWH system. This behaviour also reflects the rational choice theory that preferred choices will be those that provide the greatest reward at the lowest cost (Lovett, 2006). However, disruptive technologies or products improve over time, and eventually encroach into the space occupied by mainstream competitors (Christensen, 1997)

Between continuous and discontinuous lies a spectrum of demands for change. Discontinuous products require more learning and it represents a new level of demand on the consumer to absorb a change in behaviour (Moore, 2001). Consumers' attitude towards technology adoption become significant at least in a marketing sense, because any time they are introduced to products which require us to change our current mode of behaviour (to be energy conscious and using less energy). The technology adoption cycle is used as a marketing model to deal with the introduction of a new high technology product (discontinuous innovation).

2.4.1. Factors which affect the purchasing decision

The aim of this study is to explore the purchase motives of adopters as these may disclose to what extent additional factors like these might affect the purchasing behaviour of different groups of SWH adopters. Information like this could possibly, in future, contribute to the development more effective strategies in simulating the diffusion of SWH systems.

It is important to remember that buying a SWH is a high-involvement decision people usually make only once in their lives. A typical characteristic of a high involvement decision is that people are willing to invest cognitive effort in the decision –making process. According to (Tversky, 1972) this is marked contrast to using simple strategies (heuristics) when the outcome of a decision is less important. In other words, planned behaviour is a much more prevalent strategy when the decision is perceived to be more important.

In terms Azjen (1991) theory of planned behaviour, people will evaluate the outcomes of behaviour in terms degrees of importance, depending on the extent to which the behaviour will affect the satisfaction of that person's needs. The more a person's needs are affected by the decision is perceived to be, the more important the decision is and the more cognitive effort is likely to be invested in the process (Jager & Janssen, 2003).

As people have different needs (Maslow, 1954), the consequences of a decision may have an impact on several needs simultaneously- and, to apply this to the context of this study the decision to install a SWH may satisfy various needs. An empirically grounded taxonomy has been proposed by Max-Neef (1992), who distinguishes between subsistence, protection, affection, understanding, participation, leisure, identify and freedom as drivers of behaviour.

An individual's behaviour, like the purchase of a SWH for instance, may affect different needs simultaneously. The needs involved in this decision may relate to:

- subsistence: sustainable environmental practices to reduce their carbon footprint.
- belongingness: friends and family may have installed SWH systems
- participation: government urge consumers to do their part in reducing household energy consumption
- creation: home improvement and cost saving
- identity: becoming an environmental conscious citizen
- Freedom: Achieving a reliable source of power and partial independence from the national grid.

Some needs have more bearing on an individual's character, such as subsistence and identity, whereas others are more socially orientated, such as belonging and participation. Innovators and early adopters are considered to assign more weight to individual needs than later adopters (the majority), who assign more weight to social needs (Rogers, 1995).

Another factor to consider is the network effect, this may be critical in the diffusion process as not only information on the innovation is communicated through social networks, but also social norms related to social need (Delre *et al* , 2004). Within the context of home insulation measurements, Weening and Midden(1991) report that diffusion and final adoption were related to peoples social ties. A finding like this signifies the importance of network effects.

Brown & Eisenhardt (1995) found that new product development can originate from new technology or new market opportunities but irrespective of where the opportunities originate, when it comes to successful new products it is the consumer who is the ultimate judge. If this is accurate companies need to gain a deep understanding of 'the voice of the customer' - in order to develop successful marketing strategies for new products. Rochard (1991) expresses that though consumers may not always be able to express their wants, it is important to understand how they perceive products, how their needs are shaped and influenced and how they make product choices

In consumer research, stimuli are used to guide participants in revealing their attitudes and opinions towards products (Van Kleef et al, 2005). When a consumer is faced with a purchase decisions, such as, whether or not to buy a SWH system, they will automatically use their learned behaviour to make the final decisions. These dispositions are learned through exposure to media, peers or past experience. These internal cognitive structures or frameworks represent a network of information, feelings, attitudes and associated behaviour and ideas that a consumer has about a product (Foxall & Goldsmith, 1994).

It is generally accepted that evaluation tasks are more difficult when products are more complex and unfamiliar. Familiarity in evaluating products is defined as the number of product related experiences that have been accumulated by the consumer (Alba & Hutchinson, 1987). South Africa consumers have always understood solar water heating in the context of swimming pools; they have always used the conventional geyser to heat water for household usage. The installation of a SWH requires the consumer to collect information about the suitability of the home for mounting the SWH systems and required maintenance of the system to ensure to functions optimally. This requires a level of knowledge most consumers do not possess and makes the decision invariably complex.

Consumers have difficulty in evaluating major innovations and it can be unclear for consumers what needs the new product could satisfy. If a consumer has minimal experience with a product, it is difficult to retrieve the relevant attributes to evaluate the product. Due to the limited cognitive capacities of the human mind, people often make heuristic decisions when encountered with complex products.

Hansen (2005) summarises that consumers perspectives when choosing of products and situation fall into four categories; namely 'value', 'information processing', 'emotional', and 'cue utilisation'. The 'value' perspective is the overall assessment of utility based on what individuals give for goods, and what they receive in turn. The 'information processing' perspective changes depending on how involved the individual may be with the goods in question. Highly involved individuals (individuals very keen to consume the products) will need to avoid dissonance with the resulting decision by justifying their decision with their beliefs and attitudes ('emotional'). On the other hand, individuals with a low level of involvement with the products will judge the performance of goods on cues ('cue utilisation'), such as price.

2.5. A BROAD DEFINITION OF TECHNOLOGY ACCEPTANCE AND DIFFUSION MODELS

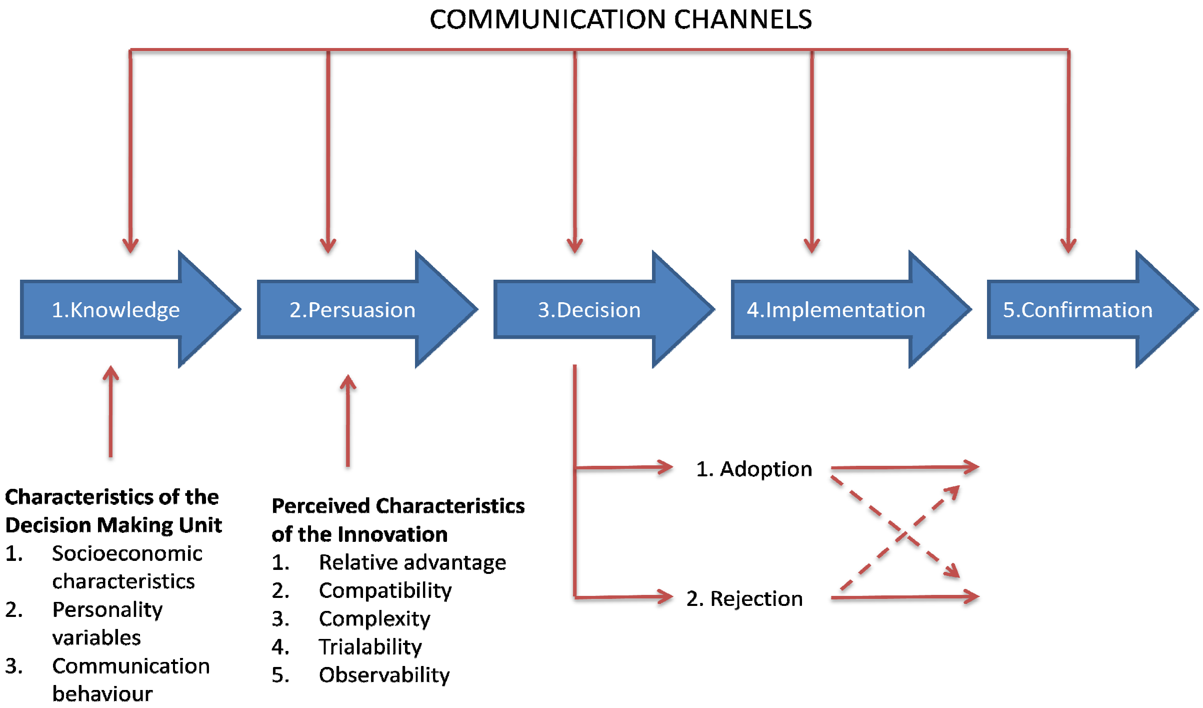
Adoption and diffusion rates have been studied across for a variety of different technologies. All these studies reveal that technology and innovations are adopted and diffuse through societies at different rates. According to Rogers (1995) diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system. The rate of adoption is the relative speed at with which an innovation is adopted by members of a social system. The Diffusion of Innovations theory has been utilised to model the diffusion of a range of products, one of them being the use of solar power systems (Labay and Kinnear,1981).

The rate of diffusion of an innovation is primarily concerned with the *time* that it takes for increasingly large numbers of people in a society to start using it. South Africa’s energy demands are not only affected by climate change but also capacity problems. It would be ideal if society would start to use renewable technology such as SWH’s to aid in reducing GHG and strain on the electricity grid.

Given this background about some of the issues related to of diffusion of an innovation in a society - there is a need to gain a better understanding about what affect the adoption process, specifically in relation to solar technology innovations. Accordingly, the effects of consumer behaviour and attitudes towards solar systems are some of the areas introduced for consideration in this literature review.

2.5.1. The innovation decision process

Figure 6: Innovation decision making process



Source: Rogers, 1995

Figure 6 above depicts Rogers (1995) innovation decision process as a process involving five steps for an individual: (i) encountering first knowledge about the innovation, (ii) forming an attitude towards the innovation, (iii) reaching a decision about whether or not to adopt or reject the innovation, (iv) choosing to implement the new idea, and finally, (v) confirming the decision.

When consumers are faced with the decision whether or not to adopt a SWH system, they are predisposed to learn more about technology and through a process that analyses the costs and benefits of an innovation. The second step is one of persuasion and the decision is informed by the knowledge gained. Once they have decided on a course of action, the consumer will implement the use of the of the innovation and confirm whether or not the innovation satisfies their need (Roger, 1995)

.

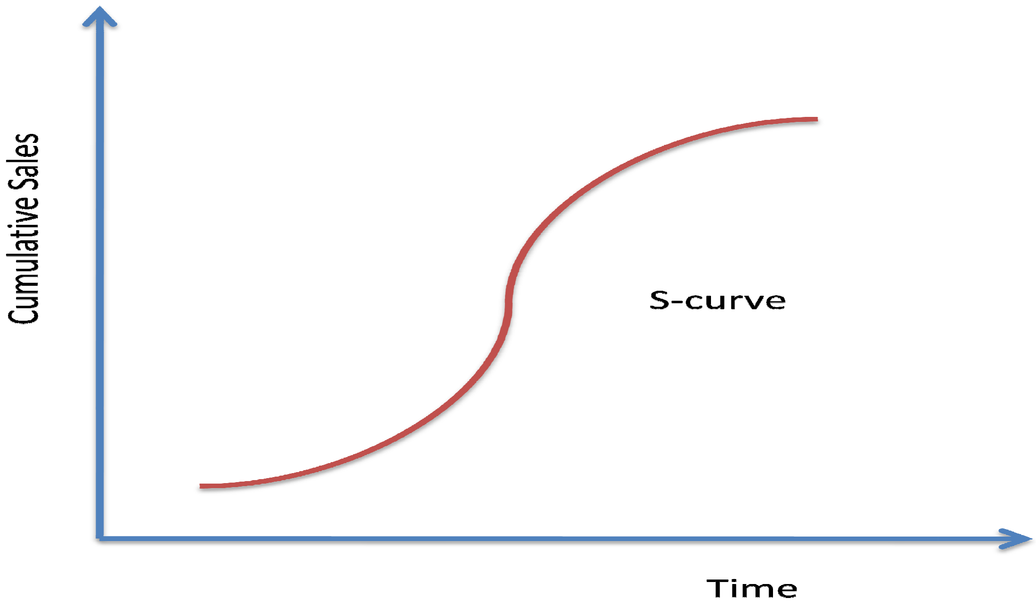
2.5.2. Rate of adoption

Adoption and diffusion rates have been studied by many authors for a variety of different technologies Bass (1969, 1994) came up with one of the first models- and today this is still one of the most often cited models in relation to marketing. Many subsequent models have extended and modifies Bass's model to help evaluate and forecast acceptance of new products and technologies. The basic premise of most of these models is that technologies and innovations are adopted and diffused through societies at different rates. These models help one understand why some technologies flourish, while others flounder and can even be overtaken before they achieve their full potential

2.5.3. S-curve

The S-curve shape of diffusion has become synonymous with diffusion of innovations. In the early stages of an innovations life cycle, just a few adventurous and more inquisitive innovators are found to adopt. Once enough early adopters have set an example for others and word has spread, the innovation takes off as the early majority, the greater part of society, adopt. They are then followed by the slightly more cautious late adopters and then, ultimately, by the most cautious, few in number, laggards.

Figure 7: S-Curve - Diffusion of innovation over time

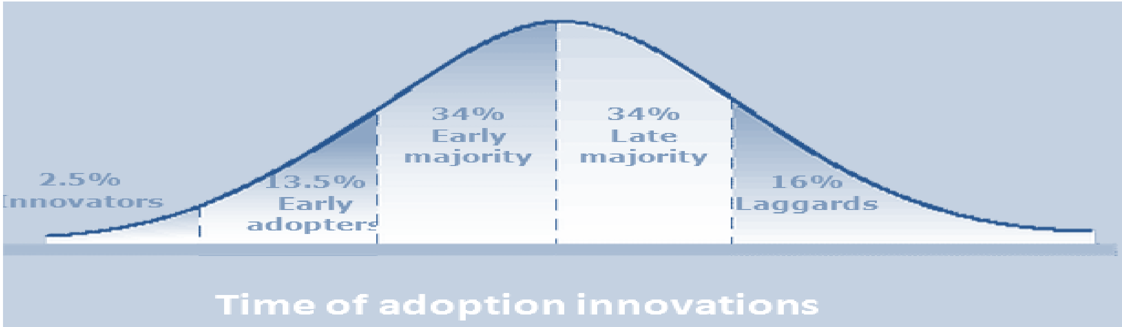


Source: Rogers, 1995

Adopter categories

Rate of adoption is the relative speed with which an innovation is adopted by members of a social system. Norton and Bass (1987) also asserts that new technologies diffuse through a population of potential buyers over time. The pace at which individuals become aware of and access information on an innovation's advantages and disadvantages will differ and this will influence the timing of final decisions to adopt. This time element associated with the diffusion process allows adopter categories to be plotted on diffusion curves. The adopter categories are defined according to the degree of innovativeness of the individual. Innovativeness indicates an overt behavioural change, rather than merely cognitive or attitude change as well as the degree to which an individual is relatively earlier in adopting new ideas.

Figure 8: Time of adoption innovations



Source: Rogers, 1995

Figure 8: Time of adoption innovations shows how adopters are categorised in (a) innovators (2.5% of adopters), (b) early adopters (12.5%), (c) early majority (35%), (d) late majority (35%) and (e) laggards (15%). The distribution of adopters follows a normal distribution curve.

- **Innovators** are adventurous with new ideas; they have a wide network of contacts and substantial financial resources to absorb losses on unprofitable innovations. They have the ability to understand complex technical knowledge and can cope with high uncertainty. They are responsible for launching new ideas into the market.
- **Early adopters** are integrated into local networks; they have the highest degree of opinion leadership and offer advice to potential adopters on new innovations. They are respected by their peers because of their ability to judge new innovations and reduce uncertainty around adoption.

Customarily, innovators and early adopters display characteristics of more formal years of education and a greater knowledge of technology

- **Early majority** adopt innovations just before the average person, they are one of the greatest adopter categories which makes them an important link in the diffusion process. They take a longer time in the innovation decision process than early adopters and although they follow with deliberate willingness in adopting innovations they seldom lead.

- **Late majority** adopt ideas after the average person; they adopt because of economic necessity or increasing network pressure. Innovations are approached with scepticism and innovations must be fully integrated and acceptable to society as a norm before the late majority are convinced.
- **Laggards** are last to adopt, their point of reference is on past traditions. They have limited resources and must be certain that a new idea will not fail before they will adopt.

This study focuses on the second and third adopter categories. The aim of the research is to identify differences in attitudes towards SWH which may be hindering the rate of diffusion of solar systems.

Rogers' (1995) who makes generalisations regarding the socioeconomic status of early adopters and draws a positive correlation between an individual's innovativeness and socioeconomic status. Ultimately the innovativeness of an individual will affect the speed at which the individual adopts new technology innovations. He established that early adopters have more formal education, are more literate, have a higher social status, a greater degree of upward social mobility and have larger units (houses, companies etc) than later adopters. There have been some criticisms about this categorisation of adopters.

Literature on 'green' marketing has attempted to profile 'green' consumer segments using a variety of variables (Kilborne and Beckman, 1998), including socio-demographic characteristics. However, most studies appear to indicate a limited or ambiguous value of social-demographic characteristics for segmenting and targeting environmentally conscious consumers. Therefore the apparent weakness of socio-demographic profiling for green consumers is of great managerial concern: if such characteristics really have no role to play, marketers are forced to turn to alternative and invariably more complex segmentations and targeting approaches (Diamantopoulpos et al, 2003).

2.5.4. Consumer's behaviour towards product attributes

Rogers (1995) indicates that individual perceptions of product attributes affect the rate of adoption of an innovation. The attributes most commonly considered include:

- relative advantage: the degree to which an innovation is perceived as being superior to the idea or product its replaces
- perceived risk: the expected probability of economic or social loss resulting from the innovation
- complexity: the extent to which the innovation appears difficult to use and understand
- compatibility: the degree to which the innovation is seen as consistent with the innovator's existing values, past experience and needs
- trialability: the extent to which one can experiment on a limited basis with the innovations, and
- observability: the degree to which the results of innovating are visible to others.

Relative advantage is considered to be the most influential of the five attribute categories (Rogers, 1995) and together with compatibility and complexity has been shown to hold the most influence over the decision of whether or not to adopt. Ostlund (1974) has predicted innovativeness (adoption vs. non-adoption) by individuals on the basis of their perception of the innovation attributes with the relationship between attribute perception and innovation behaviour are generally positive, with the exception of perceived risk and complexity. As Muller (2009) postulates, new technology adoption is jointly determined by a person's attitudes towards using the new technology and its perceived usefulness and ease of use.

While it may be obvious to a consumer that a SWH provides relative advantage in generating clean energy, provides costs savings and is compatible with the existing electrical system, the operational choice presents a very complex situation. Different providers offer various systems, varying in size, price and returns. Moreover, as it is not possible to trial a system for a limited period before purchase, the final choice has to be made without the opportunity to test the system. This lack of trialability of solar systems as a barrier to adoption is also confirmed by Labay & Kinnear (1981).

Risk is a critical determinant of innovation adoption and can be based on either physical or operational aspects of the innovation, for example, performance. This risk is incorporated to Rogers (1995) compatibility attribute.

The complexity of the SWH technology requires a knowledge most consumers do not possess and which is hard to acquire in the short term. According to Ajzen (1975) model of reasoned action, this lack of technical expertise constitutes a barrier that reduces the person's control over the behaviour. Often consultation with an expert helps to overcome this barrier. Alternatively, the individual may seek advice from their social network in order to improve their own judgement, this links to the importance of the communication channels used in the diffusion of an innovation through a social system.

The financial considerations are also complex, for the direct price of a SWH ranges from R15,000 to R20,000, with a pay-back period of under 3 years. The government rebate is offered to shorten the pay-back period to make it more financially attractive. However, these rebates focus attention on the high cost of the innovation and away from the advantageous features that might have persuaded a potential consumer (Velaydhan, 2003). The effects of temporal distance outcomes on inter-temporal choice have been extensively studied (Chapman, 1998). People tend to devalue or discount delayed outcomes. As a consequence people want to obtain positive outcomes sooner rather than later, while preferring to postpone negative consequences. The purchase of a SWH typically yields negative outcomes at the time of purchase, while positive outcomes are delayed. This can cause a dilemma situation, involving conflict between direct and delayed outcomes that can provoke cognitive dissonance reactions.

