UNIVERSITY OF KWAZULU-NATAL

SOLAR WATER HEATING: REDUCING THE BARRIERS

By

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DECLARATION

I, _____Jayson Shirinivasan Naicker_________ declare that

(i) The research reported in this dissertation/thesis, except where otherwise indicated, is my original research.

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Abstract

There is the potential to use solar energy as an energy efficient method of heating water, instead of using electricity. This study investigated the current barriers to the mass rollout of solar water heaters in South Africa and provided possible solutions to reduce these barriers.

Local experts have already identified the key barriers to the rollout of solar water heaters and this study drew from the findings of international practises and applied these findings to the South African context. The barriers that are preventing the industry from developing are: the high price of solar water heaters, the lack of awareness of the technology, the absence of legislation, a tedious process for rebates, non–mandatory standards, insufficient training facilities leading to a shortage of skills and the low price of electricity.

The research methodology was a blend of qualitative and a quantitative study including relevant theory supported by seven open-ended questionnaires completed by recognised industry specialists. The information gathered from the questionnaires was analysed and compared to the theory and international experience.

The barriers to solar water heating can be overcome by having more government involvement in the development of policies to promote and educate the public on alternative energy sources. This lack of awareness on the technology can be improved by having awareness programmes in schools and frequent broadcasts on radio and television. There is a dire need for the development of cost effective financing mechanisms because the high costs of production influences the price of solar water heaters. Financial incentive models such as rebates, could be more effective in assisting the low and middle-income groups with partial funding for the purchase of the solar water heater.

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List of Abbreviations

AMEU	Association for Municipal Electricity Undertakings
CEF	Central Energy Fund
CEO	Chief Executive Officer
CSIR	Council for Scientific and Industrial Research
DSM	Demand Side Management
EDRC	Energy and Development Research Centre
EGS	Environmental Goods and Services
ESCO	Energy Services Company
ESETA	Energy Sector Education and Training Authority
ESIF	European Solar Industry Federation (now ESTIF)
ESTIF	European Solar Thermal Industry Federation
EU	European Union
EWEB	Eugene Water & Electric Board
EWH	Electric Water Heater
GEF	Global Environmental Facility
IEA	International Energy Agency
IPP	Independent Power Producer
ISO	International Organization for Standardization
KWh	Unit of energy - Kilowatt-hour
NMME	Namibian Ministry of Mines and Energy
NAMREP	Namibian Renewable Energy Project
NER	National Electricity Regulator now NERSA
NERSA	National Energy Regulator of South Africa
RED	Regional Electricity Distributor
REEEP	Renewable Energy and Energy Efficiency Partnership
SABS	South African Bureau of Standards
SANS	South African National Standard
SEA	Sustainable Energy Africa
SESSA	Sustainable Energy Society of Southern Africa
SETA	Sector Education and Training Authority
SWH	Solar Water Heater
UNDP	United Nations Development Programme

CHAPTER ONE

Introduction

Chapter One gives a brief introduction to the problem, the utility's electricity capacity shortage, the objectives of the study, the research methodology that is used, the limitations and the structure of the study. The structure is briefly described and gives an overview of the objectives of each chapter.

1.1 Introduction

There have been significant changes across the globe as pressure from environmental activists coerce organisations toward 'greener' energy sources, in order to reduce air pollution and fossil fuel depletion. This was further highlighted by the Kyoto protocol (which was adopted in 1997), and this agreement was undertaken by several developing and developed countries which "committed to reducing their greenhouse gas emissions by an average of 5,2% of their 1990 levels" (Vernon, 2002). Since electricity generators predominantly use fossil fuels to generate electricity, these generating plants are deemed to be responsible for some of the greenhouse gases that are vented into the atmosphere. By using renewable energy to generate electricity, the air pollution from fossil fuel electricity generation is reduced significantly.

There are various sources of renewable energy that may be harnessed from the earth. These include hydro, wave, solar, and wind energy. Solar and hydro energy are favoured because they do not have an associated fuel cost, is inexhaustible and there is virtually no resulting pollution (Schobert, 2002). However, the distinct advantage that solar energy has over hydro energy is that it can be used almost anywhere where there is an abundance of sunlight, whereas hydro energy is limited to areas where there is water that is flowing continuously (Schobert, 2002).

Solar water heating is a process of utilizing the sun's heat energy to raise the temperature of water. The solar water heater (SWH) is installed on the roof of the house so that the flat plate solar collector can capture the sunlight. The flat plate solar collector operates on the basic principle that black objects absorb heat energy and this collected heat energy on the absorber plate is transferred to the water by the collecting tubes. The cover plate ensures that the heat energy from the sun remains within the solar collector. The resulting hot water rises due to density differences between hot and cold water, to the storage tank for utilization. The fluid inlet is where the cold water enters to be heated and the fluid outlet is where the hot water is released for utilisation. A basic diagram of the solar water heater and its components is shown in Figure 1.1.

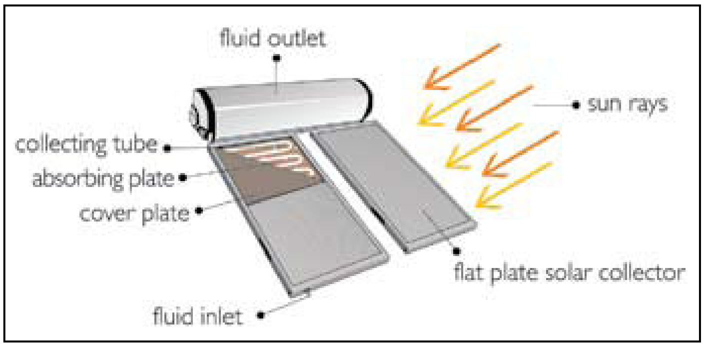

Figure 1.1. Basic Solar Water Heater and Components

Source: Eskom DSM, 2009, n.p.

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There are various types of SWHs with each being classified as an active or passive system.

Table 1.1. Various Types of SWH systems

Active Systems	**Passive Systems**
Force Circulation System	Thermo-siphon solar heat system
	Close coupled solar heat system
	Split solar heat system
	Integral solar heat system

Source: Dintchev, 2004, n.p.

The current practice in most electrified households and industries in South Africa is to heat water using electric water heaters (EWHs), known as geysers, which converts electrical energy to heat energy. This type of energy conversion is extremely inefficient, as shown in Figure 1.2, as energy is extracted from fossil fuels and then converted into many different forms before it is transmitted to the end user who finally uses this electricity to heat water. Energy losses occur during this conversion, transmission and distribution process thereby making it inefficient. Another disadvantage of heating water using electricity derived from fossil fuels is that greenhouse gases are released into the atmosphere and water is consumed when electricity is produced from non-renewable fossil fuels such as coal.