In addition, consumers discount the long-term positive outcomes by employing arguments like “too expensive”, “too much paperwork”, “it hardly contributes to the environment” or “there is too much disruption to existing electrics and roof structures”. As a consequence, initially interested consumers may decide not to invest in a SWH system.

Jager (2005) has proposed that reducing the complexity of the decision and the time discounting framing of the decision-problem would stimulate consumers to install SWH. It seems that expert support in decision-making stage would reduce complexity in consumer’s experience. People already in possession of SWH systems may function as advisors with respect to the installation of SWH and system choice, something which relates to observability of the innovation as mentioned by Rogers (1995). When a consumer has direct contact with someone who has successfully installed SWH, social comparison processes may facilitate the exchange of information. This would reduce the complexity of the decision-making context and make it more favourable for adoption. The more people there are in a social network, the more information available.

2.6. TECHNOLOGY ACCEPTANCE AND DIFFUSION MODELS

The researcher contends that SWH systems will be adopted at varying rates, depending on internal and external factors such as governments subsides, financing options and regulatory clarity. Perceived usefulness of the technology and its ease of use are vital in its acceptance. If using a solar system is too complicated, homeowners will not use the technology. Domestic consumers must bear in mind that the perceived usefulness and ease of use can be influenced by external factors, such as the reliability of suppliers and cost implications. In South Africa, external variables include uncertainties regarding the continued availability of Eskom subsidies and the further increases in the electricity tariff which affects the overall cost of living.

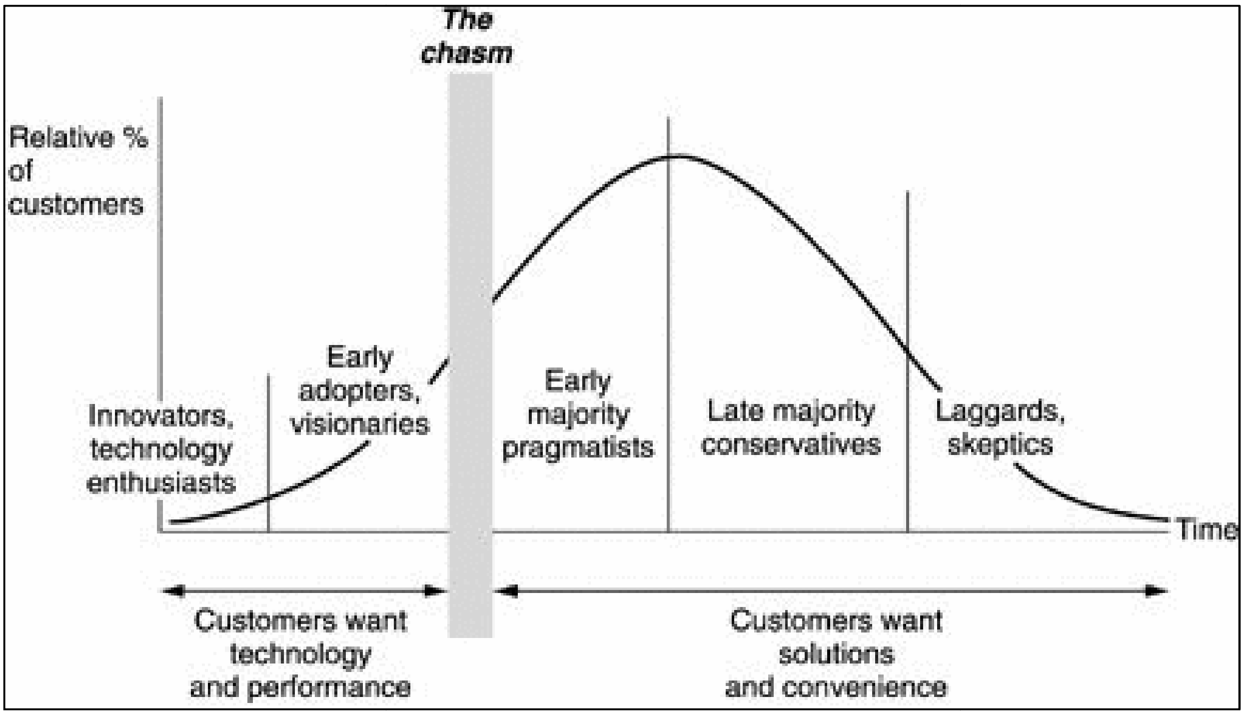
There are risks involved with investing early as opposed to investing later. The research contends that there are dangers being an “early adopter”, particularly if there are no established reliable suppliers and product quality standards are unclear. There are also dangers in being laggards, particularly as the NSWHP subsidies have a limited time span.

2.6.1. Moore’s chasm model

Moore (2002) used the S-curve and Rogers (1995) Diffusion of Innovations theory as a basis for marketing high technology products. He found that innovations are often supported by early technology enthusiasts and visionaries and that they fall into a ‘chasm’ unless the innovation can leapfrog and enter into the lucrative “mainstream” market. The key concepts are outlined in the rest of this chapter, with commentary on how these are useful to newcomers and existing players entering the solar systems market.

According to Rogers (1995), technology adoption forms a bell curve, starting off slowly with few adopters, then rising quickly as more users adopt an innovation, and finally levelling off towards the end of the diffusion process. There are generally five stages of innovation acceptance: – innovators, early adopters, early majority, late majority and laggards. These categories are based on normal distribution (bell curve). The time of adoption process as shown in Figure 8 was subsequently adapted by Moore, whose contribution to the understanding the high-tech market was to explain why the ‘technology adoption life cycle’ does not happen as expected, with the inevitable move along the bell curve.

Figure 9 : Moore's development life cycle



The early market

- **Innovators = technology enthusiasts.** They are the earliest adopters and are generally a very small group who purchase and use technologies out of pure interest in the technology. From a marketing point of view, these people do not have money but have influence. Only with their endorsement can a discontinuous innovation (an innovation that results in a paradigm shift or jump to a new S-curve) get a hearing and so technology companies will often give products to this community to get their support. This group educates the "visionaries".

- **Early adopters = visionaries.** This group appreciates the potential benefits of technology and will utilise technology when they perceive that its benefits match their own needs and desires. According to Moore, this constituency brings real money and provides seed funding for entrepreneurs, publisicing the innovation and giving it the boost to succeed in the early market. He suggests that technology providers do whatever it takes to satisfy this group so that it can serve as a good reference for the 'pragmatists'.

Moore's chasm model (1999) highlights that in practice companies often stumble in making the transition from "visionaries/early adopters" (that is the early market) to "pragmatist" (early majority). High-tech products that originally enjoy a warm reception in the early market often fall into the chasm, during which sales falter and often plummet. The reason for this "chasm", says Moore, is different underlying values. "Visionaries" are institutive. They take risks, are motivated by future opportunities and seek what is possible, whereas "pragmatists" are analytical and support evolution. They are conformists, manage risks and are motivated by present problems.

In the "chasm", the technology has lost its novelty. Its acceptance is not widespread enough to convince pragmatists that it would be a safe purchase and adoption is stalled. Moore believes that the only way for technology vendors to move forward is to target a niche market that suffers from a nasty problem ("pragmatists in pain") for which the technology is the sole solution. To cross the "chasm", Moore suggests that the company focus on a total solution for a problem built around the needs of a niche market. Moore calls this total solution a "whole product" – which he defines as the minimum set of products and services necessary to ensure that the target customer will achieve his or her compelling reason to buy.

- **Early majority = pragmatists.** This group believes in evolution, not revolution, and will wait to see if a technology delivers on its promises. Moore says technology suppliers should aim to gain the bulk of their revenue from serving the "pragmatists", ideally by becoming the market leader and setting the de-facto standards. By leveraging the "pragmatists" to gain sufficient volume and experience, technology vendors' products can become cheap and reliable enough to meet the needs of the conservatives, the next group on the bell curve.

- **Late majority = conservatives.** This group is sceptical, adopts new ideas later than average (often only under duress) and tends to be highly price sensitive and demanding. Moore says this group represents a largely untapped opportunity for high-tech products but if marketing is not incorrect this group can prove challenging to technology vendors.

- **Laggards = sceptics.** These are the technology Luddites who delight in challenging the hype of the high-tech market and pay little attention to the opinions of others. When they finally adopt an innovation, the Innovators have most likely already introduced another idea or technology.

Therefore it is important that SWH suppliers should not offer the same product to the "early majority" as the "early adopters" because the two adopters have different references bases for evaluating an innovation. Products need to be developed with the guidance and feedback of the "early adopter" categories to make them more reliable and functional; this will lead to narrowing the width of the 'chasm' so that the technology appears more attractive to the "early majority".

Moore (2004) also provides recommendations on how companies should market their technologies at the various stages of the technology adoption life.

Figure 10: Marketing and the technology adoption cycle

Moore, 1999

2.6.2. What this means for suppliers of solar systems

The reason for highlighting Moore's core thesis is to warn technology vendors that their business strategies must change dramatically as marketplaces move through the various stages. The author maintains that the SA market for solar geysers and solar photovoltaic systems are in the early stage – though solar geysers have jumped the chasm into the mainstream market due to the media attention and the subsidies offered to incentivise take-up of solar water heating systems.

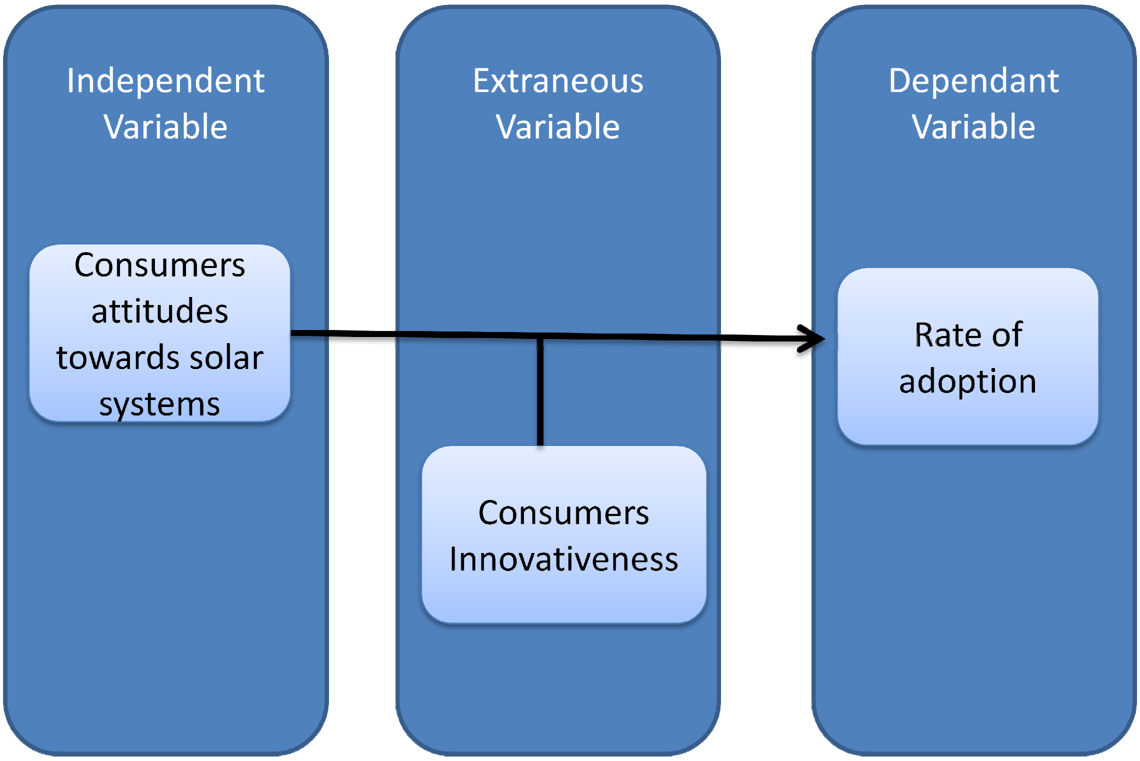
Often companies in early markets do not execute a niche strategy. Start-up companies try to leap from innovation to accepted technology. The danger for solar technology providers is that those that are able to cross the chasm are likely to find themselves in the "tornado" of competition as other companies attempt to grab market shares. As the respondents to the questionnaire highlight in the empirical study (chapter 6), most customers are interested in buying from established technology players. Well known (often big) suppliers, therefore, are likely to win the land grab race. Some of the big players may try to skip over the niche market development phase ("bowling alley") and go straight into the mass market phase ("Main street"). The implications of Moore's lifecycle model are that enterprises must mutate their core competencies over time to sustain attractive returns. Disruptive innovations, which serve a company well during the market's early stages, will not sustain it on "main street", where new expertise is needed in more mundane forms of innovation – process management, marketing and business market innovation, says Moore (2002).

Chapter 3

3. INTRODUCTION

The hypotheses that have been developed for this research revolve around the three main variables illustrated in Figure 11: The different variables that are being analysed in this research paper.

Figure 11: The different variables that are being analysed in this research paper



3.1. RESEARCH VARIABLES

3.1.1. The independent variable

The independent variable is an opinion variable which will record how the respondent feels about something or what they think or believe (Saunders *et al*, 2009). In this research, the consumer attitudes towards solar system characteristics is measured by assessing whether or not the overall attitude towards solar systems as an innovation is positive or negative. Rogers' (1995) *Diffusions of Innovation Theory* sets out a practical innovation adoption process. The speed at which an adopter proceeds through this process is influenced by the attributes of a particular innovation and also, the propensity of the adopter to accept innovation.

3.1.2. The dependent variable

The dependant variable in this research is the rate of adoption. The indicator that is often cited as the most important for determining the success of a new technology innovation is the rate of diffusion (Rogers, 1995; Moore, 2002). The measures used to establish the rate of adoption will be the same as those used in prior research: the demographics of the adopter categories and the five product attributes which are used by consumers in the purchasing decision These attributes include relative advantage, compatibility, complexity, observability and trailability (Faiers and Neame, 2006; Labay and Kinnear, 1981).

3.1.3. The extraneous variable

In this research there is one extraneous variable which may influence the dependant variable, thereby providing an alternative explanation to the independent variable. This is something taken into consideration as Saunders *et al*, advise (2009). Literature on 'green' marketing has attempted to profile 'green' consumer segments using a variety of variables (Kilborne and Beckmann, 1998), including socio-demographic characteristics. However, most studies appear to indicate a limited or ambiguous value of social-demographic characteristics for segmenting and targeting environmentally conscious consumers. This is in contrast to Rogers' (1995) who makes generalisations regarding the socioeconomic status of early adopters and draws a positive correlation between an individual's innovativeness and socioeconomic status. Ultimately the innovativeness of an individual will affect the speed at which the individual adopts new technology innovations. He established that early adopters have more formal education, are more literate, have a higher social status, a greater degree of upward social mobility and have larger units (houses, companies etc) than later adopters. The NSWHP profiled the target markets primarily household income level (R6, 000 – R16, 000 middle/low income and > R16, 000 upper income) compared to other segmentation variables. Therefore the apparent weakness of socio-demographic profiling for green consumers is of great managerial concern: if such characteristics really have no role to play, marketers are forced to turn to alternative and invariably more complex segmentations and targeting approaches (Diamantopoulpos et al, 2003).

The extraneous variable in this study is the consumers ‘adopter’ profile based on the innovativeness of the individual. This variable is measured through socio-economic characteristics. These are the same as those used in prior research: age, formal education and household income (Faiers and Neame, 2006; Labay and Kinnear,1981).

3.2. HYPOTHESES

The hypotheses were developed from the variables examined above. Three hypotheses were used to test Rogers (1995) Diffusion of innovation Theory and Moore’s (2002) concept of a “chasm” between “early adopters” and the “early majority” as applied in the South African solar systems market.

The literature on the technology adoption cycle proposes that the socioeconomic status of the consumers is likely to impact their level of innovativeness, which ultimately makes it possible to identify five adopter categories. Rogers (1995) notes the following generalisations:

- Early adopters were not different in age from later adopters.
- Early adopters have more years of formal education than later adopters.
- Early adopters have higher social status than later adopters (income, living standard).

Labay & Kinnear (1981) conducted a study in the United States on the topic of solar system; they found very few differences between the adopters and knowledgeable adopters. Education, income level and occupational status appear remarkably similar. In age adopters appear more concentrated around age 35, with less divergence from categories 26 to 45 years of age.

Thus prior research supports the view that socioeconomic status affects the level of innovativeness and ultimately influences the group of technology adopters in which a consumer will be categorised. This research focuses only on the “early adopter” and the “early majority” adopters. This leads to the first hypothesis:

Hypothesis One

“Early adopters” and “early majority” adopters of domestic solar energy systems differ on the basis of demographic measures.

- **Early adopters are younger than later adopters**
- **Early adopters have more years of formal education than later adopters**
- **Early adopters have higher social status than later adopters**

Ostlund (1974) proposes that the innovativeness (adoption vs. non-adoption) of individuals can be predicted on the basis of their perceptions of an innovations attributes. The relationship between attribute perception and innovative behaviour was generally positive, with the exception of perceived risk and complexity. Adopters of an innovation rated it higher in relative advantage, compatibility, trialability and observability and lower in perceived risk and complexity.

Hypothesis 2

“Early adopters” and “early majority” adopters have a positive attitude towards solar systems attributes.

The literature on the technology adoption cycle proposes that there is a chasm when moving along the adoption curve from “early adopters” to the “early majority”. It suggests that the lack of diffusion of high technology products, such as solar systems, is due to the inability of suppliers to transition their marketing strategies effectively from the “early adopters” to the “early majority”. This research study investigates whether there is a significant difference in the perceptions between the two populations and identifies specific characteristics which are inhibiting the adoption of solar systems in the “early majority”.

Hypothesis 3

A ‘chasm’ exists between early adopters and early majority adopter which is affecting the rate of diffusion of solar systems within South Africa.

Moore (2002) explains that each adopter group, along Rogers (1995) time of adoption bell curve (Figure 8) represents a unique psychographic profile – a combination of psychology and demographics that makes its marketing response different to those of the other groups. Understanding each adopter profile and its relationship to its proceeding adopter category is a critical component of a marketing strategy as there is dissociation between the “early adopter” and the “early majority” adopter. Moore (2002) has identified that the groups do not perceive product attributes in the same light , therefore a different marketing campaign has to be designed to capture the “early majority” adopter’s interest. This gap represents a risk for marketing to lose momentum, to miss the transition to the next segment and thereby never to grow to the profit-margin leadership in the middle of the bell curve.

Chapter 4

4. INTRODUCTION

This chapter outlines the research design and justifies why this approach was appropriate. The research method used a questionnaire; responses to this aided the researcher in extracting respondent's attitudes with regard to solar system characteristics. The sampling methodology was carefully designed to identify two populations: "early adopters" and "early majority". An overview of the statistical methods used to analyse responses is also included.

4.1. RESEARCH DESIGN

Both a quantitative and descriptive method were used to identify consumer attitudes towards solar system characteristics between two contrasting populations. A descriptive research method was selected. This is because, according to Zikmund (2003), this method is most appropriate for describing characteristics of a population or phenomenon. Previously, Robson (2002) had also identifies the objective of descriptive research to be an attempt to portray an accurate profile of people, events or situations. .

This research study posed and attempted to answer the following three questions:

1. Do the "early majority" have a positive enough attitudes towards solar systems to indicate that adoption will follow in the near future?
2. Is it possible to identify a clear enough difference in attitude between innovative populations that could inform the design of marketing strategy and related activities?
3. Is it possible to identify characteristics of solar power that may be creating the apparent adoption 'chasm' as defined by Moore (2002)?

4.2. UNIT OF ANALYSIS

The unit of analysis used is the consumer's attitude towards solar system characteristics. This would seem to be an appropriate unit of analysis in a research context with focus on investigating the innovation adoption process. The Diffusions of Innovations Theory proposed by Rogers (1995) models the innovation adoption process. According to this theory, the speed at which an adopter passes through this process is influenced by the attributes of particular innovations and the propensity of the adopter to accept innovation. The Diffusion of Innovation Theory has been utilised to model diffusion of the use of solar power (Labay & Kinnear, 1981). In South Africa, solar systems would be considered a technology innovation, as the solar system would replace the incumbent technology used to heating water: electric geysers. This study's aim was to gain an understanding about and insight into what influences the South African consumer when making a decision to purchase a solar system as well as factors that may be hindering the consumer from moving to the next stage of the adoption process.

4.3. POPULATION RELEVANCE

There are two populations of relevance for the study: the first population represents the "early adopters" and the second the "early majority". "Early adopters" are individuals who have installed solar systems into their households. They generally adopt technology due to its long term benefits and do not consider inconvenience or lack of performance as a hindrance to adoption (Faiers & Neame, 2006).

The "early majority" are considered to be the pragmatic adopters as they will find innovations attractive when the technology is established, when there are established manufacturers, when there is recognisable quality, and a fit within a supporting infrastructure (Rogers, 1995). They demand reliability and quality from suppliers, their needs are more difficult to satisfy than "early adopters" but they are vital for sustained success of the innovation as they are three times the size of the "early adopter" category (Moore, 2002).

"Early majority" adopters have been defined as individuals who have an awareness of solar systems and have expressed an interest in gaining a better understanding about the attributes of solar systems but have not yet purchased a system. Rogers (1995) theorised that the innovation-decision process moves through five phases that adopters will follow these steps when deciding whether or not to procure an innovation. Adopters require knowledge of a product and must be motivated to raise their awareness about it. At the 'awareness stage', the adopter is concerned about the attributes of the innovation and identifying the additional benefits they will gain. They compare the new product to the products they currently use.

4.4. SAMPLING METHOD AND COLLECTION METHOD

4.4.1. Sampling frame and method for "Early adopters"

The sampling frame:

- Individuals registered on the SESSA database.
- Individuals who have installed a solar water heater or solar PV system in their household.

The sample selection for "early adopters" was selected using a non-probability sampling method which took the form of self-selection sampling. A total of 1036 emails were sent to individuals registered on the SESSA database, inviting those who had installed a solar system to participate in a survey. This approach was used because, as has been pointed out, cases that self-select often do so because of their feelings or opinions about the research questions (Saunders et al., 2009).

A total of 156 respondents completed the survey. This is a response rate of 15%. A qualifying question was included to ensure that the respondent met the sample frame criteria. This question asked whether or not the individual had installed a geyser. A total of 44 respondents answered 'no'. Consequently, the results of these respondents were included in the "early majority" adopter sample as they met the criteria for that sampling frame.

4.4.2. Sampling frame and method for "Early majority"

The sampling frame:

- Individuals who had contacted a solar supplier and enquired about solar systems within the past year.
- Individuals who had an interest in learning more about solar systems.
- Individuals who have not yet purchased or installed a solar system.

The sample selection for "early majority" was selected using a non-probability sampling method which took the form of self-selection sampling. A sample of 385 individuals was accessed through the use of different networks and industry associations. Once again, this approach was used as cases that self-select often do so because their feelings or opinions about the research questions (Saunders et al., 2009).

However, as Zikmund (2003) has observed, the disadvantage of using this sampling technique is that the likelihood of the sample being representative is relatively low. The advantage though is that it is relatively cost-effective and it has the ability to get a large number of questionnaires completed in a timeous manner.

A total of 108 respondents completed this survey. This is a response rate of 28%. Once again, a qualifying question was included to ensure that the respondent met the sample frame criteria. This question asked whether or not the individual had installed a geyser. A total of 15 respondents answered 'yes', the results of these respondents are therefore included in the "early adopter" sample as they met the criteria for that sampling frame.

4.5. RESEARCH INSTRUMENT

A single data collection technique in the form of a questionnaire with quantitative data analysis procedures was implemented. Sample groups that had been selected were emailed and invited to complete in the research questionnaire and in this way, to participate in the research study.

4.5.1. Survey design

Two questionnaires were compiled for each of the sample groups. Three sections were identical for both groups as this would allow for a comparison of results in the categories of demographics, attitudes and purchasing behaviour. A forth section was included in the "early adopters" survey. This captured technical data to verify the overall statistics of the number of solar systems installed to date.

Table 2: Questionnaire sections

Sample group	Early Adopters	Early Majority
Technical data	X	
Demographics	X	X
Attitudes	X	X
Decision Priority Statements	X	X

4.5.2. Questionnaire sectional outline

4.5.2.1. Section 1 – Technical data

The technical data section included questions which were provided by a SESSA representative/ The questions were carefully formulated with the intention of gathering a clearer picture about the size of systems being adopted as well as the average energy savings and financial savings being achieved by "early adopters" since their adoption decision.

4.5.2.2. Section 2 – Demographics

The second section posed questions related to the demographic profile of the adopter category, for example, the adopter's gender, age, level of education, household income and also, the energy efficiency measures currently being practiced in their household. These were measured as interval data (for the age), dichotomous data (for the gender) and categorical data (for the education, household income and the household energy-efficient measures).

4.5.2.3. Section 3 – Product attributes

The third section comprised a series of statements with regard to the characteristics of solar power. The literature suggests that householders utilise a bounded rationality and base their decisions on heuristics they associate with innovations. Hence it is important to identify these heuristics. Faiers & Neame (2006) conducted interviews using the Kelly Repertory Grid to identify product attributes of solar systems; this resulted in the creation of bi-polar constructs that describe the attributes of solar systems (Van Kleef et al., 1984). These characteristics were used in the development of the statements for section three of the questionnaire. The questions in this section were also based on prior research that had been conducted on the attitudes of consumers towards solar systems (Labay & Kinnear, 1981; Faires & Neame, 2006).

A likert scale was used to measure the responses to pre-determined statements. Respondents had a choice of five options: strongly agree, agree, undecided, disagree and strong disagree. The advantage of this approach (as observed by Heise (2008) is that it is relatively simple to administer, it has a pedigree of use in social research and has been demonstrated as having reliability and validity.

4.5.2.4. Section 4 – Decision priority statements

The fourth section used a series of statements developed from the generalisations about the Attribute Framework within the Diffusions of Innovation theory (Faiers & Neame, 2006). The associated literature has identified discrepancies in the generalisation that category adopters will follow the same decision making process and that the main difference will be at the time that they make their adoption decision. The question used in Faiers & Neame (2006) to analyse the order of priority that respondents place on the characteristics ascribed to attribute categories was adapted from a 'Yes/No' response to three possible responses to each statements 'Always/Sometimes/Never'. The intention was that the response would reflect the respondent's perspective on the decision making process.

4.6. DATA ANALYSIS

The responses from the survey were analysed using statistical techniques. Both groups were analysed using descriptive statistic and cross-tabulation of various results to identify any significant relationships between responses. Chi-square tests were used in the comparison of solar system attribute statements and the decision priority statements. Any relationship of 5% and lower was considered to have a significant relationship and this was further investigated. The age of the two groups was compared using a t-test.

4.7. RESEARCH LIMITATIONS

4.7.1. Data validity and reliability

Alba and Hutchinson (1987) assert that the accuracy any study will be affected by the consumers' familiarity with solar systems. The more familiar the product, the more specific consumers needs can be inquired after, because concrete attributes often can be assessed in the choice situation and information about abstract attributes is usually retrieved from memory i.e. when respondents are familiar with a product, the information available in memory is higher. This means that the evaluation of such products depends on the type of information and knowledge the consumers have about the particular attributes of a product. In a situation where a consumer has minimal experience with the product it is difficult to retrieve the relevant attributes to evaluate a product. As a result, consumers' opinion about new products may not have a high predictive validity.

Solar systems are a new product in the South African market and relatively very few South Africans have been exposed to the benefits and workings of solar systems (There are 76 876 installed solar geysers and 4.2 million households with electric geysers). The frame of reference which may be used when evaluating the project is solar panels used to heat swimming pools. The concept of solar is similar to energy from the sun is used to heat water in a geyser and provide electricity to a home - in much the same way as this works for a solar-heated pool system. It has been suggested that a lack of awareness of solar products' attributes can be partly prevented by including consumers with moderate to high levels of product expertise (Schoormans et al., 1995). To some extent, this was addressed in this research as it included surveying consumers who had installed a solar system and also, consumers who had enquired about obtaining more information from solar product suppliers on the various solar systems.

4.7.2. Non-response bias

This sort of bias occurs when a portion of the sample fails to respond to the survey. It may introduce estimation error for there is no way of knowing if non-respondents would have differed in some important respect to respondents. This risk was reduced by sending the survey out twice – the seconds was sent a week after the first to serve as a reminder to those participants who had not yet completed the survey. This is recommendation made by Albright, Winston & Zappe (2006).

4.7.3. Measurement error

Measurement error occurs when the responses to questions do not reflect what the researcher intended. It may be a result of poorly worded questions, that the respondents do not fully understand (Saunders *et al,* 2009). To reduce this risk the survey was checked by five individuals from each population to ensure that the questions were clear and easy to comprehend. An independent statistician was used to calculate and verify the results of the survey responses in order to reduce the risk of researcher bias.

4.7.4. Voluntary response error

Voluntary response error occurs when the subset of people who respond to a survey differ in some important way from the potential respondents. To combat this possibility, a qualifying question (‘have you installed a solar system’) was included in both questionnaires. This question ensured that the respondents were incorporated into the correct adopter category based on the sampling frame criteria.

4.7.5. Self-selection bias

Zikmund (2003) identified a Self selection bias, where extreme positions are over represented, may be a problem in this type of self-administered context. This is because people, who feel strongly about the subject, for example energy conscious enthusiasts or climate change protestors, are more likely to respond to the survey.

Chapter 5

5. RESULTS

This chapter provides results from the statistical analysis performed on data from the completed questionnaires.

5.1. DESCRIPTIVE STATISTICS

The statistical analysis was performed on raw data using the SAS data analysis software system. The data was ‘cleaned’ to be ready for analysis by firstly removing respondents from both groups who did not meet the identified sampling criteria that was proposed in the methodology. The first question in both surveys served as the qualifying question, asking whether or not the respondent had installed a solar system. These respondents were removed from the incorrect grouping and allocated to the correct group.

The two data sets consisted of three sections which were identical and a fourth which was unique to the “early adopter” questionnaire. The three identical sections included questions on demographics of the respondent, 16 statements about solar system characteristics which were rated using a five point likert scale and six purchasing priority decision statements which were rated using a three point likert scale.

5.2. RESPONSE RATES AND PROFILES OF RESPONDENTS

Surveys were sent to the two groups: “early adopter” households who had installed SWH and “early majority” who had expressed an interest in SWHs. Of the 1036 surveys sent to the early adopters. 127 valid responses were received (12%) and from the 380 sent to the early majority, 135 valid responses were received (36%). Approximately 34 responses in the ‘early adopter’ category and

5 responses in the ‘early majority’ category did not complete the questionnaire fully and have represented in the tables as missing responses.

The two groups’ respondents shared some common features - a higher response rate from males rather than females. Both groups had a high level of education as is evident from the fact that the most frequently chosen option selected was the post graduate degree. The use of energy saving lights and automatic light switches in the home was at similar levels. This finding was anticipated due to governments drive to exchange incandescent light bulbs and supply free compact fluorescent lights (CFL) to reduce the energy consumption in residences and bring a greater awareness to the public around energy efficiency. (See Table 3: Demographic profile of respondents from the two survey groups).

The two groups had differences in age. The “early adopters” had 47% of respondents in the 36 to 50 age category, with an average age of 47 years. The “early majority” adopters had 59% in the age group 18- 35 and the average age was 36 years. The “early majority” had 17% less in the 51- 65 category.

The “early adopters” had the largest proportion of responses (29.8%) in the monthly household income in the R40, 000 – R49, 999 category, whereas the “early majority” had 22% within the R40, 000 – R49, 999 category and 24.6% in the R50, 000 + category, indicating that the “early majority” are higher income earners.

The “early majority” had a lower level of roof insulation, geyser blankets, water saving taps, gas for heating and stoves and recycling when compared to the “early adopter”. It can be said that the “early adopters” are far more environmentally friendly and energy conscious than the early majority.

Table 3: Demographic profile of respondents from the two survey groups

Demographic Profile			
Question	Responses	Early Adopters %	Early Majority %
Gender	Male	82.86%	58.46%
	Female	17.14%	41.54%
Age			
	18-35	15.69%	61.54%
	36-50	47.06%	24.61%
	51-65	30.39%	13.85%
	66+	6.86%	0.00%
		Ave:47	Ave : 36
Education			
	Matric	5.7%	7.7%
	Artisan	5.7%	3.1%
	Diploma or short courses	24.5%	13.9%
	University degree	20.8%	20.8%
	Post graduate diploma	41.5%	51.5%
	Other	1.9%	3.1%
Monthly household income			
	R0 to R4,999	4.81%	3.97%
	R5,000 to R9,999	5.77%	3.97%
	R10,000 to R15,999	13.46%	13.49%
	R16,000 to R24,999	10.58%	11.90%
	R25,000 to R29,999	17.31%	10.32%
	R30,000 to R39,999	13.46%	9.52%
	R40,000 to R49,999	29.81%	22.20%
	R50,000 +	4.81%	24.60%
Roof insulation	yes	69.52%	50.0%
	No	30.48%	50.0%
Energy saving lights	Yes	89.52%	90.0%
	No	10.48%	10.0%
Geyser Blanket	Yes	32.38%	24%
	No	67.62%	75.8%
Water saving taps	Yes	53.33%	16%
	No	46.67%	84.2%
Gas heating	Yes	31.43%	33%
	No	68.57%	67.5%
Gas stove	Yes	63.81%	31%
	No	36.19%	69.2%
Recycling	Yes	51.43%	39%
	No	48.57%	60.8%
Automatic light switches	Yes	17.14%	18%
	No	82.86%	81.7%

5.3. RESULTS OF THE "EARLY ADOPTERS" RESPONSES

The "early adopters" were asked a number of questions which related to the performance of their solar systems. The first question revealed that 75% of respondents had installed a solar water heater, while only 17% had installed both solar water heater and solar photovoltaic (PV) systems. This result was expected because SWH have a subsidy in place which provides a higher incentive to adopt than solar PV has no subsidy or policy encouraging investment into these systems. South African households have experienced recurring power cuts due to the capacity shortage and this may be encouraging households to invest in smaller PV systems to provide stored back-up power during the these period of load shedding.

The most frequently chosen reason for installing their solar systems was to save costs and the environment. The question allowed for an open ended "other" response. Eight responses were obtained with two recurring themes: the absence of grid supply and to achieve independence from the grid on a small scale (hot water, lighting and televisions).

Respondents were asked what influenced their choice when purchasing their solar systems. Only 34% (44 /127) responded and all the respondents choose "my latest electricity bill". When asked who influenced their choice, 35% indicated suppliers and 33% selected the "other". The answers received from the open ended question had a three themes:

1. Their own research and initiative
2. They worked for or owned their own solar company
3. They knew an expert or a reliable supplier

Eighty six percent (86%) of respondents who had installed SWH had done so within the last five years. This pattern was followed by respondents who had installed solar PV system: 67% were installed the last 5 years. These results are in line with the launch of the 2008 Eskom SWH program (4 years ago) which offered residential homeowners a rebate to invest in the new technology. This was the context of the power supply crisis which began in 2007 and 2008, resulting in a significant increase in power cuts. This situation led to a boom in the generator industry which could offer households with an alternative power source during load shedding. This may have spiked the increase in adoption of solar PV systems in the last 4 years.

The SWH size question gave an option of five sizes. The most frequently selected options were the 200 liters (42.7%) and the 300 liters (21.35%) This correlates to the Eskom survey (Theobald et al, 2009) which found that the market share by collector capacity is dominated by the 200-litre tank in the residential market. The 200-litre tank is recommended for a household of four people (50 litres per person per day is a rule of thumb in terms of meeting hot water demand in middle and upper middle income residences). A cross tabulation confirmed that 97% of response to 200-litre earned a monthly household income above R16, 000 (The NSWHP categorized middle income to earn between (R6, 000 – R16, 000) and upper middle income (above R16, 000).

The majority of solar PV system size respondents selected “less than 100 kWp” (37.50%) as their system size and 25% for “101 to 500 kWp”. The systems are relatively small and the results correspond with the answers from the open ended questions as to why individuals adopted solar and the main response was independence from the grid to support lighting and a few electronic appliances (such as television).

“Early adopters” had noticed a difference in their electricity consumption: 93% responded ‘yes’, this indicates that a growing awareness of system benefits on a month to month basis which assist in reducing post purchase dissonance.

Fifty percent of respondents indicated that rebates were not available at the time of their purchase. Respondents who had used rebates in the purchase of their SWH were divided in the effect the rebate had on their decision, there was an equal response of 38% to ‘it sped up the decision’ and ‘it had no influence on the decision’. However, 62% of response indicated that the rebate had a positive effect on the purchasing decision. Of the respondents who indicated that no rebate was available at the time of their purchase. A total of 64% indicated that they felt the decision made sense on its own and did not need a rebate to persuade them to adopt the technology.

Table 4: Rebate considerations

Question	Yes	No	I would consider it
Would you invest in a solar system if you recieved a tax break of R5,000 once off	80.65%	3.23%	16.13%
Would you invest in a solar system if you recieved a tax break of R5,000 split over 5 years	51.09%	22.83%	26.09%

Respondents were more compelled by the once off rebate than the rebate split over a five year period, however 77% had shown an interest in the offer.

Respondents were asked, “What is the longest you have known anyone to have a solar geyser?” and 57% indicated between 13 to 15 years followed by 18.6% indicating between 5 and 10 years. This can be seen in Table 5: Comparison of the period the respondent adopted a systems and the length of time they have known someone with a solar system. There is a clear indication that these adopters were influenced by the innovators. The interesting correlation is that 72% of individuals who selected that they have had their system for less than 2 years had known someone with a solar system for over 5 years. 80% of individuals who selected that they have had their system for between 2 and 5 years had known someone with a solar system for over 5 years. This may be an indication of the time lapse in the diffusion process between the “innovators” to the “early adopters”.

Table 5: Comparison of the period the respondent adopted a systems and the length of time they have known someone with a solar system

How long have you had your SWH?	What is the longest you have known anyone to have a solar geyser? (Years)									
	<1	1	2	3	4	5 to 10	11 to 12	13 to 15	Don't know	Total
less than 2 years	1	1	1	3	3	10		16	1	36
2 to 5 years			1	1	5	7	2	23	1	40
6 to 10 years								4		4
11 to 15 years								8	1	9
Total	1	1	2	4	8	17	2	51	3	89

The general level of awareness regarding retrofitting an electric geyser with a solar collector and pump is high as 92% of responses indicated that they were aware of this option.

A comparison between demographic and attitude variables was conducted on the "early majority" responses, this was performed to identify any relationships which could provide guidance about future marketing activity.

The comparison between genders and attitudes highlighted a few relationships (showed in Table 6):

- Ten of the attitude statements were viewed positively by all both genders.
- Females were more negative than the males on the payback period, the level of subsidy and the aesthetics of solar systems.
- Male respondents were more negative than females regarding the affordability of solar systems whereas the females were more undecided.
- Both genders were undecided regarding the ease of installation and the maintenance required but the female responses had a higher percentage of undecided than the men.