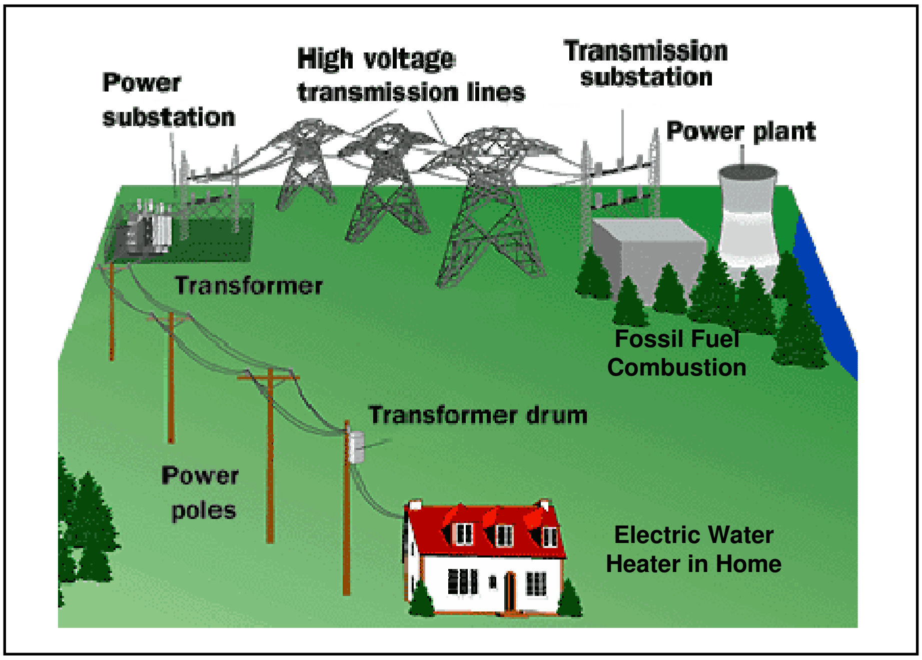

Figure 1.2. Electricity Generation (by using fossil fuels) to Heat Water

Source: Howstuffworks, 2009.

1.2 Utility Background

Eskom is South Africa's major electricity utility and generates approximately 96% of the country's electricity. The utility had built adequate capacity reserves through its aggressive construction programme during the middle 1980s and early 1990s anticipating electricity growth (Steyn, 2002). However, there was a slow down in the economy during this period and an excess of electricity capacity became available. Several power stations were mothballed because their operation was no longer necessary (Steyn, 2002). In the late 1990s Eskom forecasted that it would be experiencing capacity problems by 2007 and 2008. Initially, the utility's only shareholder, the government rejected the planned 'build project,' due to the shareholder wanting to introduce independent power producers (IPPs) into the country. When the IPPs could not be sourced, Eskom was forced to reinstate the 'build programme' to construct additional generating capacity to meet the growing demand for electricity. This reinstatement of the build programme was at a late stage and the steady growth in the electricity demand resulted in a diminishing electricity reserve margin (Eskom Annual Report, 2008).

Eskom is currently operating on a very low electricity reserve margin (about 8%) and requires the demand for electricity to be drastically reduced so that forced power outages known as load shedding, can be avoided. The international benchmark for an electricity reserve margin is 15% (Eskom Annual Report, 2008, p.47). An unnecessary load is placed on the electricity supply by using inefficient energy appliances such as electric water heaters. This unnecessary load, according to Eskom, is detrimental to Eskom's electricity reserve margin (Eskom Annual Report, 2008).

Eskom also needs to achieve 10 000 GWh of energy savings by 2011/12 and the Demand Side Management (DSM) department, within Eskom, is focusing on using energy efficient lighting in all sectors, solar water heaters, smart meters and motor systems to achieve this target (Eskom Annual Report, 2008, p. 50). Solar water heating has been identified by the DSM department as one of the technologies that could be used to reduce the demand for electricity (Eskom Annual Report, 2008, p. 50).

1.3 Motivation for the Study

This study attempts to identify the reasons for the resistance experienced in the rollout of SWH by identifying the barriers that are prevalent in the market.

The topic for this study is one of Eskom's current problems and was identified by the Eskom DSM department. Eskom is currently engaged in the rollout of solar water heaters (SWHs) around the country. The implementation of SWHs has been experiencing resistance and has therefore prompted the need for this study.

1.4 Value of the Study

Eskom has identified that solar energy has a major role to play in the organisation. The benefits from solar energy will assist the utility two-fold; the first benefit being a reduction on the current electricity demand and the second benefit being to include renewable energy as a source of its electricity generation mix. Therefore, research into the barriers to this technology will assist Eskom in meeting its objective of reducing the demand for electricity.

1.5 Problem Statement

Eskom does not have a sufficient electricity reserve margin available to supply consumers in the event of an unplanned failure of any of its electricity generating units. This situation has occurred because of the increasing demand for electricity and the delay in commencement of the capacity expansion programme which entails the construction of new electricity generating plants.

In order to curtail the demand for electricity, Eskom's DSM department has identified that lighting and water heating could be achieved in more efficient ways. Water heating accounted for a major portion of electricity usage and the SWHs could be used as a substitute to electric water heaters (geysers).

According to Dintchev (2004) the main barriers to solar water heating are:

- The low cost of electricity in South Africa contributes to the mass implementation of electric water heaters.
- The high cost of solar water heaters prevents low-income consumers using this product.
- The lack of consumer awareness of the impact of electric water heating on the environment.
- The lack of awareness regarding the potential to reduce energy related costs by using solar water heaters.

- The absence of legislation to facilitate or promote the expansion of the SWH technology.
- The absence of compulsory standards for testing and certification of SWH products.
- The lack of technically trained resources for installation and maintenance of SWH products.

Holm (2005) identified a lack of awareness and the high initial costs associated with the purchase of solar water heaters were barriers to market penetration internationally. Additional technical barriers such as "standardisation, testing, quality assurance, quality management, technical arbitration, mediation and dispute resolution, installation skills, maintenance skills and certification" were also present.
The barriers identified by Dintchev (2004) and Holm (2005) were also confirmed by other solar water heating experts. These barriers have been used as the basis for this study.

1.6 Objectives of the Study

The objectives of this study are as follows:

- to identify the barriers to solar water heating in South Africa; and
- to identify solutions to reduce these barriers.

1.7 Research Methodology

A qualitative approach was used in this study. This study investigated information from peer-reviewed articles, suppliers, manufacturers as well as responses from recognised industry experts.

Peer reviewed articles have been used to:

- determine the primary barriers that exist in the SWH market;
- investigate international practises to reduce these barriers; and

- identify solutions to reduce these barriers by considering, inter alia, the financing requirements for SWHs, the skills required to install the heaters and the introduction of possible legislation.

Seven open-ended questionnaires were forwarded to recognised SWH experts to:

- expand on and validate the barriers identified by Dintchev (2004) and Holm (2005);
- identify any additional barriers present in the market; and
- identify practical solutions to reduce the barriers in South Africa.

The questionnaires were analyzed as follows:

- Collected information was perused to establish broad categories using an inductive approach.
- Data was then analysed and interpreted recognizing relationships between categories and developing further categories.
- The data in the identified categories was further analysed to establish relationships between categories.
- The data was integrated and summarized offering proposals and acknowledging bias where this was obvious.

1.8 Limitations of the Study

This study identified possible solutions to reduce barriers to solar water heating. The study however, did not cover SWH-related costs nor did it determine the specific time required to implement such solutions.

The study was also limited to seven recognised industry respondents. Although the study has relevant opinions from market participants, it did not reflect total consensus by the solar water heating industry.

As the information contained herein is in the public domain, the study is limited to the available information. The author did not access any confidential Eskom documentation.

1.9 Structure

The study is divided into five chapters. The research methodology adopted has been highlighted in subsection 1.5. This study includes a study of the relevant theory and international studies surrounding SWH to determine a framework for the dissertation. The theory is supported by responses to the questionnaires to ensure that an objective study was undertaken.

1.9.1 Chapter One

Chapter One outlines the motivation, value, problem statement, objectives, research methodology, limitations and structure of the study.

1.9.2 Chapter Two

This chapter contains details of the literature reviewed. It encompasses various data sources to ensure a broader understanding of the topic. The reader will be able to gain a theoretical and practical perspective on the barriers that have been identified. A critical review was done on information from various data sources to expand on the objectives of the study. The findings in this chapter feed into Chapter Four.

1.9.3 Chapter Three

Chapter Three outlines the research methodology used in this study. This will describe how data was collected from primary, secondary sources. An open-ended questionnaire was used as a research instrument that was completed by recognised industry experts. The process of integrating and analysing all data sources is discussed.

1.9.4 Chapter Four

An analysis of the theory and interviews conducted are discussed in this chapter. The theory obtained from the literature review in Chapter Two is compared to the results obtained from open ended questionnaires conducted with SWH market participants. The responses from the questionnaires are critically analysed and discussed. This is to ensure that the responses are valid and assist in reducing the barriers are reinforced. A critical analysis was done on all sources of information to remove any bias and establish practical solutions that can be implemented.

1.9.5 Chapter Five

This chapter contains concludes the study and provides recommendations. The limitations to the study are discussed and areas for further work are also suggested.

1.10 Summary

This chapter provided the framework for the study that has been undertaken. It identifies the problem and sets out objectives to resolve this problem. The research approach is described to inform the reader of the methodology applied and possible research instruments that are being utilised. The limitations and structure of the dissertation are also discussed briefly. Recommendations for further work are made in the concluding chapter.

CHAPTER TWO

Literature Review

This chapter examines the current literature available on the barriers to solar water heating. It is therefore necessary to initially define the concept of the barriers to entry and then identify the context in which the barriers exist. The barriers that are researched includes: the high price barrier, the lack of awareness barrier, the barrier caused by insufficient legislation and incentives, the indirect standards barrier, the lack of training facilities barrier and the low cost of electricity barrier. The summary briefly concludes the findings of the chapter.

The theory is a mixture of primary, secondary data sources from books, journals, research reports, the internet and the media.

The solar water heating market is already widely established in countries such as Cyprus, Israel and Greece whereas South Africa is experiencing barriers to the use of SWHs resulting in poor sales. It is crucial to identify the barriers to solar water heating that other countries have experienced and relate these to the South African context. South Africa is currently manufacturing most types of domestic SWHs. The local production accounts for approximately 75% of SWHs with the remaining 25% being imported. About 20% of local production is exported (Harris *et al*., 2008).

2.1 The Concept of Barriers to Entry

Jones and George (2003, p. 157) defined barriers to entry as “Factors that make it difficult and costly to enter a particular task environment or industry”

The definition by Jones and George (2003) is applicable to this study because Eskom is presently having difficulty in rolling out solar water heaters to electricity end users. This difficulty is attributed the several barriers identified later in the chapter. The cost factor associated with the definition by Jones and George (2003) is also a barrier that is analysed further in this study.

The barriers to entry for SWH in South Africa are not those imposed by competition but are rather economical barriers. The barriers prevent end users from using SWHs more extensively. It is important to note that competitors are not considered as a barrier to entry into this market in this study because the SWH market is not adequately developed to enable proper competition between competitors. The limited number of manufacturers and product types available does not allow competitive forces to assist in price reduction because economies of scale in manufacturing cannot be achieved. Therefore, manufacturing costs among producers of SWHs remain high and competition cannot assist the high cost of the product.

Jones and George (2003) further explain that barriers to entry stem from two main sources, namely: "economies of scale" and "brand loyalty." These two sources, as in Figure 2.1, assist in creating barriers so that potential competitors do not penetrate the market.

In this study, the purpose is to make recommendations that will assist Eskom and other stakeholders to overcome or reduce these barriers.

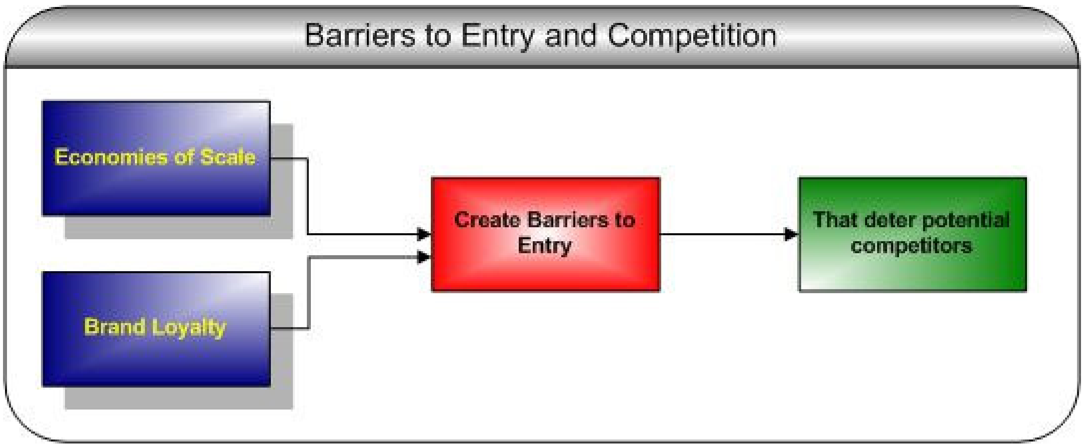

Figure 2.1. Barriers to Entry and Competition

Source: Jones and George, 2003, p. 158.

As referred to in Figure 2.1, economies of scale are defined as the cost advantages obtained when the product is produced in large quantities (Jones and George, 2003). The cost of SWHs could therefore be reduced if these were produced in sufficiently large quantities. Once economies of scale are achieved, the product then becomes cost effective and this prevents the end user from switching to an alternate product. With reference to SWHs, this product has to become cost-effective and affordable so that end users can change to it. However, in any market, supply and demand should be balanced and since SWHs are not extensively used, the demand is low, compelling manufacturers to produce smaller quantities and thereby not achieving economies of scale. Etzinger (2007) suggests that there is potential for economies of scale but only once the market has developed.

Brand loyalty, as shown in Figure 2.1, does not strictly apply to this study, as solar water heating does not have extensive market exposure. It is more appropriate to use the term 'technology of choice,' rather than brand loyalty because the choice for the end user is either electric water heating or solar water heating.

There are other reasons that prevent end users from switching to a substitute product. Thompson *et al*. (2005, p. 59) mentions that there can be competitive pressures arising from the suppliers of substitute products. The strength of the competitive forces from the sellers is typically based on three factors:

- the substitutes are "readily available and attractively priced;"
- the buyers should view the substitute products "as being comparable or better in terms of quality, performance, and other relevant attributes; and"
- the cost involved for end users to switch to substitute product.

These competitive pressures referred to by Thompson *et al*. (2005), are relevant to the study and will be assessed in Chapter 4 when concluding.

2.2 The High Price Barrier

The initial costs for the purchase and installation of a SWH is high when compared to an electric water heater (Dintchev, 2004). The SWH is not attractively priced due to the poor market share and can cost up to 10 times that of an electric water heater. This high initial cost prevents low-income households from switching to this technology resulting in the non-utilisation of the SWH by the end user in their household. South Africa is a large developing nation that has a majority of low-income earners who cannot afford

SWHs. Holm (2005) agrees that affordability is one of the barriers to solar water heating to the end user. Low-income households utilise their income primarily for their basic necessities. Many low-income households do not even have proper water and electricity facilities and so solar water heating is not a concern to them. In some low-income households, hot water is obtained by the primitive method of heating water in metal containers over a wood fire.