Table 6 : Attitudes compared by gender

Solar attribute	Gender	Positive	Undecided	Negative
It takes a long period to recoup the financial benefits	Male	16%	32%	50%
	Female	7%	20%	57%
There is a high level of subsidy available for solar geysers	Male	17%	21%	58%
	Female	6%	28%	61%
Solar systems help to reduce pollution	Male	89%	9%	1%
	Female	94%	6%	0%
Solar systems generate savings	Male	85%	14%	1%
	Female	84%	14%	2%
Solar systems require the same maintenance as an	Male	27%	45%	28%
	Female	20%	60%	20%
Solar systems are hidden away and affect the aesthetics of your home	Male	30%	20%	46%
	Female	22%	22%	48%
Solar systems are value for money	Male	52%	37%	11%
	Female	57%	39%	4%
Solar systems are an affordable technology	Male	33%	31%	36%
	Female	24%	43%	33%
Solar provides a reliable source of power	Male	63%	32%	5%
	Female	67%	27%	6%
Solar could develop in the future	Male	66%	33%	1%
	Female	55%	41%	4%
Solar systems add value to a property	Male	73%	23%	4%
	Female	65%	27%	8%
Solar systems reduce carbon emissions	Male	85%	14%	1%
	Female	94%	6%	0%
Solar systems provide a visual statement of beliefs	Male	63%	33%	4%
	Female	76%	18%	6%
Solar systems are easy to install	Male	21%	45%	32%
	Female	13%	70%	9%
Solar systems are a safe form of power generation	Male	92%	8%	
	Female	86%	14%	
Solar power is compatible with modern living	Male	95%	5%	0%
	Female	86%	10%	4%

<u>The comparison between age categories and attitudes highlighted a few relationships:</u>

Each research question requires statistical analysis, in order to ensure spurious results do not occur, the data analysed must be normally distributed. Statisticians have proved that a sample size of at least 30 will usually result in a sampling distribution for the mean which is very close to a normal distribution (Saunders et al., 2009).

There were less than 30 responses for '51 to 65' age category to do a comparison across three age groups '18 – 35', '36 – 50' and '51 – 65'; therefore the last two groups were combined into category '36 – 65'

- Ten of the attitude statements were viewed positively by all three age groups.
- The '18 – 35' and '36 – 65' age categories were more undecided on solar characteristics such as affordability, value for money, ease of installation and the amount of maintenance a system required.
- Both age categories had a negative attitude towards the payback period, of level of subsidy and the aesthetics. However, the '36 – 65' age category has a more negative attitude towards the payback period and the level of subsidy than the other '18 – 35' category, whilst they have an equally divided view on the aesthetics and maintenance required.

<u>The comparison between household incomes categories and attitudes highlighted a few relationships:</u>

There were insufficient responses per category to do a comparison across the eight household income groups, therefore the groups were combined to form two new categories '0 to R40, 000' and 'above R40, 000'.

- Ten of the attitude statements were viewed positively by both household income categories.
- Both groups had a negative attitude towards the payback period, the level of subsidy and the aesthetics of the systems. The category "R0 to R40,000" was more negative of both categories
- The higher household income category was more undecided about the affordability of the system, whereas the lower income groups had a negative attitude.

- Both household income categories were undecided about the ease of installation; the higher income group had a higher percentage for the undecided response.

Solar attribute	Houehold income	Positive	Undecided	Negative
It takes a long period to recoup the financial benefits	R0 to R40,000	19.67%	18.03%	62.30%
	R40,000 +	10.17%	40.68%	49.15%
There is a high level of subsidy available for solar geysers	R0 to R40,000	13.11%	21.31%	65.57%
	R40,000 +	11.86%	28.81%	59.32%
Solar systems help to reduce pollution	R0 to R40,000	86.89%	11.48%	1.64%
	R40,000 +	94.92%	5.08%	0.00%
Solar systems generate savings	R0 to R40,000	91.80%	8.20%	0.00%
	R40,000 +	76.27%	20.34%	3.39%
Solar systems require the same maintenance as an electric geyser or grid-	R0 to R40,000	19.67%	49.18%	31.15%
	R40,000 +	28.81%	54.24%	16.95%
Solar systems are hidden away and affect the aesthetics of your home	R0 to R40,000	24.59%	19.67%	55.74%
	R40,000 +	32.20%	23.73%	44.07%
Solar systems are value for money	R0 to R40,000	55.74%	36.07%	8.20%
	R40,000 +	51.72%	43.10%	5.17%
Solar systems are an affordable technology	R0 to R40,000	31.67%	33.33%	35.00%
	R40,000 +	25.86%	41.38%	32.76%
Solar provides a reliable source of power	R0 to R40,000	71.67%	20.00%	8.33%
	R40,000 +	54.24%	42.37%	3.39%
Solar could develop in the future	R0 to R40,000	98.36%	1.64%	0.00%
	R40,000 +	96.55%	1.72%	1.72%
Solar systems add value to a property	R0 to R40,000	77.05%	16.39%	6.56%
	R40,000 +	61.02%	33.90%	5.08%
Solar systems reduce carbon emissions	R0 to R40,000	91.67%	6.67%	1.67%
	R40,000 +	84.75%	15.25%	0.00%
Solar systems provide a visual statement of beliefs	R0 to R40,000	77.05%	19.67%	3.28%
	R40,000 +	56.90%	36.21%	6.90%
Solar systems are easy to install	R0 to R40,000	19.67%	50.82%	29.51%
	R40,000 +	16.95%	66.10%	16.95%
Solar systems are a safe form of power generation	R0 to R40,000	90.00%	10.00%	0.00%
	R40,000 +	88.14%	11.86%	0.00%
Solar power is compatible with modern living	R0 to R40,000	95.08%	3.28%	1.64%
	R40,000 +	86.21%	12.07%	1.72%

There were limitations to the comparisons across age groups and household incomes because the sample size for a number of the categories had less than 30 responses which made analysis statistically irrelevant as it would not be proper representation of attitudes.

5.4. RESULTS OF ATTITUDES TO SOLAR SYSTEM ATTRIBUTES

The groups were asked to rate solar system characteristics through a series of 16 statements, intended to capture the respondent's attitudes toward solar systems. The statements included both positively and negatively phrased questions; respondents were asked to express their perceptions by rating each statement using a five point likert scale (strongly agree, agree, undecided, disagree and strongly disagree).

The results were statistically analysed using descriptive statistics Chi-square tests to identify any significant relationships between the two groups. The chi square test requires that the two groups are mutually exclusive. If the probability of the test statistic is very low (usually p <0.05 or lower), then there is a statistically significant relationship and if it is higher than 0.05 it is not statistically significant (Saunders *et al*, 2009). The questionnaire and results can be found in the appendices. The responses 'strongly agree' and 'agree' were combined to form the positive attitude and the responses 'strongly disagree' and 'disagree' were combined to form the negative attitude. This combining of results allowed for an easier comparison and clearer pattern in the findings. The results of the negative statements were reversed to ensure the consistency of the positive and negative attitudes.

The "early adopters" attitudes are displayed in Table 7 below. This provides a summarised view of the responses towards solar systems characteristics. Twelve statements clearly show a positive attitude towards solar systems. Early adopters had a negative attitude towards the long pay-back period, the low level of subsidy, the ongoing maintenance of the system and the overall change in aesthetics after the system has been installed on the roof. There were extremely divided views regarding the pay-back period: 44% indicated that they felt the pay-back period was not a long period, 5% were undecided and 51% felt that the pay-back period was long.

Table 7: Early adopter attitudes toward solar system characteristics

Solar systems attribute statements	Positive %	Undecided %	Negative%
It takes a long period to recoup the financial benefits	44.2	4.81	51
There is a high level of subsidy available for solar geysers	23.3	8.74	67.96
Solar systems help to reduce pollution	95.19	2.88	1.92
Solar systems generate savings	99.04	0.96	0
Solar systems require the same maintenance as an electric geyser or grid-power source	33.98	18.45	47.57
Solar systems are hidden away and affect the aesthetics of your home	25.74	7.92	66.34
Solar systems are value for money	77.67	13.59	8.74
Solar systems are an affordable technology	53.54	11.11	35.35
Solar provides a reliable source of power	82.35	11.76	5.88
Solar could develop in the future	99.04	0	0.96
Solar systems add value to a property	85.29	13.73	0.98
Solar systems reduce carbon emissions	92.16	6.86	0.98
Solar systems provide a visual statement of beliefs	81.55	16.5	1.94
Solar systems are easy to install	56.44	6.93	36.63
Solar systems are a safe form of power generation	100	0	0
Solar power is compatible with modern living	96.12	2.91	0.97

Ten statements from the "early majority" responses were positive towards the solar systems characteristics. Three statements returned negative responses; the views on the long payback period, the low subsidy offering and the negative aesthetics of solar systems were shared with the "early adopter" respondents. The group seemed unsure about the level of maintenance required for the system, whereas the "early adopters" were clear in their views that the solar systems required more maintenance than an average electric geyser.

"Early majority" respondents were unclear on the affordability of systems; the responses were relatively equal scattered across positive, undecided and negative views and the ease of the installation process raised a pertinent point which could be affecting adoption.

Table 8: “Early majority” attitudes towards solar system characteristics

Solar systems attribute statements	Positive %	Undecided %	Negative%
It takes a long period to recoup the financial benefits	16.13	28.23	55.65
There is a low level of subsidy available for solar geysers	12.9	25	62.1
Solar systems help to reduce pollution	91.2	8	0.8
Solar systems generate savings	84.8	13.6	1.6
Solar systems require the same maintenance as an electric geyser or grid-power source	24.19	50.81	25
Solar systems are hidden away and affect the aesthetics of your home	28.46	21.95	49.59
Solar systems are value for money	54.03	37.9	8.06
Solar systems are an affordable technology	29.27	35.77	34.96
Solar provides a reliable source of power	64.52	29.84	5.65
Solar could develop in the future	97.58	1.61	0.81
Solar systems add value to a property	69.6	24.8	5.6
Solar systems reduce carbon emissions	88.62	10.57	0.81
Solar systems provide a visual statement of beliefs	68.55	26.61	4.84
Solar systems are easy to install	18.55	58.06	23.39
Solar systems are a safe form of power generation	89.52	10.48	0
Solar power is compatible with modern living	91.13	7.26	1.61

A further comparison of the two groups was performed using Chi-square test, this identified relationships between the two groups which were within a 5% level of significance.

“Early majority” adopters were predominately in disagreement or undecided regarding the short pay-back period of the solar investment, whereas the “early adopters” were equally divided as to whether or not the payback period was long.

Although the attitudes towards the high subsidy were equally negative, there was a clearer pattern that the “early majority” were undecided as to the alternative option whereas, the “early adopters” responded that the subsidy available was not low.

Table 9: A comparison between the two groups' attitudes towards solar system attributes

Solar systems attribute statements	Positive %	Undecided %	Negative%	Chi-Square
It takes a longt period to recoup the financial benefits	44 16	5 28	51 56	<0.001
There is a low level of subsidy available for solar geysers	23 13	9 25	68 62	0.0022
Solar systems help to reduce pollution	95 91	3 8	2 1	0.1959
Solar systems generate savings	99 85	1 14	- 2	0.007
Solar systems require the same maintenance as an electric geyser or grid-power source	34 24	18 51	48 25	<0.001
Solar systems are intrusive and affect the aesthetics of your home	26 28	8 22	66 50	0.0072
Solar systems are value for money	78 54	14 38	9 8	0.0002
Solar systems are an affordable technology	54 29	11 36	35 35	<0.0001
Solar provides a reliable source of power	82 65	12 30	6 6	0.0043
Solar could develop in the future	99 98	- 2	1 1	0.4263
Solar systems add value to a property	85 70	14 25	1 6	0.013
Solar systems reduce carbon emissions	92 89	7 11	1 1	0.6198
Solar systems provide a visual statement of beliefs	82 69	17 27	2 5	0.0732
Solar systems are easy to install	56 19	7 58	37 23	<0.0001
Solar systems are a safe form of power generation	100 90	- 10	- -	0.0008
Solar power is compatible with modern living	96 91	3 7	1 2	0.3111

Table 9 above highlights the comparison of attitudes between the two groups, it can be seen that there were eleven instances when statistically significant differences arose:

- Five characteristics showed different levels of positive response, where the "early adopters" were more positive each time while the early majority were more uncertain. i.e. generates savings, value for money, value to property, safe form of power generation and reliable source of power.

- Two characteristics showed that while the “early adopters” were positive and some negative, the “early majority” were more undecided. i.e. affordable technology and easy to install
- Two characteristics showed that while “early adopters” were negative, the “early majority” were less negative, for example, poor aesthetics and level of subsidy.
- One characteristic showed that while “early adopters” were negative, the “early majority” were more undecided, for example, the level of going maintenance.
- One characteristic showed that while “early adopters” were equally divided, the “early majority” were more negative, for example, the e.g. pay-back period.

The value of this comparison was to find the differences in attitudes that may contribute to the chasm.

The “early adopters” have indicated that they feel that the solar system requires more maintenance compared to the traditional solar geyser. This could be a key barrier to adoption when communicating this opinion to new adopters. An innovation is less likely to be adopted if it is not compatible with the adopter’s current lifestyle and the product has an increased complexity which requires more time and attention than their current electric geyser. This is clearly indicated by the high ‘undecided’ response from the “early majority” who seem unsure as to the level of maintenance required for the solar system.

“Early majority” adopters were mainly in agreement that solar systems are intrusive and affect the aesthetics of their homes but there was a far higher indecision compared to “early adopters” who were more likely to disagree than be undecided. This may indicate Rogers (1995) observablitity attribute for there may not be enough visible solar systems within the respondent’s residential area for them to have noticed the true visual effects of a solar system.

While, overall solar systems were seen as value for money and a reliable power source by both groups but there was also a high amount of indecision amongst "early majority" attitudes. This could be considered a barrier to adoption because the next adopter category then does not see a significant relative advantage of solar systems over electric geysers.

The greatest difference between the groups was evident in the attitudes towards maintenance. The attitudes of "early adopters" were divided in a similar level to the pay-back period. Over half (56%) felt that systems were easy to install, while 44% were in disagreement or undecided. This shows a highly divided view around the installation process. This is reflected by the "early majority" who are more undecided and in disagreement by 81% that systems are easy to install. This is a major barrier to entry because the solar systems are considered complex and more incompatible.

Table 10: Solar system characteristics statements categorised into Rogers (1995) innovation attributes

It takes a long period to recoup the financial benefits	R			
There is a low level of subsidy available for solar geysers	R			
Solar systems help to reduce pollution	R	C		
Solar systems generate savings	R			
Solar systems require the same maintenance as an electric geyser or grid-power source	R			
Solar systems are intrusive and affect the aesthetics of your home	R	C		O
Solar systems are value for money	R			
Solar systems are an affordable technology	R			
Solar provides a reliable source of power	R		C	
Solar could develop in the future			C	
Solar systems add value to a property	R			
Solar systems reduce carbon emissions	R	C		
Solar systems provide a visual statement of beliefs	R			O
Solar systems are difficult to install			C	
Solar systems are a safe form of power generation	R	C		
Solar power is compatible with modern living	R	C		

R = Relative advantage
C = Compatibility
C2 = Complexity
O= Observability

5.5. RESULTS OF THE DECISION PRIORITY STATEMENTS

There were no significant relationships found when comparing the decision priority statement responses between the two groups, in fact the answers were similar. However, the "early majority" were more undecided regarding the importance of a product fitting their lifestyle bearing more weight than first trying the product.

Table 11: Comparison of the decision priority statements

When you buy a product	Adopter	Always %	Sometimes %	Never %	Chi-square
Do you consider the advantages and disadvantages of a product to be the most important factor in the decision to buy one	Early Adopter	74.51	24.51	0.98	
	Early Majority	70.73	29.27	0.00	<0.4104
Do you only purchase a product if it works with what you already own?	Early Adopter	31.37	66.67	1.96	
	Early Majority	26.23	69.67	4.10	<0.4966
If you thought a product was too complex, it might discourage you from buying it regardless of the benefits	Early Adopter	13.73	59.80	26.47	
	Early Majority	18.03	62.30	19.67	<0.4014
You would be less likely to buy a product if you hadn't seen it in popular use	Early Adopter	16.67	59.80	23.53	
	Early Majority	19.67	63.93	16.39	<0.3932
You would be more likely to buy a product if you could either try it first or see it working close up?	Early Adopter	47.06	47.06	5.88	
	Early Majority	58.54	40.65	0.81	<0.3943
Knowing a product fits your lifestyle is more important than trying it first	Early Adopter	30.39	50.98	18.63	
	Early Majority	25.20	60.16	14.63	<0.0386

Chapter 6

6. DISCUSSION

The chapter reviews the research outcomes of the study. Each research hypothesis will be discussed based on the outcomes of the results and the relevant linkages to the literature review presented in Chapter two.

6.1. RESEARCH HYPOTHESIS ONE

This section reviews the literature on demographics of the "early adopters" and the "early majority" and discusses the results obtained.

<u>Hypothesis One</u>

"Early adopters" and "early majority" adopters of domestic solar energy systems differ on the basis of demographic measures.

- **"Early adopters" are younger than later adopters.**
- **"Early adopters" have more years of formal education than later adopters.**
- **"Early adopters" have higher social status than later adopters.**

6.1.1. Literature Comparison

In the literature review in Chapter Two the Diffusion of Innovations Theory introduced the consideration that the time element of the diffusion process allows for adopters to be the classified into adopter categories and that the criterion for adopter categorisation is innovativeness i.e. the degree to which an individual is relatively earlier than others in a social systems in adopting new ideas. Rogers (1995) proposed general profiles for each adopter category, based on socio-economic status, personality and communication behavior. This research study only tested the socio-economic characteristics of both "early adopter" and "early majority" profiles for solar power systems in South Africa.

Rogers' (1995) generalisations regarding socioeconomic characteristics tested in this study included:

- "early adopters" are not different from late adopters in age
- "early adopters" have more years of formal education than later adopters, and
- "early adopters" have a higher social status than later adopters (income, level of living).

The results that have been attained indicate a pattern which disproves the hypotheses about socio-economic status based on age, formal education and social status. This would indicate that the categorisation of adopters based on the consumer's demographics is not an accurate measure of innovativeness when evaluating the rate of adoption of solar power systems in South Africa.

An explanation for this finding can be found in the research which has opposed Rogers (1995) adopter profiles in the past. Sultan and Winter (1993) argue that there is an inconsistency in behavior across products; that an "innovator" for one product may be a "laggard" for another, suggesting that innovativeness is a relative phenomenon.

Meanwhile, Garling and Thorgorsen (2001) propose that earlier adopters have developed internal reference prices based on knowledge and competence. The actual cost of the innovation is not represented by the worth to the individuals. These values transcend demographic or socio-economic categorisation. Muller (2009) reiterates the above statement, "It is important to understand the customer's *perceptions* of the economics and not just the economics themselves."

Lacorche et al (2001) found that 'green consumers' are inconclusive and incompatible with the profile of Rogers' adopter categories. Pederson (2000) found that the features of an innovation or the environmental features have greater influence on the adoption decision than an adopter's demographic profile.

6.1.2. Evaluating the sample

The results indicate that “early adopters” were older than “early majority”, the average age of “early adopters” being 47 years old compared to the “early majority” age of 36. Faiers & Neame (2006) found that their “early adopter” category comprised mainly of people who were retired or approaching retirement. Their primary motivation for adoption was focused on financial and environmental considerations aspects and they indicated that they were preparing for the future based on the fact that the electricity prices were rising, leading to a lower disposable income being available for them in the future. They purchased systems with the intention of utilizing the savings benefits these systems offer over the longer term as well as their perception that these systems increase the value of their property for resale purposes.

The “early majority” showed a higher rate of formal education and a higher average monthly household income than the “early adopters”.

An explanation for the “early majority” may be due to the electricity price increases which have started to impact households across South Africa. Middle income domestic consumers which use more than 351kWh per month will be the most affected by the price increases. NERSA approved increases of 24.8% in 2010/2011, 25.8% in 2011/201 and an increase of 25.4% in 2012/213. The electricity expense for households will increase in a higher proportion to other living expenses, not only as a direct expense, but also as an indirect expense as companies selling other goods will pass the increased energy cost on to the consumer.

Both groups were asked to indicate the energy saving measures which had been implemented in their homes and their responses, in Table 3 it can be seen that “early adopters” have a greater propensity to implement energy saving measures than “early majority” adopters. Truffer et al. (2001) identified that solar systems raise a householder’s awareness of energy consumption by means of a monitoring facility provided with the installation. This enhanced awareness of energy use could encourage further energy efficiency. This type of energy efficiency was further explained as using 'megawatts' i.e. units of energy never used, perhaps due to the intervention by an energy efficient product or more efficient behavior arising from changing attitudes towards energy use. The results indicate that the use of energy saving lights, automatic light switching and gas heating were equally used by both groups. This can be explained by the building regulations which require roof insulation as a legal requirement and Eskom's national energy saving light campaign which implored domestic consumers to exchange their incandescent light bulbs for compact florescent lights at their nearest community center.