SWHs have also been piloted in low-income households in South Africa as part of internationally funded programmes by the United Nations to assist the poor with basic facilities. However, the high cost of the SWH deters this technology from developing in this low-income sector and the impact of these projects could be greater if the SWH was more cost effective (Prasad, 2007). The Kuyasa pilot project has already commenced in Khayelitsha in Cape Town, to determine the financial and technical viability of assisting the low-income households with retrofitted SWHs. Another project, SESSA50 (Sustainable Energy Society of Southern Africa), also installed approximately fifty subsidised SWHs in and gathered useful performance data for a full assessment of the SWH (Prasad, 2007).

Ongoing efforts are being made by the South African Government to electrify low-income rural houses. However, even at current electricity prices, electricity remains unaffordable to several low-income households in South Africa. The majority of the low-income sector relies heavily on the government's 'free basic electricity' of 50 kWh per month for their needs. However, this free basic electricity is insufficient to sustain the operation of an EWH and the SWH is an alternative. According to Prasad (2007), several low-income households have access to electricity but they cannot afford the monthly electricity costs and continue to cook using primitive methods. "The electricity consumption rate among the poor remained extremely low" (Prasad, 2007, p. 4). This is a clear indication of the abject poverty evident in South Africa.

According to Dintchev (2004) SWHs are used (in limited numbers) by the middle-income market because they can afford SWHs. This middle-income market can rely on their electricity savings to offset the capital cost over a period. GEF (1997) states that in the middle to high-income sector, SWHs are considered as luxury items. This means that only a small percentage of people within the middle-income sector would be able to afford SWHs and be able to benefit from the electricity savings. Harris *et al* (2008) states that the electricity savings is a long-term benefit of SWHs and these savings can equate to approximately 36% of the consumer's electricity bill.

The high-income market sector also uses SWHs, but price is not an issue for them, as they are more concerned with the reliability of the product (Dintchev, 2004). High-income end users prefer reliability because they do not want the inconvenience of dealing with failures and re-installations. Intensive marketing is required to convince this sector to purchase a SWH. However, this is a small sector accounting for only 11% (Department of Energy, 2009) of households and the impact for mass rollout in the high-income sector is possible but can be limited. The greatest rollout effect for solar water heating would be to target households that currently used stove based water heating and EWHs.

There is enormous potential for the SWH industry to achieve economies of scale and critical mass prospects. However, a crucial barrier to overcome is the cost of the system since the market is still in its infancy stage. Austin and Morris (2005) as cited in Visagie and Prasad (2006, p. 3) disagree with the term "infancy" used by Etzinger (2007) and believe that the SWH industry is generally "a matured industry in South Africa." In addition, "there is a significant body of knowledge in both industry and academia to support the modelling and development of the industry." Generally, mature industries should have sufficient entrants and the resulting market forces should bring the prices of SWHs down. This is, however, not the case for the SWH industry in South Africa.

The cost of SWHs ranges from R 5,000 to R 30,000 (Etzinger, 2007). The SWH is priced very high in comparison to its substitute, the EWH. The price of a 150 litre EWH averages at R 7,000 fully installed (SEA, 2009). Hence, there could be a natural tendency from the end user to select the more cost-effective product, which in this case, is the EWH, because it achieves the same result. Furthermore, consumers, generally, do not have access to large amounts of money and would choose the lower priced product to minimise their investment. In Brazil and Namibia, countries with low electricity prices, the high upfront cost and the constraints on the availability of financing were also identified as barriers to SWHs (Lutes *et al*., 2008 and Emcon, 2005).

Internationally, the cost of a SWH system varies considerably between countries. According to Menanteau (2007), the cost of SWHs in India and China can range from 300 € to 400 € whereas countries of northern Europe have costs ranging from 5,000 € to 7,000 €. The cost differences are due to the hot water requirements and hours of sunshine resulting in installed surface area of the collector varying from 2m² to 6m² per installation. However, there are also significant differences in the cost per unit of area (Figure 2.2, below) of the solar collector. In Europe, a SWH system costs on average between 600 €/m² to 900 €/m² compared with 200 €/m² to 300 €/m² in India, China, Greece, Turkey and Israel. In general, systems cost less in southern countries because they have more sunshine (Menanteau, 2007).

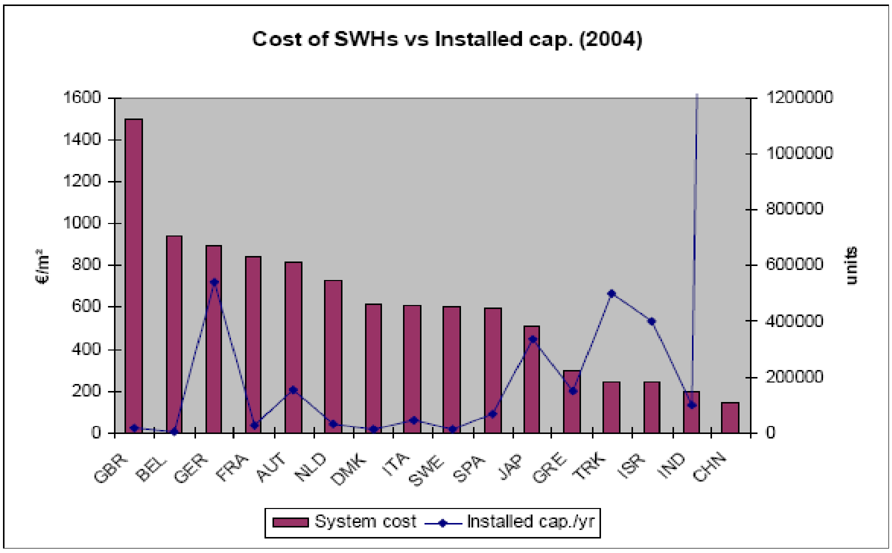

Figure 2.2. Cost of SWH versus Installed Capacity

Source: ESTIF, 2006 as cited in Menanteau, 2007, p. 6.

From Figure 2.2, it can be seen that the price of SWHs in China, India, Israel and Turkey are the lowest from the countries surveyed. These countries also have a large base of installed capacity of SWHs, with the exceptions of Germany and Japan. The countries that have large installed capacities have already developed SWH markets and this could possibly be the reason for the lower costs of their SWHs.

Another contributor to the price of SWHs is import duties in South Africa. Currently, SWH components are subject to a 15% import duty (Du Plooy, 2007, p. 81). The import duty was introduced to protect employment and the local manufacturing industry. This import duty combined with the Value Added Tax (VAT) of 14% places a huge levy on the SWH purchaser. The World Trade Organisation is currently seeking to remove import duties on environmental goods and services (EGS) among its member countries across the globe. However, this process is being hampered by the improper and agreed-upon definition of EGS (Du Plooy, 2007) resulting in no immediate relaxation on import duties.

In an opening address to delegates of the AMEU convention, the South African Minister of Minerals and Energy stated that, "The reduction of import tariffs exemptions for equipment like solar water heaters which are currently in short supply nationwide and globally is an enabling norm for the country" (AMEU, 2008). The comment from the Minister is relevant and may be an indication of future policy changes regarding import duties. Reducing import duties can assist the SWH market to develop but cognisance has to be taken of the macro and micro economic climate in South Africa.

If the SWH is to be promoted to consumers, then a financing facility must be offered to assist the consumer pay off the high upfront cost. Visagie and Prasad (2006, p. 23) are in support of attractive financing options since "the high capital cost and the absence of affordable financing schemes prevents the uptake of SWH." The SWH finance policy should focus on financial institutions, manufacturers, suppliers, end users, household insurance providers and installers. Tulleth (2008) supports the notion of financing schemes but mentions that capacity is required to develop these attractive financing schemes and that such funding models should target different niche markets.

Kevin Nassiep (2008), Chief Executive Officer (CEO) South African National Energy Research Institute (SANERI), advocates the need for policy measures so that financial institutions can be encouraged to support SWH financing through models such as utility models, municipal savings recovery or mortgage bond access. It is further mentioned that some of these financial institutions have shown interest in financing solar water heaters, even without subsidies.

International research found that India had offered a wide range of financial incentives to end users to promote the use of Domestic Solar Water Heating Systems (DSWHS). These included capital subsidies, low interest loans and an accelerated depreciation related benefits. These incentives could be applied to the South African SWH industry to promote the technology. However, the expected levels of penetration of SWHs were not satisfactory in India when measured in 2001. One of the critical factors identified for the low penetration level was the dissemination of information to inform the public of the financial viability of the SWH (Chandrasekar and Kandpal, 2003). It is therefore critical to analyze the various factors that contribute to the distribution of information on SWHs and the use of DSWHS in any country. By merely introducing financing mechanisms will not guarantee an immediate increase in SWH market penetration, as discovered in India. The process will take time as consumers begin to absorb and analyse the information at hand to effect change in behaviour that leads to purchasing a SWH.

The financial support given by the government of Greece for the promotion of locally manufactured SWHs “created an opportunity, and a market for the emergence and establishment of a local industry," which developed during the 1980s. Although the local industry was quite developed by the early 1990s, this local industry was a significant contributor to the growth of the SWH industry in Greece (East Harbour Management Services Ltd and Energy Library & Information Services Ltd, 2002).

In Jordan, the government had assisted the local industry to produce inexpensive SWHs by exempting Jordanian companies from paying customs duty on materials needed for the production of solar water heaters (ESIF, 1995). Similarly, in Barbados, legislation was promulgated to allow manufacturers to import materials duty-free and consumers were provided with either a partial or full tax deduction (Meyer, 2008c, p. 48). In Barbados, “There are currently over 35,000 solar water heaters installed and this is equivalent to about one in every three households. Solar water heaters are also widely used in the hotel industry” (Refocus, 2004). Although Barbados is a small island, the support given by the State to in terms of legislation and incentives to promote SWHs are commendable. The reduction of import duties on the components for SWHs in South Africa could be an important catalyst to the SWH industry.

The solar water heater market in Morocco has been faced with the following impediments relating to the price and financing of the product (UNDP, 1999, p. 4):

- The end users could not clearly distinguish between systems since low price and low quality systems were being offered next to high price and high quality systems. Therefore, competition based on a reasonable price compared to the quality was impossible;

- The current market is small and bulk importing of SWHs and/or components is limited, resulting in low production with high prices;

- The price of SWHs in Morocco was more than 1,5 times that of SWHs in countries in Europe, Asia and Africa.

- The development of dedicated financial instruments was hindered by the limited ability of financial institutions to appraise SWH loan applications thereby preventing potential domestic end users from purchasing SWHs;

- The time involved and overhead costs in providing these loans for domestic SWHs are best handled by financial institutions.

The experience from Morocco shows that there are no simple solutions to remove the high price barrier to SWH since financing mechanisms also has further associated problems.

Many experts believe that SWHs have long-term financial benefits when compared to EWHs. The long run operating cost can provide an indication of the feasibility of the SWH. A substitute product should not cost higher to operate over the life of the product because this depletes any accumulated benefits. Using the assumptions that a 150 litre EWH costs R 6,900 and a 150 litre SWH costs R14,000 after the Eskom rebate, the following graph compares operating costs for the SWH and EWH over a 20-year period.

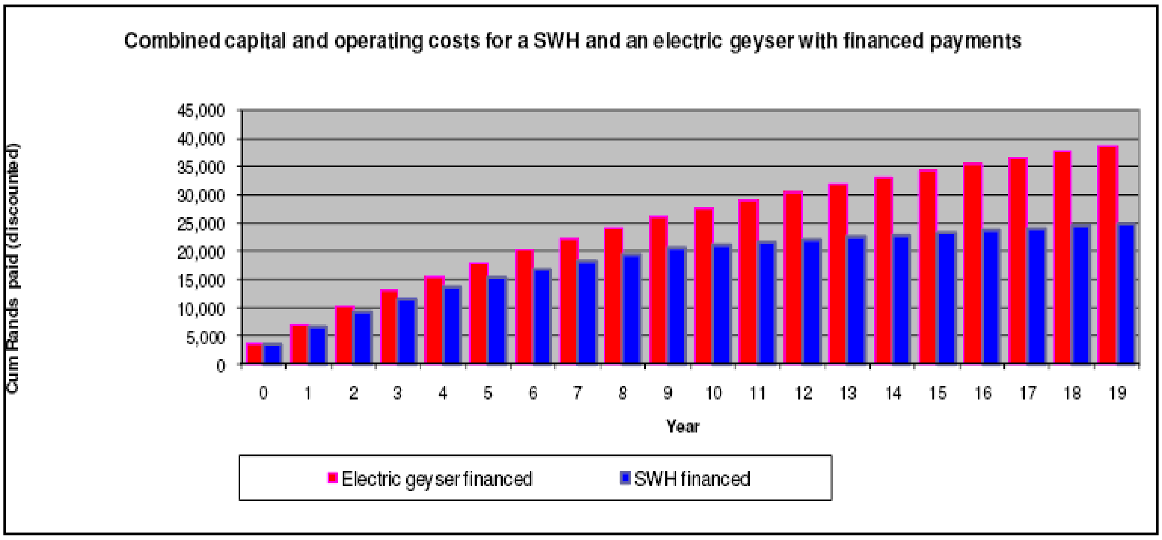

Figure 2.3. Operating Cost Comparison of the SWH versus EWH

Source: SEA, 2009, p. 4.

When a broken geyser needs to be replaced with a SWH which is financed at an interest rate of 15% over 5 years then the end user pays an annual bond instalment of R 2,789.52 (R232.46 x 12), whereas a financed EWH over the same period costs R 1,375 in annual bond instalments. The electricity costs for the SWH in year 0 is R 786 while the electricity costs for the EWH R 2,313 (SEA, 2009). According to Figure 2.3, the total costs for the SWH in year 0 are R 3,576 as compared to the EWH costs of R 3,687 yielding a financial benefit of approximately R 112 in year 0 in favour of SWHs. This financial benefit increases annually over the life of the product and in year 10, the end user could save R 7,620 by using the SWH. Also noticeable in Figure 2.3 is that the operating cost of an EHW steadily escalates due to electricity price increases whilst the operating cost of the SWH tends to escalate at a much slower rate, due to its lower dependence on electricity. The benefits continue throughout the estimated 20-year life for a SWH (SEA, 2009). The source data for figure 2.3 can be found in Appendix 1.

An economic barrier was the main reason for the solar water heating technology not being adopted in Namibia. That is, consumers could not justify the cost and return of installing a SWH due to the high upfront cost while the price of electricity was low. However, Howard and Scholle (2006) argue that the economics are improving in favour of SWH.

Many commercial users of SWHs believe that financial institutions make it difficult for them to get finance. The economic case for commercial and institutional facilities is even stronger than the domestic case. "Commercial finance is made available based on bankable information which can show real savings over the life of a project" (Howard and Scholle, 2006, p. 113).