6.1.3. Overall finding

Overall, it seems that these findings do not support the *Diffusion of Innovations Theory* adopter categorisation, based on demographic profiles of adopters. Rather, the results support literature that identifies inconsistency in behaviour across products, and which suggest that innovativeness is a relative phenomenon.

6.2. RESEARCH HYPOTHESIS TWO

Hypothesis 2

Early adopters and early majority adopters have a positive attitude towards solar systems attributes.

6.2.1. Literature Comparison

The results show that 'adopters' responses to solar system characteristics are a better measure for predicting the rate of adoption than demographics. This is supported by past research conducted by Labay and Kinnear (1981), who discovered that the prediction of adopter membership was more accurately classified from attribute perceptions than from demographics. The study of perceptions has been used in marketing research to form the basis for studying motivations and attitudes (Hsu et al., 2000), and it has been found that perceptions and attitudes can affect consumer behaviour and innovation adoption.

Ostlund (1974) predicted the innovativeness (adoption vs. non-adoption) of individuals on the basis of their perceptions of an innovation's attributes. The relationship between attribute perception and innovative behaviour were generally positive, with the exception of perceived risk and complexity. Adopters of an innovation rated it higher in relative advantage, compatibility, trialability and observability and lower in perceived risk and complexity.

It can be concluded from the above statement, that the adoption of SWH by the "early adopter" must indicate that they had a positive attitude towards SWH attributes when they made their purchase. The results indicated that 'early adopters' had a generally positive attitude towards SWH systems but they had negative attitudes towards four attributes associated with relative advantage and observability. The "early adopter" reflected positive attitudes towards the environmental benefits their overall response was not sufficiently positive to indicated adoption in the near future. Their perceptions of the SWH attributes were in line with the "early adopters, they had negative attitudes towards the same statements as the "early adopters", however they were predominately undecided on to other attributes: The ease of the installation process and the ongoing maintenance of the systems.

Responses were measured in the following way: the choices 'strongly agree' and 'agree' were combined to create the positive attitude and the same process was followed for 'strongly disagree' and 'disagree' to create the negative attitude; then the frequency of responses was calculated for the three levels of attitude - 'positive', 'negative' and 'undecided'. The level of attitude with the highest percentage frequency was considered the overall attitude for the solar system attribute statement.

6.2.2. “Early adopter” discussion

The “early adopters” had an overall positive response to the solar system attributes as can be inferred from the fact that; they rated 12 out of the 16 solar attribute statements positively. These statements were assessed against the innovative attributes defined by Rogers (1995). The results suggest that the “early adopters” perceptions of solar systems attributes met the expectations of the adopters sufficiently in terms of relative advantage, compatibility, complexity and observability at the point of adoption.

The four attribute statements viewed negatively were the low level of subsidy, the higher ongoing maintenance, poor aesthetics and a long recoupment period. However, the ‘early adopters’ seemed equally divided on the length of the payback period. This may be explained by the latest electricity price hikes which are causing the pay-back period to shorten. Luque (2001) suggests that unless electricity prices rise or cheaper solar systems are developed, solar energy will not be competitive with conventionally produced electricity.

The rise in electricity prices in South Africa is helping to shorten the period in which adopters see returns from their systems. The effect of the temporal distance of outcomes on inter-temporal choice (Chapman 1998) explains this phenomenon. Consumers tend to devalue or discount delayed outcomes, they want to obtain positive consequences sooner, while preferring to postpone the negative consequences. The purchase of a SWH system typically yields negative outcomes at the time of purchase, while positive outcomes are delayed and this can cause cognitive dissonance reactions. Consumers are tempted to discount long-term positive outcomes by employing arguments like ‘too expensive’, ‘low subsidy’ and ‘it hardly contributes to the environment’.

The negative statements relate to relative advantage (low subsidy and high payback period), observaibility (poor aesthetics), and complexity (higher going maintenance). When these results are compared to the UK study conducted by Faeirs and Neame (2006), “early adopters” had identified the pay-back period as negative and ‘do not know’ to three characteristics relating to affordability, visual attractiveness and available grants.

In 2008, the number of SWH companies operating in South Africa increased dramatically, from 20 to 200 resulting in a higher deployment of SWH. This indicates that a large portion of these companies are small, medium and micro enterprises (SMME). This was confirmed by Hardie’s (2010) research findings that 73% of South Africa’s SWH suppliers are less than five years old. The “early adopters” perception that SWH required higher maintenance may be due to poor quality products which were installed prior to the SABS standards approval process. This testing requirement is viewed by the suppliers as a restriction on the industry growth because the testing periods can be as long as six months before the necessary approval is received to be eligible to receive the Eskom subsidy (Energy Research Centre, 2010). However, when there are no minimum quality controls related to SWH’s this is considered to be a barrier to consumer adoption, given the lack of standards means quality can be variable, energy savings (and thus pay-back periods) are not guaranteed and more maintenance is required to up-keep the system.

Poorly installed systems would also lead to higher maintenance; this would arise from the lack of skills in an emerging economy. The industry is in its early years of development and the professional skills to install systems have not been mastered over such a short period. Until such time that the necessary skills are developed for efficient and minimal disturbance during the installation process. The higher maintenance may be indicative of a barrier which is hindering further adoption in the South African context.

Past research has found that a long simple payback period, high capital costs and a lack of confidence in the long-term performance of the system is limiting widespread adoption (Timilsina et al., 2000). Knudsen (2002) reported that oversized systems are often installed which adds further expense. This would explain why some adopters feel that the pay-back period is shorter than other adopters. An oversized system will take a long period to payback because of the higher capital outlay.

Despite these four attributes being negative, they are negated by the fact that these individuals have adopted the technology. When “early adopters”’ who had not received a rebate were asked, “What influenced their decision to adopt the SWH?”, 93% of responses indicated that the ‘system made sense on its own’ or ‘I took a long-term view’. This behavior can be related back to the literature which defines “early adopters”, as being change agents; they want to be the first to adopt. They expect radical discontinuity between the old ways and the new was. They are prepared to champion the cause against extended resistance and they are prepared to bear with the inevitable bugs and glitches that accompany any new innovation (Moore, 2002). This result also confirms Rogers’ (1995) generalisation that ‘early adopters are better able to cope with uncertainty than late adopters’.

A further confirmation that the “early adopters” had a positive view towards solar is that 99% of responses indicated that they were ’Pro-solar’.

6.2.3. “Early majority” discussion

“Early majority” results indicate that ten of the 16 statements were positive, 3 were negative and 3 were undecided. The three negative statements matched those of the “early adopters”: a low level of subsidy exists, systems are intrusive and the disadvantage of the long payback period. If the negative percentages are compared to the percentages of the “early adopters” a larger number of undecided responses than positive responses can be discerned.

Two of the attributes rated ‘undecided’ were related to elements of operational elements of the solar systems, such as the installation and maintenance. This can be expected because individuals unfamiliar with the technology will not know how the systems operate on a day-to-day basis. Based on the literature which indicates that compatibility must be viewed positively to encourage adoption, the higher maintenance required impacts compatibility with “early majority” lifestyles in a negative way. If a SWH is seen to be incompatible with the consumers personal priorities it reduces the ‘willingness to pay’ for the technology (Berger, 2001). The “early majority” want to buy a productivity improvement for the existing operations. They are looking to minimise the discontinuity with the old ways. They want evolution not revolution. They want technology to enhance, not overthrow the established way of doing things. They do not want to debug someone else’s product. By the time they adopt it, they want it to work properly and to integrate appropriately with the existing technology base (Moore, 2002).

Kaplan (1999) showed that the adoption of renewable energy systems often requires extensive research and deliberation by the householder, and therefore, marketing activities that increase the awareness through customer education programmes, marketing material and information about processes involved - including disruption that may occur during the installation process and going maintenance requirement, are beneficial.

The complexity of installation process was viewed as undecided which Ostlund (1974) finding that consumers perceptions of an innovation attributes are positive, with the exception of perceived risk and complexity. This finding may not necessarily indicate a true barrier to adoption.

While the results confirm that “early adopters” agree that solar systems provide relative advantage in generating clean electricity a consideration identified by Luque (2001), it’s compatible with existing electrical installation as identified by Knudsen (2002), the operational choice with the existing presents a very complex choice (Jager, 2005). Different providers offer a variety of size, price and returns and solar systems cannot be trialed (Labay & Kinnear, 1981) and the final choice has to be made without the opportunity to test the system. Therefore, information has to be collected on the purchasers home suitability to mount the system, involves analysis of construction. This requires a level of knowledge most consumers do not posses and which is hard to acquire in the short term. The model of reasoned action explains that a lack of technical expertise constitutes a barrier reducing a consumers control over behavior, often consultation with an expert is required to overcome this barrier (Azjen, 1975).

A suggestion to the high upfront costs may be solved by innovative financing methods and the improved communication of the savings consumers will make on their systems. Consumers want to know the potential savings the system will provide on a monthly basis and how they can work them out each month, they want to feel empowered their system is working at full potential and they are getting the benefit from the investment. This is confirmed in the literature that hhouseholders need information such as descriptions of the technology, methods of operation and their overall performance with regards to energy savings and environmental benefits (Berger, 2001; Vollink et al, 2002). The energy savings are the greatest need in the South African context and hence should be considered as an important fact to clearly convey.

The third attribute which was viewed as 'undecided' was the affordability of the technology. This links back to the negative perceptions of solar technologies discussed in the literature review and the need to reduce the high upfront costs to promote increased adoption. Cabraal et al. (1998) proposes that quality service, products and support should help overcome the high initial costs.

6.2.4. Overall finding

It is clear from the literature that the "early majority" must have a positive attitude towards solar to encourage adoption. The results indicate that "early majority" consumers have a positive attitude towards some of the characteristics of solar but do not have a sufficiently positive perspective of solar systems against the 'innovation attributes' in order for them to pass along the innovation decision making process. There is negativity towards relative advantage (economics: pay-back, affordability, level of subsidy), compatibility (higher maintenance), complexity (ease of installation) and observability (poor aesthetics). Suppliers in the industry should consider ways to address these barriers to adoption, especially the negativity expressed by the 'early adopters' towards the long pay-back period, low level of subsidy, poor aesthetics and higher maintenance. If the "early adopters" are communicating these messages to the next adopter category, these characteristics - if not corrected - will remain a serious hindrance to adoption in a long term way.

6.3. RESEARCH HYPOTHESIS THREE

Hypothesis 3

A 'chasm' exists between early adopters and early majority adopter which is affecting the rate of diffusion of solar systems within South Africa.

6.3.1. Literature Comparison

The literature on the technology adoption cycle proposes that there is a chasm when moving along the adoption curve from "early adopters" to the "early majority". It suggests that the lack of diffusion of high technology products, such as solar systems, is due to SWH suppliers' inability to transition their marketing strategies effectively from the "early adopters" to the "early majority" target market. Even though it appears to be more challenging to satisfy the "early majority", they are vital for sustained success of the innovation as they number three times more than the innovative category (Rogers, 1995).

Each group represents a unique psychographic profile – a combination of psychology and demographics that makes its marketing response different to that of the other group. Understanding each profile and its relationship to its neighbours is a critical component because there is dissociation between the two groups. The reason this difference exists is that the "early adopter" is a change agent; they are prepared to bear with the inevitable bugs and glitches that accompany any new innovation. The "early majority" want to buy a productivity improvement, by the time they adopt it, they want it to work seamlessly and to integrate appropriately with the existing technology base. This hypothesis will test what differences in perceptions exist between the two adopter categories which may be causing a 'chasm' to exist (Moore, 2002).

The statistical results from the Chi-square test show that there were 11 SWH characteristics, which can be clearly seen in Table 9, these differences in attitudes (Chi-square showed a significance of < 5%) between "early adopter" and "early majority" which are indicating that specific characteristics in solar which are inhibiting the adoption of solar systems in the "early majority".

The results of the survey show that the "early majority" perceive to a <u>greater extent than</u> the early majority - that:

- it takes a long time to recoup the financial benefits from the solar system

The "early majority" also require further convincing that:

- there is a significant level of subsidy available,
- solar systems are less or equal maintenance when compared to their current electric geyser,
- they are not visually intrusive,
- they are affordable, and that
- the installation process is simple, with minimal disruption.

The most contrary findings from this study were that the "early adopters" perceived the following more negatively than the "early majority":

- there was a low level of subsidy available for solar systems, and
- solar systems are intrusive and this can affect the aesthetics of their home.

"Early adopters" adoption of solar systems, despite their negativity towards the visual unattractiveness of solar systems can possibly be explained by Moore's (2002) identification of adopter categories of "innovators" and "early adopters". These people are committed to the concept of innovation, and will put up with inconvenience factors to do with product complexity or the lack of performance because they are focused on the long-term benefits the innovations have to offer. Rogers (1995) proposes that "early adopters" have a greater knowledge about technology; this could indicate that "early adopters" are aware of the level of grants available in other countries in the world and they think that the subsidy offered in South Africa is unacceptable in comparison.

The width of the 'chasm' becomes smaller if the innovation attributes are sufficiently developed to appear more attractive to the more pragmatic "early majority". Manufacturers have to develop products with the "early adopters" to make them more reliable and productive (Moore, 2002). Pragmatic "early majority" adopters will find innovations attractive when they originate from an established manufacturer have a recognisable quality and fit with the supporting infrastructure of products and systems. "Early majority" care more about the quality and reliability of services they receive from suppliers.
Rogers (1995) defines the "early adopter" as a person the potential adopters look to for advice and information on an innovation. This person is considered as a role model for other members in a social system because they are not too far ahead of the "early majority". The "early adopter" decreases uncertainty about a new idea by adopting it and then conveying a subjective evaluation of the innovation to near-peers through personal communication.

However, there is a contrasting view that there are vast differences between the two categories of adopters that 'early adopters' do not make good reference for the "early majority" (Moore, 2002).

The results from this study indicate that "early adopters" have slightly more negative views towards solar system attributes and they are not good agents for diffusion of solar systems in South Africa.

Moore (2002) identified a 'chasm' between the "early adopter" and "early majority" categories. He explains that the chasm typically goes unrecognised because the two customer lists and the size of the order can look the same, however the difference lies in what has been promised and what must be delivered. The "early adopter" is a change agent and wants to be the first to adopt. "Early adopters" expect radical discontinuity between the old ways and the new ones. They are prepared to champion the cause against extended resistance and they are prepared to bear with the inevitable bugs and glitches that accompany any new innovation.

The "early majority" want to buy a productivity improvement for existing operations. They are looking to minimise discontinuity with old ways. They want evolution not revolution. They want technology to enhance, not to overthrow, the established way of doing things. They do not want to debug someone else's product. By the time they adopt the technology, they want it to work properly and to integrate appropriately with the existing technology base.

Moore (2002) believes that the only way for technology vendors to move forward is to target a niche market that suffers from a nasty problem ("pragmatists in pain") for which the technology is the sole solution. To cross the "chasm", Moore suggests that the company focus on a total solution for a problem built around the needs of a niche market. Moore calls this total solution a 'whole product' – and defines this as the minimum set of products and services necessary to ensure that the target customer will achieve his or her compelling reason to buy.

An interesting phenomenon was identified in the "early adopter" results. A cross-comparison was done with the time frame within which the adopter had adopted the technology and the length of time they knew someone with a solar system. It was found that 65% of responses indicated that they had known someone with a system for between 5 and 15 years, although they had only adopted less than five years ago. This is a confirmation of the slow rate of adoption in South Africa.

The literature explains that the purchase of a solar system is a high-involvement decision people usually make once in their lifetime. These high involvement decisions require people to invest cognitive effort in the decision making process (Tversky,1972). People are unlikely to have all the relevant information on hand to deal with the complexity of the decision and the decision process may take considerable time and effort. Jager (2006) proposes that reducing the complexity of the decision making and the time discounting of the decision-problem would stimulate consumers to install a solar system.

6.3.2. Overall finding

The difference in perception between householders who have installed solar systems and those who have not adopted as yet is suggested to constitute the adoption ‘chasm’. The “early majority” are unlikely to adopt solar systems if the following considerations are not addressed: the long pay-back period, the low subsidies, the poor aesthetics, the higher maintenance and the process around the installation. The “early adopters” have a negative view towards similar solar attributes and they are considered inappropriate influences for the “early majority” because they are willing to accept functional flaws in the products whereas a ‘pragmatist’ requires the product to function perfectly before they adopt.

It is suggested that solar suppliers and installers should focus on a niche market that suffers from a nasty problem (“pragmatists in pain”) for which the technology is the sole solution. To cross the ‘chasm’, Moore suggests that a supplier should focus on a total solution for a need identified within a niche market. Moore calls this total solution a “whole product” – and defines this as the minimum set of products and services necessary to ensure that the target customer will achieve his or her compelling reason to buy.

Chapter 7

7. CONCLUSION

This research has identified differing points of view in the literature regarding the diffusion of innovations: one that shows that the rate of adoption will follow a bell curve over time and the other indicates gaps in the bell curve, gaps where a technology can be lost and never successfully diffuse through the market. These contrasting pints of view makes it confusing for solar suppliers and policy makers to discern what is hindering consumers from adopting solar systems and what can be done to gain a higher rate of diffusion through the South African market.

Reference has also been made to the complexity of the decision making process involved when considering adopting a solar system and the hindrance that this can be for consumers to commit to a purchase.

The academic contribution of this research stems from having highlighted what consumers perceptions are towards solar systems in the South African context and in the process, have reviewed the slow rate of diffusion in a new light explained by the technology adoption theory. This is an innovative contribution because most previous research in South Africa has focused on dual aspects of policy and the barriers suppliers face as the main limitations to growth of the industry.

It is thought-provoking that “innovators” and “early adopters” who have a wealth of knowledge and understand the relative advantages of a product believe that if the economics work, then the whole market will see the benefits above the costs - and there will be widespread diffusion. However, it is important to understand the customer’s perception of the product adoption and not to view the product economics in isolation. Through this research study, consumer’s perceptions were taken into consideration and tested statistically from the data obtained.

Two independent variables were used to measure the effects of consumer's perceptions on their willingness to adopt an innovation (the dependant variable). Demographics was the first variable used to identify whether or not these perceptions impact on the 'category of adopters' to which the respondent belonged as well as their impact on the willingness of the adopter to adopt the innovation. It was concluded that the respondent's attitude towards solar systems (the second independent variable) was a more reliable reflection for identifying adopter categories.

The statistical significance test conducted on respondents' perceptions established that there are six solar system characteristics which were viewed as possible hindrances for future adoption. These are the long payback period, the low level of subsidy, the poor aesthetics, the higher maintenance required, the low affordability of the technology and the complexity of the installation. The literature suggests that the publics' low level of awareness about environmental issues and the benefits solar systems have to offer, have had a negative impact on the demand for the technology. However, the results show that consumers have a significantly positive perception of the benefits solar systems can offer from an environmental and a cost saving perspective.

The study revealed that there is a "chasm" which exists between the "early adopters" and the "early majority" due to the difference in their perceptions of solar system attributes. The literature suggests that solar suppliers and installers should focus on a niche market that suffers from a nasty problem i.e. "pragmatists in pain" for whom the technology is the sole solution. To cross the 'chasm', Moore (2002) suggests that the company focus on a total solution for a problem and that this solution should be constructed around the needs of a niche market. As of February 2010, there were a total of 136 different systems on offer and solar suppliers predominately sold to the middle to upper-income residential market as well as the commercial sector. The main media channel for marketing has been and is the internet. There does not seem to be an industry leader or any differentiation amongst competitors.

Solar suppliers need to offer an innovative solution, a combined product and service offering, which will be sustainable over the long term. The long-term objective of government in offering tax incentives is to develop a renewable energy marketplace and not to create an industry which is strongly dependent upon tax incentives and government subsidies to survive.