The Namibian Ministry of Mines and Energy (NMME) has created a Solar Revolving Fund, which provides finance for renewable energy technologies on favourable terms. In addition, the NMME has also reached a financing agreement with commercial banks. These methods of finance are essentially a form of subsidy for consumers in Namibia. The table below shows the options for financing a SWH in Namibia.

Table 2.1. Financing Methods in Namibia

Institution	Deposit	Interest Rate	Maximum Term	Capital Loan limit
Namibian Ministry of Mines and Energy	5%	5%	5 years	N$30,000
Commercial Banks	5%	Prime less 5%	6 years	>N$30,000

Source: Howard & Scholle, 2006, p. 113.

By introducing low interest rates of 5%, the SWH monthly repayments for a loan become more affordable to the purchaser.

For the lower income household, the home loan option over a longer term (20-25 years) is more affordable than the other sources of finance. The "subsidized" finance is mainly being used by middle to higher income households and is no longer a barrier to the high and middle-income households in Namibia. In the average household, if the family can afford an EWH they should be able to afford a financed SWH (Howard and Scholle, 2006). Extended home loan financing could be applied to the South African environment for end users that would have access to such a facility. This would provide affordable monthly repayments due to the longer finance term.

To assist the development of the SWH market the following solutions are proposed to unlock price advantages (Botha, 2008, pp. 8 - 11):

- Make the instalments as cost effective as "possible for homeowners only pay savings portion." This term for the finance could be from 5 years onwards;
- Increase the local production capability,
- "Target high density applications such as townhouses, residential, new housing developments, mining and villages;"
- Eskom employees should be included in the first phase of the SWH rollout as this automatically creates a mass rollout;
- Banks can be good corporate citizens who actively promote SWHs and encourage environmental sustainability; and
- Household insurance providers are to ensure that a failed EWH is replaced with a SWHs.

The solutions identified by Botha (2008) are key to unlocking the high price barrier to SWH. These will be discussed in Chapter 4.

Milton (2006, p. 2) suggests that in areas, where the prices of SWHs are outside the reach of most people, governments can be active in providing subsidies to the end-user. Governments can exercise several options to assist end users that are purchasing SWHs. These include:

- Governments can intervene to provide subsidies to low-income households;
- Governments can force financial institutions to provide "low or no interest" rate loans to buyers of SWH systems; and
- Governments can offer tax incentives such as "sales tax exemptions and personal income tax deductions" to the purchasers of SWHs (Milton, 2006, p. 2).

The government in South Africa has offered minimal support to the SWH industry and therefore the options identified by Milton (2006) are not available in South Africa. The only financial assistance available is the Eskom rebate.

2.3 The Lack of Awareness Barrier

Solar water heaters have been used in South Africa, but their prevalence has varied over the years. During the period, 1978 to 1983, the Council for Scientific and Industrial Research's (CSIR) communication strategies had encouraged homeowners to fit SWHs. The market focussed on the high to middle-income earners who were able to afford the initial expense, "either with a home improvement loan or by paying cash." The SWH industry flourished having six major companies manufacturing and/or installed SWHs. However, in 1983 the SWH communication project ended after the discontinuation of the CSIR awareness campaign resulting in the SWH market collapsing (Prasad, 2007). The government support (via the CSIR) and promotion assisted the SWH market during times when the price of electricity was exceedingly high during the early 1980s. During this period of high electricity tariffs, consumers sought to reduce their electricity bill and the most efficient method to achieve this, was to install a SWH. The option of SWH existed and the public was aware of this option at the time.

The White Paper on Renewable Energy (2003) gave a new perspective and created renewed interest in the SWH market during 2003. According to Nassiep (2008, p. 13), the White Paper on Renewable Energy (2003) calls for:

- "Real and measurable increase in the use of renewable energy, based on prescribed targets;
- strategies to be developed to promote specific areas where renewable energy could be developed;" and
- policy (development) to create an enabling environment for renewable energy" Nassiep (2008, p. 13).

The White Paper (2003) on Renewable Energy included SWHs resulting in SWHs being recognised as a means to achieving renewable energy targets.

The SWH 500 project was launched in South Africa in 2003 and one of the objectives of the project was to create awareness through SWH exhibitions, media, manufacturer consultations, municipalities, non-governmental organisations, public and private entities and renewable energy conferences. Manufacturers had tendered for the project and subsidies had been given for the 500 SWHs to be purchased (Moosa, 2007). This was the first initiative following the late 1980s campaign to promote the use of SWHs.

Although the SWH technology does exist in South Africa, there is limited communication promoting this technology. According to Cawood (2007), in South Africa, there was almost no marketing or promotion of SWH and therefore there was very little known about the SWH. Of recent note, Eskom has been providing financial rebates for consumers who install certified SWHs. Although there are mixed views on the process of claiming this rebate, it is creating some awareness on the benefits of solar water heating. However, a comprehensive approach to awareness is required and governments should get involved to promote environmental sustainability. Holm (2005) explains that the market can develop when there are government policies to help with the promotion of the product. The introduction of financial incentives for SWH utilisation could also improve awareness and promote solar water heating. "Countries with good solar radiation levels but lack government policy, have not achieved market transformation" (Holm, 2005, p. 19). This is definitely evident in South Africa because there is an absence of government interventions to promote SWHs. Consequently, the benefits of this technology are not being fully explored and disseminated to the broader public by the mainstream television or radio. Cawood (2007) mentions that government support was evident in China and almost all European Union countries and this had helped expand their markets. According to the Emcon (2005, p. 43), the SWH market can be stimulated by government support where public and private sectors are encouraged to use SWH at their facilities. The Namibian Renewable Energy Programme (NAMREP) found that a lack of awareness was the largest barrier to SWH and as a result commissioned a SWH awareness project that targeted specific stakeholders to promote accelerated government and private sector uptake. The target of this campaign included the following stakeholders in Namibia:

- "The National Housing Enterprise (responsible for the construction of houses);
- The hospitality industry;
- Department of Works (responsible for capital projects and maintenance);
- Government ministries;

- Financial institutions;
- Plumbers;
- Housing developers;
- Consultants; and
- The public (through media programmes)" (Howard and Scholle, 2006, p. 113).

Findings from Namibia have shown that awareness among stakeholders and the end users is poor due to the following factors (Emcon, 2005, p. 5):

- Awareness of the solar technology as an option for providing hot water, is lacking;
- The capital and operational costs throughout the product life are not transparent;
- There is very knowledge on the environmental pollution that results from electricity generation;
- There is insufficient awareness on the products quality, reliability and performance.

The findings from Namibia can be applied to South Africa and alludes to the existence of an awareness problem.

Meyer (2008c, p. 49) identifies 'another barrier' related to awareness that prevents governments from adopting sound policies to support solar thermal technologies – "there is a lack of awareness of its possibilities." Meyer (2008c, p. 49) further discusses the three critical factors as identified by the International Energy Agency (IEA) to ensure success of a SWH programme: "Take a long hard look at what needs to be done to get people not only to buy the products, but to want to buy them" Meyer (2008c, p. 49). The domestic sector does not see any potential benefits of the product because they have not been informed of the benefits. However, if the consumer acknowledges the benefits of the product, the high upfront costs become the next hurdle.

Recent surveys have indicated that consumers in general, are not aware of the potential of SWH to reduce electricity bills and the indirect environmental impacts of EWHs (Dintchev, 2004). The customer is generally unaware that by using a SWH, they can save at least 25% off the electricity bill. In some cases, customers may not even be aware of the equivalent monetary value that would be saved by using SWHs in their homes. It is not necessarily in Eskom's best interest to promote the use of SWHs since Eskom generates revenue by electricity sales. However, with the current electricity reserves being depleted by additional demand, Eskom is rethinking its position and has begun promoting energy efficiency measures. Although, the electricity savings from using SWHs have been published in their information brochures, there is no direct cost attached to this (Eskom DSM, 2009). Eskom does not determine the tariff that is being charged by individual municipalities, so the savings will vary according to the tariff in the specific area. Therefore, only the daily energy savings in kWh is published. The long-term benefits and operational costs of SWHs are not officially publicised for the end user to be aware of and to evaluate.

Public awareness of the cost and benefits of SWH technologies was also found to be lacking in Albania. The benefits could easily be derived since Albania has over 220 sunny days per year and approximately 82% of their water heating is achieved by electricity. The project to raise awareness through marketing in the private sector included awareness campaigns on the television, radio, printed media information, leaflets and booklets (Fida, 2005).

In a study commissioned by the Central Energy Fund, one of the lessons learnt is that the investment in public awareness programmes can lead to flourishing SWH industries. This has been evident is India, China, Australia and Austria (Balmer, 2007, p. 16). These countries are amongst the top ten for having the highest solar collector installation per capita.

South Africa's Department of Energy (DoE) has acknowledged that heating consumes vast amounts of electricity and the widespread installation of SWHs in domestic, industrial and commercial buildings has the potential to postpone the need for building new electricity generation plants. However, there is a lack of demand for SWHs due to "low public awareness of the technology or its economic benefits" (White Paper, 2003, p. 36). Several strategies have been outlined in the White Paper (2003) to assist in increasing public awareness of the benefits of SWH.

In Brazil, there is a "lack of awareness of the technology's multiple advantages, characteristics and aesthetic solutions on the part of architects, engineers, builders, and other professionals" (Lutes *et al.*, 2008, p. 10).

The awareness on the supply side as proposed in a United Nations Development Programme (UNDP) project suggests that the plumbing and building construction sectors need to be aware of the benefits that SWHs can provide to end users. This awareness could be increased if the technical and economic information on SWHs is circulated amongst plumbers. Plumbers are regularly involved in executing repairs and installations at end user's premises and would be ideal 'ambassadors' to promote SWH awareness in non-urban areas. The information pack for plumbers could include: technical SWH standards, most cost effective applications from various suppliers, detailed financing information, technical installation brochures and maintenance tips (GEF, 1997). The question on whether plumbers can be competent teachers or salespeople has to be considered when plumbers are required to step outside of their profession.

Awareness of SWH systems was also hampered in Morocco and the following promotion related barriers were subsequently identified by the UNDP (1999). These are:

- "Little experiential knowledge on the costs and benefits of SWHs is available (to the public)" (UNDP, 1999, P. 4);
- Many old solar water heating systems function inefficiently or have stopped working all together, thereby creating a bad image for the SWH industry; and
- "There is very limited awareness of the potential of solar water heating for public, residential and private commercial sectors (among key decision makers, architects, engineers and end-users)" (UNDP, 1999, p. 4).

There have been high participation levels achieved in Hawaii through multi-channel marketing, financial incentives and strong quality assurance (Richmond *et al.*, 2003). This marketing has led to a form of awareness in Hawaii.

During the 1980s, low quality installations had a negative influence on the Italian solar heating market. A new initiative 'Paese del Sole,' supported by the stimulated demand through advertisements, public relations and public events in cooperation with local promoters, installers and suppliers. The main objectives relating to awareness were:

- "create a strong local promotion network;
- stimulate demand with advertisements, public relations, public events and customer support services" (Ambiente Italia, 2003, p. 1).

A number of promotion tools and customer services had been developed on a national level as part of the "Paese del Sole" initiative:

- "the creation of an internet platform: www.paesedelsole.org;
- a call centre run by Assolterm (solar industry association in Italy);
- production of a leaflet for residential customers;
- brochures and presentations for groups such as public housing, hotels, sport centres etc.;
- training for planners and installers;
- updated details of competent installers; and
- information on the subsidy schemes" (Ambiente Italia, 2003, p. 1).

Recently, Eskom DSM has published information on certified suppliers, the rebates offered and SWH information brochures on their website. Eskom DSM also has established a SWH call centre (Eskom DSM, 2009). These initiatives by Eskom are similar to the Italian awareness campaign.
In Berlin, the Solar Campaign was launched in 2000 by the Berlin Senator, Peter Strieder. The main barriers that the Solar Campaign sought to remove were a lack of information and a low degree of willingness amongst consumers and organisations to invest in the technology. The public awareness-raising effort revolved around the Solar-Service-Centre which provides competent technical advice, gives information on grant programmes and brokers contacts to solar enterprises. There is also a dedicated hotline and internet homepage (http://www.berlin-solar.de), the Solar- Info-Mobile (organises and conducts more than 20 information tours per year) and targeted information and

press activities. These included the publication of a free information brochure on solar energy use, prize draws and the hosting of a solar festival. An incentive for contractors was the Berlin contractor, who installed the largest number of solar installations, is crowned as the ‘solar king’ (Energie-Cites, 2001). South Africa has not yet implemented a comprehensive campaign as Berlin did and could use Berlin’s strategy for the development of its local SWH industry.

Barcelona implemented a broad communications programme to publicise its Solar Ordinance programme. A booklet was published explaining the programme in different languages and held regular meetings with engineers, contractors' associations, architects, environmental organizations, neighbourhood associations and the public to promote solar water heating. The State also promoted the ordinance programme in nearby cities, demonstrated projects such the as solar thermal installations at swimming pools and hosted a ‘Solar Day’ in Barcelona (Mendonça, 2006).

There has been widespread agreement by many experts that marketing and communication in support of SWH is required. Education is also required to change the perceptions of consumers (Etzinger, 2007). This is a huge task and responsibility should lie with the Government and other corporate organisations to promote awareness so that consumers can change and understand why change was required.

According the GEF (1997), the most effective method of creating awareness in South Africa is by disseminating information to the public through industry bodies such as the Institute of Plumbing of South Africa (IOPSA). This industry body produces a quarterly trade journal called “Plumbing Africa” in which articles could be submitted for publication. Articles could be submitted to the editors of industry journals for the building sector. The use of journals to disseminate information on solar water heating could increase awareness but the audience is limited because only a selected number of people subscribe or have access to these journals. It may be beneficial to create awareness in family and personality-oriented magazines that are purchased by households. Newspaper articles, television and radio broadcasts could target a broader audience to improve awareness.

Contrary to some research findings, the SWH industry in South Africa is currently experiencing growth with many positive sentiments. “The media have included more coverage; notably advertisements in several local and national newspapers from the Central Energy Fund (CEF) and two articles by Eskom encouraged the industry” (Prasad, 2007, p. 7). There have been several articles in the print media about SWH and the incentives offered by Eskom. Technical articles relating to SWHs are also published in engineering periodicals. Furthermore, Eskom has published relevant information on their website containing energy savings tips, SWH brochures and the facts on fossil fuel consumption for electricity generation. These modest attempts to create awareness are optimistic. However, in light of the current electricity security concerns, widespread awareness campaigns are required to expedite the rollout of SWHs. Howard and Scholle (2006, p. 114) iterate that “awareness creation requires a sustained effort.”