7.1. LIMITATIONS FROM THE RESEARCH AND SUGGESTIONS FOR FURTHER STUDY

One of the limitations that that emerged during this research was respondent bias. This bias went deeper than self-selection bias by adopter because some of the 'early adopters' were in the solar water heater industry and they may have had their own agenda for choosing to respond to the questionnaires. Add to this response bias is the circumstance that the age of the 'early majority' respondents were skewed by the age of the researchers contact base within the solar industry and also, which solar suppliers were willing to contact clients directly to invite them to participate in the survey.

Another possible limiting factor is that the respondents data received for 'early majority' monthly household income were skewed to the higher income brackets and there was an insufficient number of responses in the lower household income categories to conduct meaningful statistical analysis. This may have influenced the results due to this group not being truly representational of possible respondents from other income groups. It would have been an interesting comparison to discover whether the findings would have been similar for lower revenue generating households.

This study was undertaken in a very different context to previous studies in developed countries such as The United Kingdom and the Unites States of America. This study was done in a South African environment during a time when the world coming out of a global recession. This context means that the global recession may have played a part in influencing the findings i.e. the disposable household income available to purchase solar systems and the availability of credit facilities may have been influenced by this recession.

This study briefly touched on the advertising medium that 'early adopters' use to research solar systems, a comparison between how solar suppliers currently advertise and what seems to spark consumers' interest to do further research into solar products, may provided insights into structuring future marketing activities.

An area for future research would be to identify the level of understanding consumers have about the differences between solar water heaters and solar photovoltaic systems in South Africa.

7.2. SUMMARY

It is important to realise that adoption of solar plays a huge role in reducing the demand on the grid, increasing the disposable income available to households, creating jobs in the development of a new market and uplifting communities economically. For reasons like these, in South African where the price of electricity is rising and there are capacity constraints on supply of electricity and where the unemployment rate is high - it is vital that installation of solar systems should be encouraged and supported at all levels.

In this context, it is vital that suppliers identify niche markets to target in order to create an ever-increasing demand for solar systems. There needs to be a move away from the over-reliance on website advertising to the mass-market and suppliers need to differentiate their service offering from competitors. The next adopter category is looking to buy from an established supplier, which has a recognisable quality product and reliable service. The "early majority" adopters want to buy a productivity improvement which will not overthrow the established way of doing things. By the time they adopt it, they want it to work properly and to integrate appropriately with the existing infrastructure. This point speaks to barriers identified around both the uncertainty of the level of maintenance required and the ease of the installation process.

This research has revealed that the right service offering can reduce the consumers' focus on the high initial outlay. This indicates the necessity for suppliers to look into new ways to adapt their products and services to correct barriers revealed through this research. For instance both adopter groups indicated that they save for a product purchase over R10, 000 which could indicate that people are saving up and waiting for a supplier to stand out from the crowd. The next group of consumers wants an established and reliable supplier that would give them excellent service. Suppliers can only do this if they have a set of products and services which are designed to offer a solution to a particular problem for a particular group of people.

The key to influencing South African consumer attitudes towards domestic solar power systems in the future will be differentiation.

References

Alba, J., & Hutchinson, J.W. (1978). Dimensions of consumer expertise. *Journal of Consumer Research*, 13,411-454.

Albright, S.C., Winston, W.L & Zappe, C. (2006). *Data analysis & decision making with Microsoft Excel.* (3rd ed.). Ohio, United States: Thomson South Western.

Afrane-Okese, Y. (2009, November). Development of the South African National Solar Water Heating Strategy and Implementation Plan. In E.Thabethe (Chair), *The national solar water heating conference.* Symposium conducted at the meeting of the Department of Energy, Johannesburg.

Ajzen, I. (1991). The theory of planned behaviour. Organisational Behavior and Human Decision Process, 50, 179-211.

Austin, G and Morris, G. (2005). *The status of solar water heating for domestic hot water supply in the low-income sector in South Africa*. Agama Energy. Stellenbosch.

Bass, F.M. (1994). The evolution of a general theory of diffusion of technological innovations. The University of Texas, Dallas.

Berger, W. (2001). Catalysts for the Diffusion of Photovoltaics – A review of selected programmes. *Progress in Photovoltaics: research and applications,* 9, 145-160.

BRECSU (2001). Solar hot water systems in new housing: A monitoring report. Energy efficiency Best Practice General Information Report 88. BRESCU Watford UK.]

Boardman, B. (2004) New directions for household energy efficiency: Evidence from the UK. *Journal of Energy Policy,* 32, 1921-1933. Retrieved from http://www.sciencedirect.com.

Book, T. (1999). Marketing and selling solar energy equipment. *Renewable Energy, 16*, 800-804. Retrieved from http://www.sciencedirect.com.

Brown, L. (1981). *Innovation diffusion: A new perspective.* [DX Reader version]. Retrieved from http://books.google.co.za/books?hl=en&lr=&id=A_kNAAAAQAAJ&oi=fnd&pg=PR11&dq=%22Lawrence+Brown%22+%2B%221981%22&ots=7aBfm-n73b&sig=zApjKX67Nst0nOyQWZLBucBllxQ#v=onepage&q&f=false

Brown, S.L. & Eisenhardt, K.M. (1995). Product development: past research, present findings and future directions. *Academy of Management Review*, 20(2), 343-378.

Cabraal, A., Cosgrove-Davies, I., & Schaeffer, L. (1998). Accelerating Sustainable Photovoltaic Market Development. *Progress in Photovoltaics: research and Applications,* 6,297-306

Chalmers, R. (2006, March 7). Remote Roots of the Power Shock. *The Business Day.* Retrieved from http://www.businessday.co.za/ Accessed 07/02/2011.

Chapman, G.B. (1998) Sooner or later: The psychology of inter-temporal choice. The Psychology of Learning and Motivation, 38, 83-113.

Christensen, C.M. (1997). *The Innovators Dilemma*. Boston: Harvard Business School Press.

Covary, T. (2010). Renewable Energy: Benefits of converting urban households to solar water heating. (Master's thesis). University of Pretoria, South Africa.

Department of Minerals and Energy (DME). (2003). *White Paper on Renewable Energy.* Retrieved from http://unfccc.int/files/meetings/seminar/application/pdf/sem_sup1_south_africa.pdf

Department of Minerals and Energy. (2008 a). *National Energy Efficiency Strategy of the Republic of South Africa* (Government Gazette No.32342 3 General Notice. (Notice 908 of 2009). Retrieved from http://www.info.gov.za/view/DownloadFileAction?id=103164

Department of Minerals and Energy. (2008 b). *National response to South Africa's electricity shortage: Interventions to address electricity shortages.* Retrieved from http://www.info.gov.za/otherdocs/2008/nationalresponse_sa_electricity1.pdf

Department of Minerals and Energy (2009). The National Solar Water Heating Workshop: A Programme for Action (Executive summary).

Diamantopoulous, A., Schlegelmich, B.B., Sinkovics, R.R., & Bohlen, G.M. (2003). Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. *Journal of Business Research, 56, 465 -480*. doi: 10.1016/S0148-2963(01)00241-7

Eskom (2009, February). Solar Water Heating Rebate Programme. (Presentation by Cedric Worthmann, Eskom Renewable Portfolio Manager, at The National Solar Water Heating Workshop.

Eskom (2010). Eskom increases rebates as part of an improved solar water heating programme.(Media Release).{online). Retrieved from http://www.eskomdsm.co.za/sites/default/files/u1/rebates_increased_media_release_11_Jan_2010_pdf. Accessed 20 July 2011.

Faiers, A., & Neame, C. (2006). Consumer attitudes towards domestic solar systems. *Energy Policy,* 34, p.1979 – 1806. doi.10.1016/j.enpol.2005.01.001.

Fillippini, M. (1999). Swiss residential demand for electricity. *Applied Economics Letter*, 6(8), 533.

Fishbein, M., & Azjen, I. (1975). *Belief, attitude, intention and behaviour: An introduction to theory and research*. USA: Addison-Wesley.

Foxall, G.R. & Goldsmith, R.E. (1994) *Consumer Psychology for Marketing*. New York: Routledge.

Ferreira, E., Strydom, J., & Nieuwenhuizen, C. (2010). The process of business assistance to small and medium enterprises in South Africa: Preliminary Findings. *Journal of Contemporary Management*, 7, 94-109.

Garling, A. & Thorgorsen, J. (2001). Marketing electric vehicles. *Business strategy and the environment, 10, 56-65.* Retrieved from http://0-atoz.ebsco.com.innopac.up.ac.za

Hardie, M. (2010). *Developing SA's solar water heater industry: Identifying key success factors for future growth* (Master's thesis). University of Stellenbosch, South Africa.

Holm, D. (2005). Market survey of solar water heating in South Afriuca for the Energy Development Corporation (EDC) of the Central Energy Fund (CEF). Johannesburg: Central Energy Fund.

Hsu, S.U., Chaung, M.C., & Chang, C.C. (2000). A semantic differential study of designers' and product users' product form perceptions. *International Journal of Industrial Ergonomics, 25, 375-391.* Retrieved from: www.elsevier.nl/locate/ergon.

Jager, W. (2006). Stimulating the diffusion of photovoltaic systems: A behavioural perspective. *Energy Policy, 34, 1935-1943.* doi:10.1016/j.enpol.2004.1.022.

Kilborne, W.E., & Beckman, S.C. (1998).Review and critical assessment of research on marketing and the environment. *Journal of Marketing Management,* 14,613.

Knudesn, S. (2002). Consumers influence on the thermal performance of small SDWH systems – theoretical investigations*. Solar Energy, 73(1), 33-42).* Retrieved from

Krueger, D. (2009). A background to major power usage areas. *Energy Efficiency Made Simple, 2, 6-9.*

Labay, G.D., & Kinnear, T.C. (1981). Exploring the consumer decision process in the adoption of solar energy systems. *Journal of Consumer Research*, 8, p.271 – 278. Retrieved from http://0-web.ebscohost.com.innopac.up.ac.za/

Laroche, M., Gelb, B., & Barbaro-Ferleo, G. (2001). Targeting customer who want are willing to pay more for environmentally friendly products. Journal of Consumer Marketing, 18 (1), 503-520. Retrieved from: http://0-search.proquest.com.innopac.up.ac.za.

Luque, A. (2001). PV market and cost forecast based on a demand elasticity model: Progress in PV's. Research and Application, 9, 303-312. Retrieved from: http://0-web.ebscohost.com.innopac.up.ac.za/

Maslow, A.H. (1954). *Motivation and Personality*. New York, USA : Harper and Row.

Max-Neef, M. (1992). *Development and human needs*. New York: Routledge.

Menanteau, P. (2007). *Policy measures to support solar water heating: Information, incentives and regulations*. LEPII/CNRS – Universite de Grenoble.

Moore, G.A. (2002). Crossing the Chasm. (Rev ed.). New York: HarperCollins Publishers.

Muller, D. (2009). *Selling Solar: The diffusion of renewable energy in emerging markets*. London, Sterling VA: Earthscan.

Norton, J. A., & Bass, F.M. (1987). A diffusion theory model of adoption and substitution for successive generations of high-technology products. *Management Science*, 3(9), 1069 – 1086.

Nortje, T. (2005, June). South Africa's DSM Programme: A saving opportunity. *International Pump User Conference.* Symposium conducted at the meeting of the Eskom DSM, Johannesburg.

Ostlund, L. E. (1974). Perceived innovation attributes as predictors of innovativeness. *Journal of Consumer Research,* 1(2), p. 23-29. Retrieved from *http://0-web.ebscohost.com.innopac.up.ac.za/ehost/*

Pedersen, L.H. (2000) The Dynamics of Green Consumption: A matter of Visibility? *Journal of Environmental Policy and Planning ,2, 193-210.*

Robson, C. (2002). *Real world research.* (2nd ed.). Oxford: Blackwell

Rochford, L. (1991). Generating and screening new product ideas. *Industrial Marketing Management*, 20,287.

Rogers, E.M. (1995). *Diffusion of innovations*. (4th ed.). New York: The Free Press

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students.* (5th ed.). England: Person Education Limited.

South African Government (2009). Draft Clean Technology Fund Investments Plan for South Africa – October 2009.(Review Draft).

Statistics South Africa (2006). Energy Accounts for South Africa 2002-2006. National Accounts – Environmental Economic Accounts. Retrieved from: http://www.satssa.gov.za/PulicationsHTML/D04051.12006/html/D04051.12006_28.html. Accessed 20 July 2011.

Statistics South Africa (2010). *Millennium Development Goals.* Retrieved from http://www.statssa.gov.za/news_archive/Docs/MDGR_2010.pdf

Sultan, F., & Winter, R. (1993) Time preferences for products and attributes and the adoption of technology-driven consumer durable innovations. *Journal of Economic Psychology, 14, 587-613.*

Timilsina, R., Lefevre, T., & Shrestha, S. (2000). Financing solar thermal technologies under DSM programs; an innovative approach to promote renewable energy. *International Journal of Energy Research,* 24,503-510. Retrieved from: http://www.sciencedirect.com.

Truffer, B., Makard, J., & Wüstenhagen, R. (2001). Eco-labelling of electricity-strategies and tradeoffs in the definition of environmental standards. *Energy Policy,* 29, 885-897. Retrieved from: http://www.sciencedirect.com.

Tversky, A. (1972). Elimination by aspects: a theory of choice. *Psychological Review, 79, 281-299.*

Van Kleef, E., Trjip, H.C.M., & Luning, P. (2005). Consumer research in the early stages of new product development: A critical review of methods and techniques. *Food Quality and Preference,* 16,181-201. doi:10.1016/j.foodqual.2004.05.012

Velayudhan S.K. (2003) Dissemination of Solar Photovoltaics: a study on the government programme to promote solar lantern in India. Energy Policy, 31(14),1509-1518. Retrieved from http://www.sciencedirect.com.

Vollink, T., Meertens, R., & Midden, C.J.H. (2002). Innovating diffusion of dnnovations theory: Innovation characteristics and the intention of utility companies to adopt energy conservation interventions. *Journal of Environmental Psychology,* 22, 333-344.

Zikmund, W. G (2003) *Business Research Methods.* (7TH ed.). Ohio: Thomson South Western.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Denkleiers • Leading Minds • Dikgopolo tša Dihlalefi

Appendix A

"Early adopters" Questionnaire

1. Solar System Questionaire

INTRODUCTION

Thank you for agreeing to participate in this survey, which should take about 10 minutes to complete. I am an MBA student at the University of Pretoria's Gordon Institute of Business Science (GIBS) and this research project is a requirement for the successful completion of the programme.

The aim of the survey is to collect information about the perceptions and attitudes of solar system characteristics amongst energy conscious South Africans. Solar systems refer to solar geysers which provide water heating and solar photovoltaic (panel) systems which provide electricity, both systems generate energy from the sun.

INFORMED CONSENT

Your participation in this survey is voluntary and you may withdraw at any time. By completing the survey you indicate that you voluntarily participate in this research. All data collected during this research will be kept strictly confidential and participants will remain anonymous. Any contact details obtained during the study will be kept confidential and not solicited to solar suppliers. You may seek clarification or access to a summary of the results by requesting them from me or my research supervisor on the details provided below.

Researcher: Sian Adams
Email: sian@thepowercompany.co.za
Cell: 079 696 3218

Supervisor: Dr Zoe Lees
Email: zoe.lees@mweb.co.za
Cell: 082 601 1155

The results of this thesis will be published by GIBS

2. Solar Adoption

1. Have you installed a solar system ?

- ◯ Yes
- ◯ No - I have never thought about it
- ◯ No - I am thinking about it
- ◯ No - I thought about it and decided against it

3. Your solar experience

2. What type of solar system have you installed?

- ☐ Solar water heater
- ☐ Solar photovoltaic system
- ☐ Both

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Denkleiers • Leading Minds • Dikgopolo tša Dihlalefi

3. Why did you install your solar system?

- [ ] To save costs
- [ ] To have a reliable power source
- [ ] To be independent from the national grid
- [ ] To save the environment
- [ ] To add value to my property

Other (please specify)

4. What influenced your choice when purchasing your solar system?

- [ ] It's trendy
- [ ] The marketing campaign
- [ ] A trade show
- [ ] My latest electricity bill
- [ ] None of the above

5. Who influenced your choice when purchasing your solar system?

- [ ] Family
- [ ] Friends
- [ ] Suppliers
- [ ] None of the above

Other (please specify)

6. How long have you had your current solar system?

	Solar Water Heater	Solar Photovoltaic System
Please select a year in both boxes		

7. What size solar system did you install?

	Solar Water Heater	Solar Photovoltaic
Please click on the arrows and select a size		

8. Have your noticed a difference in your electricity usage, since installing your solar system?

- ◯ Yes
- ◯ No

9. What has been the approximate savings in rands per month?

	Approx. Monthly Savings
Please click on the arrow and select an option	

10. What has been the approximate usage reduction per day?

Approx. kWh's per day

Please click on the arrow and select an option

11. How long do you expect the solar collector to last?

Years

Please click on the arrow and select an option

12. When your solar geyser fails, who pays for it?

- [ ] Insurance (less excess)
- [ ] Myself
- [ ] Landlord

Other (please specify)

13. At the time of your purchase was a rebate available for your solar geyser ?

- ( ) Yes
- ( ) No

4. Solar Water Heater Rebate

14. If there was a rebate when you bought your solar geyser, did it ?

- [ ] Speed up your decision
- [ ] Make the decision possible
- [ ] Not influence the decision

5. Solar Water Heater Rebate

15. If there was no rebate when you bought your solar geyser, did your decision ?

- [ ] Make sense on its own
- [ ] Make you take a longer term view
- [ ] Occur because your geyser had burst

Other (please specify)

6. Solar Adoption

16. Are you expecting to replace your electric geyser soon?

- ( ) Yes
- ( ) No

17. Would you invest in a solar system if you received a tax break of R 5,000 once off?

- ◯ Yes
- ◯ No
- ◯ I would consider it

18. Would you invest in a solar system if your received a tax break R 5,000 split over 5 years?

- ◯ Yes
- ◯ No
- ◯ I would consider it

19. What is the longest you have know anyone to have a solar geyser?

	Years
Please click on the arrow and select an option	

20. Did you know you can retrofit some geysers with a solar collector and pump?

- ◯ Yes
- ◯ No

7. PART 1 Demographics

Please tell us about yourself

21. What is your gender?

- ◯ Male
- ◯ Female

22. In what year were you born?

	Year
Please select the year in which you were born	

23. What is the highest level of education you have completed?

- ◯ Primary School
- ◯ Matric
- ◯ Artisan certificate
- ◯ Diploma or short courses
- ◯ University degree
- ◯ Post graduate degree
- ◯ Other

24. Does you house have any of the following: (you can tick more than one option)

- [ ] Roof insulation
- [ ] Energy saving light bulbs (CFL LED lights)
- [ ] Geyser blanket
- [ ] Water saving taps and shower heads
- [ ] Gas heating
- [ ] Gas stove
- [ ] Recycling
- [ ] Automatic light switches

25. Before you installed your solar system, what did your house already have in place: (you can tick more than one option)

- [ ] Roof insulation
- [ ] Energy saving light bulbs (CFL LED lights)
- [ ] Geyser blanket
- [ ] Water saving taps and shower heads
- [ ] Gas heating
- [ ] Gas stove
- [ ] Recycling
- [ ] Automatic light switches

26. Please indicate the category which best describes your monthly household income?

- ◯ R 5,000 to R 9,999
- ◯ R 10,000 to R 15,999
- ◯ R 16,000 to R 24,999
- ◯ R 25,000 to R 29,999
- ◯ R 30,000 to R 39,999
- ◯ R 40,000 to R 49,999
- ◯ R 50,000 +

8. PART 2 Using solar power in your home

Below are a number of statements that could describe solar energy use in the home.

For each phrase, please click on the box that best describes your feelings towards the statements

27. It takes a long period to recoup the financial benefits

	Stongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

28. There is a low level of subsidy avaliable for solar geysers

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Please choose:	◯	◯	◯	◯	◯

29. Solar systems help to reduce pollution in the environment

	Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

30. Solar systems generate savings

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Please choose	◯	◯	◯	◯	◯

31. Solar systems require the same amount of maintenance as an electric geyser or grid-power source?

	Strongly Agree	Agree	Undecided	Disagree	Stongly Disagree
Please choose:	◯	◯	◯	◯	◯

32. Solar systems are intrusive and affect the aesthetics of your home

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

33. Solar systems are value for money

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

34. Solar systems are an affordable technology

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

35. Solar provides a reliable source of power

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

36. Solar could develop in the future

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

37. Solar systems add value to a property

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

38. Solar systems reduce carbon emissions

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose	◯	◯	◯	◯	◯

39. Solar systems provide a visual statement of beliefs

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

40. Solar systems are easy to install

	Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

41. Solar systems are a safe form of power generation.

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

42. Solar power is compatible with modern living.

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose	◯	◯	◯	◯	◯

9. PART 3 Purchasing behaviour

43. Do you lead the way in technology amongst your friends (Are you an innovator)?

◯ Yes
◯ No
◯ Don't know

44. Do you think you influence others with your behaviour ?

◯ Yes
◯ No
◯ Don't know

45. When you buy a product for more than R10,000 do you ?

◯ Require financing
◯ Pay from an access bond
◯ Save for it and buy it cash

Other (please specify)

46. When you buy a product for more than R10,000 do you ?

◯ Do extensive research yourself
◯ Do a quick internet search
◯ Ask a friend or family members advice
◯ Request quotes and judge by the salesperson

Other (please specify)

47. When you buy a product :

	Always	Sometimes	Never
Do you consider the advantages and benefits of a product to be the most important factor in the decision to buy one.	◯	◯	◯
Do you only purchase a product if it works with what you already own	◯	◯	◯
If you thought a product was too complex, it might discourage you from buying one regardless of the benefits it has.	◯	◯	◯
You would be less likely to buy a product if you hadn't seen it in popular use.	◯	◯	◯
You would be more likely to buy a product if you could either try it first or see it working close up.	◯	◯	◯
Knowing a product fits with your lifestyle is more important than trying it first.	◯	◯	◯

48. Do you regard yourself as Pro -solar ?

◯ Actively

◯ If Asked

◯ Neutral

◯ Not at all

10. THANK YOU

I would like to take this opportunity to thank you for your time and input.

If you would like to see a summary of this survey, please submit your email address and we will send you the link when we have analysed the survey.

49. Please type your email address in the box provided:

50. SESSA would like to do a geographical mapping of all respondents in the near future.
If you would like to be included in this process, please type in your email address in the box provided below.

Appendix B

"Early majority" Questionnaire

1. Solar System Questionaire

INTRODUCTION

Thank you for agreeing to participate in this survey, which should take about 10 minutes to complete. I am an MBA student at the University of Pretoria's Gordon Institute of Business Science (GIBS) and this research project is a requirement for the successful completon of the programme.

The aim of the survey is to collect information about the perceptions and attitudes of solar system characteristics amongst energy conscious South Africans.Solar systems refer to solar geysers which provide water heating and solar photovoltaic (panel) systems which provide electricity, both systems generate energy from the sun.

INFORMED CONSENT

Your participation in this survey is voluntary and you may withdraw at any time. By completing the survey you indicate that you voluntarily participate in this research. All data collected during this research will be kept strictly confidential and participants will remain anonymous. Any contact details obtained during the study will be kept confidential and not solicited to solar suppliers. You may seek clarification or access to a summary of the results by requesting them from me or my research supervisor on the details provided below.

Researcher: Sian Adams
Email: sian@thepowercompany.co.za
Cell:079 696 3218

Supervisor: Dr Zoe Lees
Email: zoe.lees@mweb.co.za
Cell: 082 601 1155

The results of this thesis will be published by GIBS

2. Solar Adoption

1. Have you installed a solar geyser or solar photovoltaic system?

- ◯ Yes
- ◯ No

3. Solar Installation

1. Why did you install your solar system?

- ☐ To save costs
- ☐ To have a reliable power source
- ☐ To be independent from the national grid
- ☐ To save the environment
- ☐ To add value to my property

Other (please specify)

4. Solar Adoption

1. Why have you not installed a solar system?

- [ ] The initial cost is expensive
- [ ] I have a back-up generator
- [ ] I have a mainline gas supply
- [ ] My housing complex does not allow solar systems due to the aesthetics
- [ ] I have no need to change

Other (please specify)

5. PART 1 Demographics

Please tell us about yourself

1. What is your gender?

- ◯ Male
- ◯ Female

2. How old are you?

Age (in years)

3. What is the highest level of education you have completed?

- ◯ Primary School
- ◯ Matric
- ◯ Artisan certificate
- ◯ Diploma or short courses
- ◯ University degree
- ◯ Post graduate degree
- ◯ Other

4. Does you house have any of the following: (you can tick more than one option)

- [ ] Roof insulation
- [ ] Energy saving light bulbs (CFL,LED lights)
- [ ] Geyser blanket
- [ ] Water saving taps and shower heads
- [ ] Gas heating
- [ ] Gas stove
- [ ] Recycling
- [ ] Automatic light switches

5. Please indicate the category which best describes your monthly household income?

- ◯ R 0 to R 4,999
- ◯ R 5,000 to R 9,999
- ◯ R 10,000 to R 15,999
- ◯ R 16,000 to R 24,999
- ◯ R 25,000 to R 29,999
- ◯ R 30,000 to R 39,999
- ◯ R 40,000 to R 49,999
- ◯ R 50,000 +

6. How often do you experience a power cut?

- ◯ At least once a week
- ◯ At least every two weeks
- ◯ At least once a month
- ◯ At least every three months
- ◯ At least once a year
- ◯ Never

7. Does your house have any of the following? (You can tick more than one option)

- ☐ A Generator
- ☐ Battery back-up
- ☐ Uninterupted power supply
- ☐ Mainline gas supply

6. PART 2 Using solar power in your home

Below are a number of statements that could describe solar energy use in the home.

For each pair of phrases, please click on the box that best describes your feelings towards the statements

1. It takes a long period to recoup the financial benefits

	Stongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

2. There is a low level of subsidy avaliable for solar geysers

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Please choose:	◯	◯	◯	◯	◯

3. Solar systems help to reduce pollution in the environment

	Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

4. Solar systems generate savings

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Please choose	◯	◯	◯	◯	◯

5. Solar systems require the same amount of maintenance as an electric geyser or grid-power source.

	Strongly Agree	Agree	Undecided	Disagree	Stongly Disagree
Please choose:	◯	◯	◯	◯	◯

6. Solar systems are intrusive and affect the aesthetics of your home

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

7. Solar systems are a value of money

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

8. Solar systems are an affordable technology

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

9. Solar provides a reliable source of power

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

10. Solar could develop in the future

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

11. Solar systems add value to a property

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

12. Solar systems reduce carbon emissions

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose	◯	◯	◯	◯	◯

13. Solar systems provide a visual statement of beliefs

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

14. Solar systems are easy to install

	Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

15. Solar systems are a safe form of power generation.

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose:	◯	◯	◯	◯	◯

16. Solar power is compatible with modern living.

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Please choose	◯	◯	◯	◯	◯

7. PART 3 Purchasing behaviour

1. When you buy a product for more than R10,000 do you?

- [ ] Require financing
- [ ] Pay from an access bond
- [ ] Save for it and buy it cash

Other (please specify)

2. When you buy a product for more than R10,000 do you?

- [ ] Do extensive research yourself
- [ ] Do a quick internet search
- [ ] Ask a friend or family for advice
- [ ] Request quotes and judge by the sales person

Other (please specify)

3. When you buy a product :

	Always	Sometimes	Never
Do you consider the advantages and benefits of a product to be the most important factor in the decision to buy one.	○	○	○
Do you only purchase a product if it works with what you already own.	○	○	○
If you thought a product was too complex, it might discourage you from buying one regardless of the benefits it has.	○	○	○
You would be less likely to buy a product if you hadn't seen it in popular use.	○	○	○
You would be more likely to buy a product if you could either try it first or see it working close up.	○	○	○
Knowing a product fits with your lifestyle is more important than trying it first.	○	○	○

8. THANK YOU

I would like to take this oppourtunity to thank you for your time and input.

If you would like to see a summary of this survey, please submit your email address and we will send you the link when we have analysed the survey.

1. Please type your email address in the textbox below:

Appendix C

<u>"Early Adopters" - Descriptive Statistics</u>

Table 12: Frequency table (Gender)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	87	68.5%	82.86%	82.86%
	Female	18	14.2%	17.14%	100.00%
	Total	105	82.7%		
Missing	Missing	22	17.3%		
Total		127			

Table 13: Frequency Table (Age)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-35	16	12.6%	15.69%	15.69%
	36-50	48	37.8%	47.06%	62.75%
	51-65	31	24.4%	30.39%	93.14%
	66 +	7	5.5%	6.86%	100.00%
	Total	102			
Missing	Missing	25	19.7%		
Total		127			

Table 14: Frequency Table (level of education)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Matric	6	4.7%	5.66%	5.66%
	Artisan certificate	6	4.7%	5.66%	11.32%
	Diploma or short course	26	20.5%	24.53%	35.85%
	University degree	22	17.3%	20.75%	56.60%
	Post graduate degree	44	34.6%	41.51%	98.11%
	Other	2	1.6%	1.89%	100.00%
	Total	106			
Missing	Missing	21	16.5%		
Total		127			

Table 15: Frequency Table (Monthly household income)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	R0 to R4,999	5	3.9%	4.81%	4.81%
	R5,000 to R9,999	6	4.7%	5.77%	10.58%
	R10,000 to R15,999	14	11.0%	13.46%	24.04%
	R16,000 to R24,999	11	8.7%	10.58%	34.62%
	R25,000 to R29,999	18	14.2%	17.31%	51.92%
	R30,000 to R39,999	14	11.0%	13.46%	65.38%
	R40,000 to R49,999	31	24.4%	29.81%	95.19%
	R50,000 +	5	3.9%	4.81%	100.00%
	Total	104			
Missing	Missing	23	18.1%		
Total		127			

Table 16:: Frequency Table (type of installed solar system)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Solar water heater	71	55.9%	74.74%	74.74%
	Solar photovoltaic system	2	1.6%	2.11%	76.84%
	Both	22	17.3%	23.16%	100.00%
	Total	95			
Missing	Missing	32	25.2%		
Total		127			

Table 17: Frequency Table (reasons for purchasing a solar system)

		Responses
Valid	To save costs	91
	To have a reliable power source	34
	To be independent of the national grid	30
	To save the environment	64
	To add value to my property	31

Table 18: Frequency Table (No. of years SWH has been installed)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 2 year	37	29.1%	40.66%	40.66%
	2 to 5 years	41	32.3%	45.05%	85.71%
	6 to 10 years	4	3.1%	4.40%	90.11%
	11 to 15 years	9	7.1%	9.89%	100.00%
	Total	91			
Missing	Missing	36	28.3%		
Total		127			

Table 19: Frequency Table (No. of years solar PV system has been installed)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 2 year	9	7.1%	33.33%	33.33%
	2 to 5 years	9	7.1%	33.33%	66.67%
	6 to 10 years	4	3.1%	14.81%	81.48%
	11 to 15 years	5	3.9%	18.52%	100.00%
	Total	27			
Missing	Missing	100	78.7%		
Total		127			

Table 20: Frequency Table (Size of SWH system)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	100 litre	4	3.1%	4.49%	4.49%
	150 litre	19	15.0%	21.35%	25.84%
	200 litre	38	29.9%	42.70%	68.54%
	250 litre	5	3.9%	5.62%	74.16%
	300 litre	23	18.1%	25.84%	100.00%
	Total	89			
Missing	Missing	38	29.9%		
Total		127			

Table 21: Frequency Table (Size of solar PV system)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 100 kWp	9	7.1%	37.50%	37.50%
	101 to 500 kWp	6	4.7%	25.00%	62.50%
	501 to 1000 kWp	2	1.6%	8.33%	70.83%
	1001 to 2000 kWp	2	1.6%	8.33%	79.17%
	2001 to 3000 kWp	2	1.6%	8.33%	87.50%
	Greater than 3001 kWp	3	2.4%	12.50%	100.00%
	Total	24			
Missing	Missing	103	81.1%		
Total		127			

Table 22: Frequency Table (Noticed a change in electricity consumption)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	86	67.7%	93.48%	93.48%
	No	6	4.7%	6.52%	100.00%
	Total	92	72.4%		
Missing	Missing	35	27.6%		
Total		127			

Table 23: Frequency Table (Monthly rand savings)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than R100	9	7.1%	10.59%	10.59%
	R100 - R200	15	11.8%	17.65%	28.24%
	R201 - R300	26	20.5%	30.59%	58.82%
	R301 - R400	9	7.1%	10.59%	69.41%
	R401 - R500	17	13.4%	20.00%	89.41%
	More than R501	9	7.1%	10.59%	100.00%
	Total	85			
Missing	Missing	42	33.1%		
Total		127			

Table 24: Frequency Table (Daily reduction in power usage)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Don't know	17	13.4%	19.10%	19.10%
	0 kWh to 5 kWh	20	15.7%	22.47%	41.57%
	6 kWh to 9 kWh	9	7.1%	10.11%	51.69%
	10 kWh to 14 kWh	9	7.1%	10.11%	61.80%
	15 kWh +	34	26.8%	38.20%	100.00%
	Total	89			
Missing	Missing	38	29.9%		
Total		127			

Table 25: Frequency Table (Expected lifespan of the solar collector)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5 years	4	3.1%	4.40%	4.40%
	6 years	-	0.0%	0.00%	4.40%
	7 years	1	0.8%	1.10%	5.49%
	8 years	3	2.4%	3.30%	8.79%
	9 years	-	0.0%	0.00%	8.79%
	10 years	24	18.9%	26.37%	35.16%
	12 years	3	2.4%	3.30%	38.46%
	15 years	15	11.8%	16.48%	54.95%
	20 years	15	11.8%	16.48%	71.43%
	20+ years	26	20.5%	28.57%	100.00%
	Total	91			
Missing	Missing	36	28.3%		
Total		127			

Table 26: Frequency Table (Rebate at the time of purchase)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	46	36.2%	50.00%	50.00%
	No	46	36.2%	50.00%	100.00%
	Total	92			
Missing	Missing	35	27.6%		
Total		127			

Table 27: Frequency Table (The rebate's effect on the decision)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Speed up you decision	19	38.0%	38.00%	38.00%
	Make the decision possible	12	24.0%	24.00%	62.00%
	Not influence the decision	19	38.0%	38.00%	100.00%
	Total	50			
Missing	Missing	-	0.0%		
Total		50			

Table 28: Frequency Table (No rebate available, why did they install)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Make sense on it own	29	64.4%	64.44%	64.44%
	Make you take a longer term view	13	28.9%	28.89%	93.33%
	Occur becuase your geyser burst	3	6.7%	6.67%	100.00%
	Total	45			
Missing	Missing	-	0.0%		
Total		45			

Table 29: Frequency Table (How long have they known someone with solar)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	2	1.6%	2.20%	2.20%
	1 year	1	0.8%	1.10%	3.30%
	2 year	2	1.6%	2.20%	5.49%
	3 year	4	3.1%	4.40%	9.89%
	4 year	8	6.3%	8.79%	18.68%
	5 to 10 year	17	13.4%	18.68%	37.36%
	11 to12 year	2	1.6%	2.20%	39.56%
	13 to 15 year	52	40.9%	57.14%	96.70%
	I don't know anyone esle with a solar system	3	2.4%	3.30%	100.00%
	Total	91			
Missing	Missing	36	28.3%		
Total		127			

Table 30: Frequency Table (Knowledge of solar systems)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	84	66.1%	92.31%	92.31%
	No	7	5.5%	7.69%	100.00%
	Total	91			
Missing	Missing	36	28.3%		
Total		127			

Table 31: Cross tabulation (SWH system size vs Monthly Household income)

Count

		Monthly Household income							Total
		R 5,000 to R 9,999	R 10,000 to R 15,999	R 16,000 to R 24,999	R 25,000 to R 29,999	R 30,000 to R 39,999	R 40,000 to R 49,999	R 50,000 +	
SWH size	100-litre					1	2	1	4
	150-litre	2	4	4	2	2	3	2	19
	200-litre		1	3	4	6	6	14	34
	250-litre			1	2			1	4
	300-litre		1	4	2	5	1	10	23
	Total	2	6	12	10	14	12	28	84

Comparison of Percentages

Table 32: Table of percentage for the system attributes (all responses)

Solar systems attribute statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Agree	Total Responses	Missing
It takes a long period to recoup the financial benefits	14%	37%	5%	32%	13%	104	23
There is a low level of subsidy available for solar geysers	18%	50%	9%	19%	4%	104	23
Solar systems help to reduce pollution	66%	29%	3%	0%	2%	104	23
Solar systems generate savings	63%	36%	1%	0%	0%	103	24
Solar systems require the same maintenance as an electric geyser or grid-power source	4%	30%	18%	34%	14%	101	26
Solar systems are intrusive and affect the aesthetics of your home	29%	38%	8%	22%	4%	103	24
Solar systems are value for money	30%	48%	14%	8%	1%	99	28
Solar systems are an affordable technology	13%	40%	11%	29%	6%	102	25
Solar provides a reliable source of power	35%	47%	12%	6%	0%	104	23
Solar could develop in the future	59%	40%	0%	1%	0%	102	25
Solar systems add value to a property	38%	47%	14%	0%	0%	102	25
Solar systems reduce carbon emissions	62%	30%	7%	1%	0%	103	24
Solar systems provide a visual statement of beliefs	28%	53%	17%	2%	0%	101	28
Solar systems are difficult to install	6%	31%	7%	42%	15%	101	26
Solar systems are a safe form of power generation	46%	54%	0%	0%	0%	103	24
Solar power is compatible with modern living	53%	43%	3%	1%	0%	103	24

Table 33: "Early adopters" percentage responses to solar attributes (The strongly agree and agree to responses were combined to form the positive column and the same was done for strongly disagree and disagree to form the negative column)

Solar systems attribute statements	Strongly Agree+ Agree%	Undecided%	Strongly Disagree+ Disagree%
It takes a long period to recoup the financial benefits	50.96	4.81	44.23
There is a low level of subsidy available for solar geysers	67.96	8.74	23.3
Solar systems help to reduce pollution	95.19	2.88	1.92
Solar systems generate savings	99.04	0.96	0
Solar systems require the same maintenance as an electric geyser or grid-power source	33.98	18.45	47.57
Solar systems are intrusive and affect the aesthetics of your home	66.34	7.92	25.74
Solar systems are value for money	77.67	13.59	8.74
Solar systems are an affordable technology	53.54	11.11	35.35
Solar provides a reliable source of power	82.35	11.76	5.88
Solar could develop in the future	99.04	0	0.96
Solar systems add value to a property	85.29	13.73	0.98
Solar systems reduce carbon emissions	92.16	6.86	0.98
Solar systems provide a visual statement of beliefs	81.55	16.5	1.94
Solar systems are easy to install	56.44	6.93	36.63
Solar systems are a safe form of power generation	100	0	0
Solar power is compatible with modern living	96.12	2.91	0.97

Table 34: "Early majority" adopter's percentage responses to solar attributes (the the three negative statements (highlighted in light blue) have been inverted to identify the overall attitude of the early adopters)

Solar systems attribute statements	Positive%	Undecided%	Negative%
It takes a long period to recoup the financial benefits	44.2	4.81	51
There is a high level of subsidy available for solar geysers	23.3	8.74	67.96
Solar systems help to reduce pollution	95.19	2.88	1.92
Solar systems generate savings	99.04	0.96	0
Solar systems require the same maintenance as an electric geyser or grid-power source	33.98	18.45	47.57
Solar systems are hidden away and affect the aesthetics of your home	25.74	7.92	66.34
Solar systems are value for money	77.67	13.59	8.74
Solar systems are an affordable technology	53.54	11.11	35.35
Solar provides a reliable source of power	82.35	11.76	5.88
Solar could develop in the future	99.04	0	0.96
Solar systems add value to a property	85.29	13.73	0.98
Solar systems reduce carbon emissions	92.16	6.86	0.98
Solar systems provide a visual statement of beliefs	81.55	16.5	1.94
Solar systems are easy to install	56.44	6.93	36.63
Solar systems are a safe form of power generation	100	0	0
Solar power is compatible with modern living	96.12	2.91	0.97

Table 35: Solar system characteristic statements and their categories of innovation attributes (after Rogers, 1995)

It takes a long period to recoup the financial benefits	R			
There is a low level of subsidy available for solar geysers	R			
Solar systems help to reduce pollution	R	C		
Solar systems generate savings	R			
Solar systems require the same maintenance as an electric geyser or grid-power source	R			
Solar systems are intrusive and affect the aesthetics of your home	R	C		O
Solar systems are value for money	R			
Solar systems are an affordable technology	R			
Solar provides a reliable source of power	R		C	
Solar could develop in the future			C	
Solar systems add value to a property	R			
Solar systems reduce carbon emissions	R	C		
Solar systems provide a visual statement of beliefs	R			O
Solar systems are difficult to install			C	
Solar systems are a safe form of power generation	R	C		
Solar power is compatible with modern living	R	C		

R = Relative advantage
C = Compatibility
C2 = Complexity
O= Observability

Figure 12 : Graph showing attitude statements of Relative Advantage

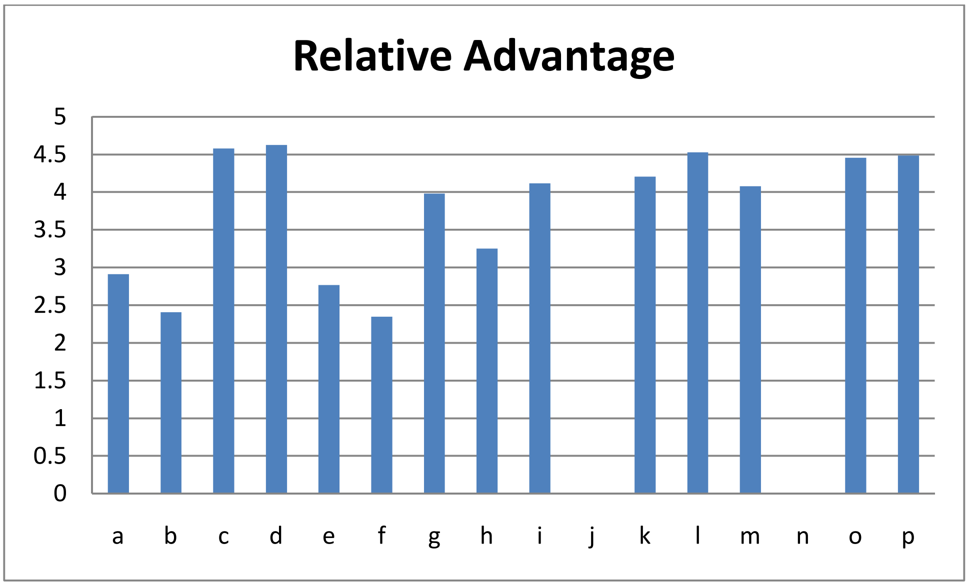


Figure 13 : Graph showing attitude statements of Compatibility

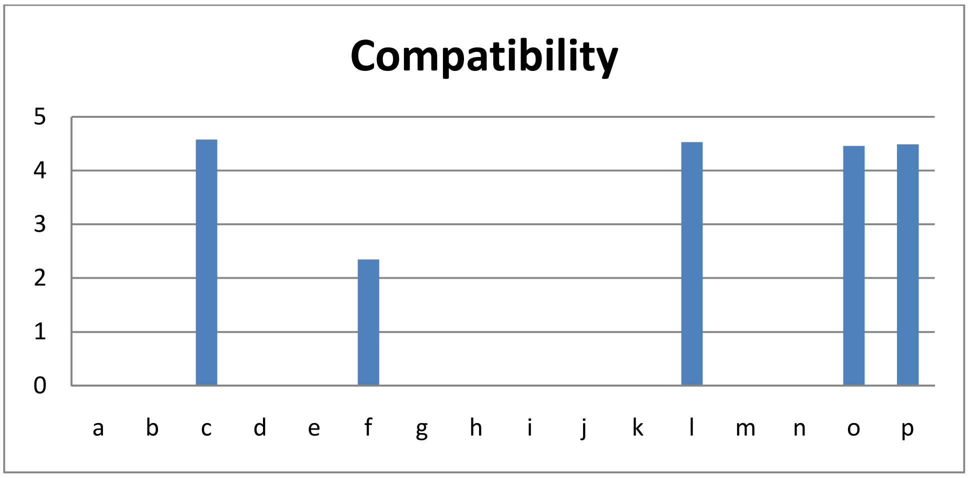


Figure 14: Graph showing attitude statements of Complexity

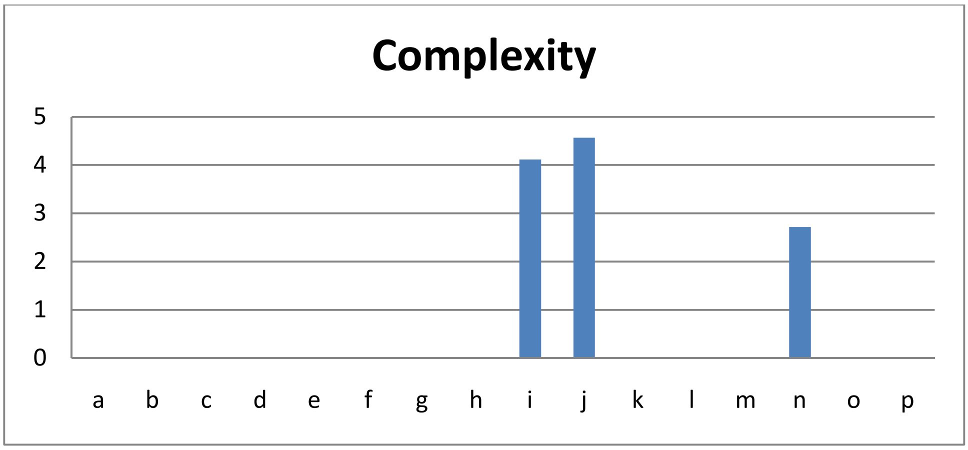
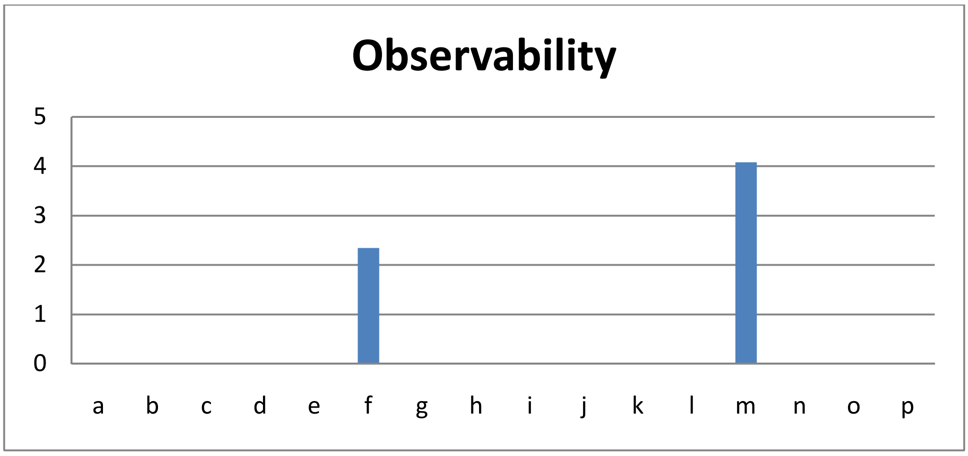


Figure 15: Graph showing attitude statements of Observability



Appendix D

"Early majority" - Descriptive Statistics

Table 36: "Early majority" frequency table (Gender)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	76	56.3%	58.46%	58.46%
	Female	54	40.0%	41.54%	100.00%
	Total	130	96.3%		
Missing	Missing	5	3.7%		
Total		135			

Table 37: "Early majority" frequency table (Age)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-35	80	59.3%	61.54%	61.54%
	36-50	33	24.4%	25.38%	86.92%
	51-65	17	12.6%	13.08%	100.00%
	66 +	-	0.0%	0.00%	100.00%
	Total	130			
Missing	Missing	5	3.7%		
Total		135			

Table 38: "Early majority" frequency table (Level of education)

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Matric	10	7.4%	7.69%	7.69%
	Artisan certificate	4	3.0%	3.08%	10.77%
	Diploma or short course	18	13.3%	13.85%	24.62%
	University degree	27	20.0%	20.77%	45.38%
	Post graduate degree	67	49.6%	51.54%	96.92%
	Other	4	3.0%	3.08%	100.00%
	Total	130			
Missing	Missing	5	3.7%		
Total		135			

Table 39: “Early majority" frequency table (Monthly household income)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	R0 to R4,999	5	3.7%	3.97%	3.97%
	R5,000 to R9,999	5	3.7%	3.97%	7.94%
	R10,000 to R15,999	17	12.6%	13.49%	21.43%
	R16,000 to R24,999	15	11.1%	11.90%	33.33%
	R25,000 to R29,999	13	9.6%	10.32%	43.65%
	R30,000 to R39,999	12	8.9%	9.52%	53.17%
	R40,000 to R49,999	28	20.7%	22.22%	75.40%
	R50,000 +	31	23.0%	24.60%	100.00%
	Total	126			
Missing	Missing	9	6.7%		
Total		135			

Comparison of Percentages

Table 40: Table of percentage for the system attributes (all responses)

Solar systems attribute statements	**Strongly Agree**	**Agree**	**Undecided**	**Disagree**	**Strongly Agree**	**Total responses**	**Missing**
It takes a long period to recoup the financial benefits	10%	46%	28%	15%	2%	124	11
There is a low level of subsidy available for solar geysers	12%	50%	25%	11%	2%	124	11
Solar systems help to reduce pollution	58%	34%	8%	1%	0%	125	10
Solar systems generate savings	36%	49%	14%	2%	0%	125	10
Solar systems require the same maintenance as an electric geyser or grid-power source	1%	23%	51%	21%	4%	124	11
Solar systems are intrusive and affect the aesthetics of your home	9%	41%	22%	25%	3%	123	12
Solar systems are value for money	18%	36%	38%	5%	3%	124	11
Solar systems are an affordable technology	4%	25%	36%	30%	5%	123	12
Solar provides a reliable source of power	15%	50%	30%	4%	2%	124	11
Solar could develop in the future	61%	36%	2%	0%	1%	124	11
Solar systems add value to a property	26%	44%	25%	6%	0%	125	10
Solar systems reduce carbon emissions	50%	39%	11%	1%	0%	123	12
Solar systems provide a visual statement of beliefs	25%	44%	27%	5%	0%	124	11
Solar systems are difficult to install	6%	17%	58%	18%	1%	124	11
Solar systems are a safe form of power generation	33%	56%	10%	0%	0%	124	11
Solar power is compatible with modern living	38%	53%	7%	2%	0%	124	11

Table 41: "Early majority" percentage responses to solar attributes (The strongly agree and agree to responses were combined to form the positive column and the same was done for strongly disagree and disagree to form the negative column)

Solar systems attribute statements	Strongly Agree + Agree %	Undecided %	Strongly Disagree + Disagree%
It takes a long period to recoup the financial benefits	55.65	28.23	16.13
There is a low level of subsidy available for solar geysers	62.1	25	12.9
Solar systems help to reduce pollution	91.2	8	0.8
Solar systems generate savings	84.8	13.6	1.6
Solar systems require the same maintenance as an electric geyser or grid-power source	24.19	50.81	25
Solar systems are intrusive and affect the aesthetics of your home	49.59	21.95	28.46
Solar systems are value for money	54.03	37.9	8.06
Solar systems are an affordable technology	29.27	35.77	34.96
Solar provides a reliable source of power	64.52	29.84	5.65
Solar could develop in the future	97.58	1.61	0.81
Solar systems add value to a property	69.6	24.8	5.6
Solar systems reduce carbon emissions	88.62	10.57	0.81
Solar systems provide a visual statement of beliefs	68.55	26.61	4.84
Solar systems are easy to install	23.39	58.06	18.55
Solar systems are a safe form of power generation	89.52	10.48	0
Solar power is compatible with modern living	91.13	7.26	1.61

Table 42: "Early majority" percentage responses to solar attributes (the the three negative statements (highlighted in light blue) have been inverted to identify the overall attitude of the early adopters)

Solar systems attribute statements	Positive %	Undecided %	Negative%
It takes a long period to recoup the financial benefits	16.13	28.23	55.65
There is a high level of subsidy available for solar geysers	12.9	25	62.1
Solar systems help to reduce pollution	91.2	8	0.8
Solar systems generate savings	84.8	13.6	1.6
Solar systems require the same maintenance as an electric geyser or grid-power source	24.19	50.81	25
Solar systems are hidden away and affect the aesthetics of your home	28.46	21.95	49.59
Solar systems are value for money	54.03	37.9	8.06
Solar systems are an affordable technology	29.27	35.77	34.96
Solar provides a reliable source of power	64.52	29.84	5.65
Solar could develop in the future	97.58	1.61	0.81
Solar systems add value to a property	69.6	24.8	5.6
Solar systems reduce carbon emissions	88.62	10.57	0.81
Solar systems provide a visual statement of beliefs	68.55	26.61	4.84
Solar systems are easy to install	18.55	58.06	23.39
Solar systems are a safe form of power generation	89.52	10.48	0
Solar power is compatible with modern living	91.13	7.26	1.61

Table 43: Solar system characteristic statements and their categories of innovation attributes (after Rogers, 1995)

It takes a long period to recoup the financial benefits	R			
There is a low level of subsidy available for solar geysers	R			
Solar systems help to reduce pollution	R	C		
Solar systems generate savings	R			
Solar systems require the same maintenance as an electric geyser or grid-power source	R			
Solar systems are intrusive and affect the aesthetics of your home	R	C		O
Solar systems are value for money	R			
Solar systems are an affordable technology	R			
Solar provides a reliable source of power	R		C	
Solar could develop in the future			C	
Solar systems add value to a property	R			
Solar systems reduce carbon emissions	R	C		
Solar systems provide a visual statement of beliefs	R			O
Solar systems are difficult to install			C	
Solar systems are a safe form of power generation	R	C		
Solar power is compatible with modern living	R	C		

R = Relative advantage
C = Compatibility
C2 = Complexity
O= Observability

Figure 16: Graph showing attitude statements of Relative Advantage

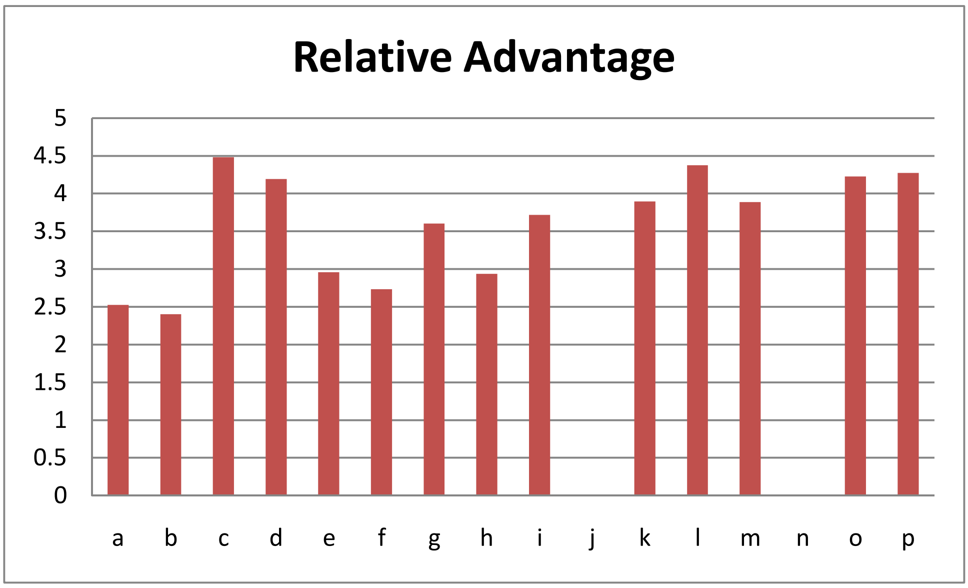


Figure 17: Graph showing attitude statements of Compatibility

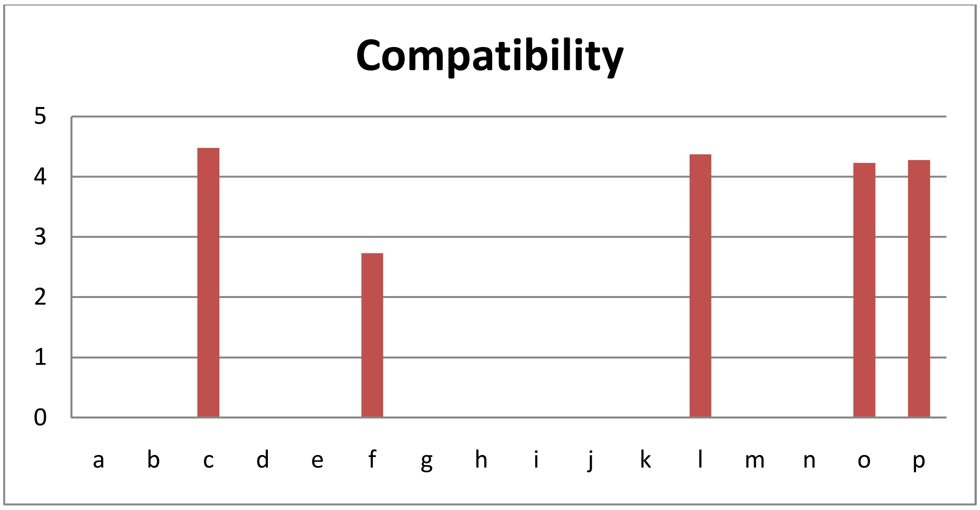


Figure 18: Graph showing attitude statements of Complexity

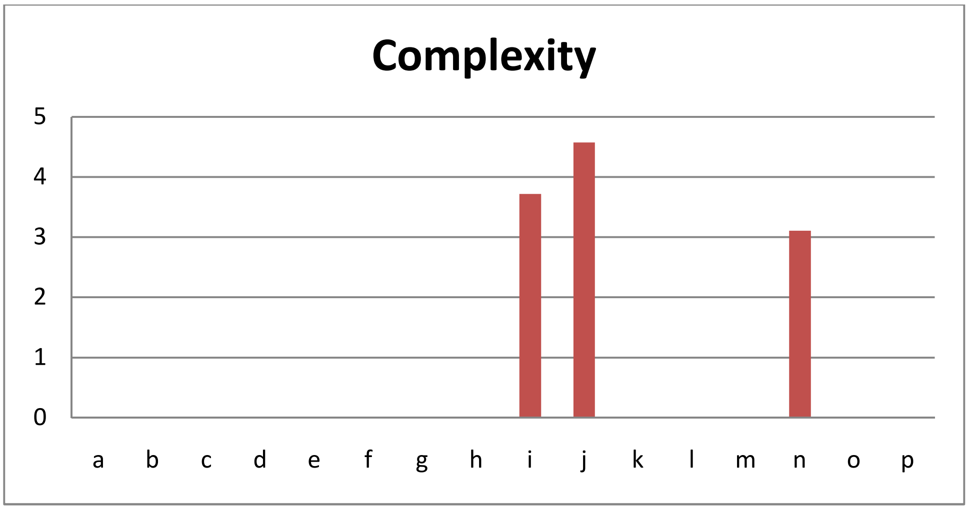


Figure 19: Graph showing attitude statements of Observability