2.4 Insufficient Legislation and Incentives Barrier

The SWH market in South Africa was destroyed in 1961 when the local manufacturer (who had been in operation since 1954) was forced to close down. The government did not at the time, offer support but opposition. “In 1961 the government doubled the rail rates for all manufactured goods and reclassified solar heaters so that they were subjected to the highest transportation tariffs” (Butti and Perlin, 1980, as cited in Meyer, 2008c, p. 48). The high transportation costs forced the price of the SWHs to increase resulting in it being unaffordable to a majority of the end users. The Government funded research on SWHs by the CSIR at the time, was not considered in the decision to reclassify SWHs (Meyer, 2008c) and this meant that the government was working in opposition to its own research.

2.4.1 Legislation

To date, South Africa unlike other countries, has not introduced legislation, which not only enforces usage of SWHs but also facilitates the expansion of the SWH technology (Dintchev, 2004). With South Africa’s largest utility, Eskom, having low electricity reserve margins, greater effort should be put into reducing the demand for electricity. However, the lack of legislation to enforce this, results in the status quo being left unchanged. Nassiep (2008) agrees that one of the barriers to SWH is that the "legislation to make SWH mandatory is not promulgated" Nassiep (2008, n.p.) This regulation should be applicable to the residential sector. Similar recommendations were made by Visagie and Prasad (2006) supporting local government bylaws for the mandatory use of SWH in homes.

Cape Town's Energy and Climate Change Strategy sets a target of 10% for all urban households to use SWHs by 2010. Nevertheless, the inevitable question is; "Why is this not currently happening?" (Energy, 2008, p. 17).
"A willing-buyer, willing-seller environment will not deliver on renewable energy targets in time," says Nassiep. "We need to explore other ways of delivery" (Energy, 2008, p. 17).

One problem that exists in South Africa is that, at least until the six Regional Electricity Distributors (REDs) are operational, local municipalities are reselling the electricity purchased from Eskom and promoting electricity savings technologies (Energy, 2008, p. 17). The revenue from electricity sales assists the municipalities in subsidising some of its other services and is regarded as an important source of income. With the creation of the REDs, revenue from electricity sales will go to the operating cost of the RED and not to the municipality to subsidise other services.

The Energy Services Companies (ESCO) model could assist municipalities in providing hot water solutions using SWHs to end users. ESCOs are companies that conduct an energy audit and develop solutions to reduce energy consumption. In this case, the ESCO purchases or finances the SWH and sells the hot water to the domestic or commercial end user (GEF, 1997). The municipality would arrange for the ESCO to install SWH in some households and create the necessary contracts with the owner of the household for the delivery of hot water at a negotiated price. The municipalities can then negotiate a percentage (or royalty) with the ESCO so that the municipality does not lose revenue when the consumer begins to use less electricity. Municipalities could adopt the ESCO model into their services agreement with electricity consumers.

Recent developments in the City of Cape Town suggest that a bylaw is imminent in order to meet climate change targets (Janisch, 2008). Cape Town is the first city in South

Africa to draft a bylaw that focuses on SWHs. Drafted well before the recent energy crisis in 2008, the bylaw will soon be ready for public comment. All new and renovated buildings above a certain cost (R 500,000 is the proposed figure), must achieve at least 60% of their household heating needs with solar energy. This prescriptive bylaw is going to negatively affect the growth of the property market since it targets the middle-income sector. However, it will only be applicable to new and renovated buildings above R 500,000 and the impact to the property market may be negligible.

There are several impediments to this bylaw being implemented and its inception in 2010 may be at risk. The proposed bylaw called City of Cape Town: Solar Water Heater Bylaw, "has been criticised for not addressing the issue of cost and financing of the SWH and for simply not being do-able" (Energy, 2008, p. 17).

In Brazil, there was a 15% increase in the sales of SWHs once end users learnt that legislation to make solar water heaters was being promulgated (Jennings, 2007). The end users might change their mind once they become aware of the proposed bylaw and subsequent enforcement. Therefore, the decision to introduce bylaws across the country should be communicated widely, before being promulgated. This could positively influence sales in the market and also ensures that manufacturers and suppliers have the necessary resources.

The successful campaign in Brazil for SWHs is the Cidades Solares (Solar Cities). Initiated in 2005, the two main objectives of the campaign were to implement solar building codes at the provincial and municipal levels and to organise training for engineers, architects and representatives of local authorities. Since there are about 5,564 municipal districts, the campaign only targets the main and strategic cities in the hope that its effects would spread across to other districts. By 2006, SWH bylaws had already been adopted in three cities in 2006 and a further twelve cities are considering implementation, says the Vitae Vicilis Institute (Jennings, 2007). The 2007 São Paulo law ensured that residential and non-residential buildings had SWHs installed (Alencar, 2009).

In Namibia, there's a cabinet decision for all new public, and state-owned buildings to install solar water heating (Refocus, 2004). This support from Government is a giant step in mobilising the public to begin to install SWHs.

Barcelona commenced drafting the Solar Ordinance in September 1995 and this entered into force in August 2000. The aim of the ordinance was to regulate the implementation of low-temperature SWH systems by applying legislation. The Solar Ordinance, was a major milestone in urban energy policy in Barcelona and required all new and refurbished buildings above a predetermined size category (292 Mega Joules (MJ) per day hot water energy consumption) to provide at least 60% of their domestic hot water requirements using SWHs. Swimming pool heating had to be achieved completely by solar means. Within a year after the ordinance became active, the total amount of solar collector area of solar thermal applications had quadrupled (Mendonça, 2006). The impact of this ordinance has been substantial for Barcelona. According to Prasad (2007), the draft SWH bylaw in Cape Town was extracted from the Barcelona ordinance.

Currently, Israel has the highest market penetration of SWHs in the world. Meyer (2008c, p. 48) offers an explanation and sums up the reason for this in three words: "intelligent government support." The Israeli government introduced a regulation under the planning and construction law in 1980, requiring new private dwellings to install SWHs. (Grossman *et al*, 2007, as cited in Meyer, 2008c). The legislation had increased the demand for SWH in Israel and once the local market had developed substantially, manufacturers had capitalised on export markets. Holm (2005) confirms that Israel has over 80% of SWH market penetration due to mandatory regulation. According to Roulleau and Lloyd (2008) the Israeli government enforced a mandatory policy for SWH deployment and nearly every household in Israel used a SWH in 2006. This policy was "radical but highly successful, mainly thanks to the very favourable solar regime and a strong emphasis on security of supply for the nation's energy system" (Roulleau and Lloyd, 2008, p. 1849).

The renewable energy certificate (REC) scheme in Australia was a world's first and included SWHs. Anybody generating renewable energy from eligible sources is able to register under the Act and apply for a REC. Legislation was enacted in 2000 in Australia to mandate targets for solar water heating and define the property rights relating to RECs. This created a greater demand for SWHs thereby making their economics more viable (Rossiter, 2007). The REC becomes more attractive to the electricity generator because they receive penalties if their energy generation mix does not contain renewable energy. The REC can be purchased from the holder and be used to offset the energy generation mix. The demand for REC's had grown rapidly, resulting in the country already reaching its initial 2010 renewable energy target (Jennings, 2007).

In the United States, Hawaii has become the first state to enforce SWHs in all new houses. Governor Linda Lingle, introduced a law requiring the energy saving SWH systems to be installed in homes, commencing in 2010. The new law also prevents building permits to be issued for single-family homes unless a SWH is installed. Exceptions to the law are for houses in forested areas (New York Times, 2008).

Howard (2006) believes that economic forces are inclined to support the utilisation of the SWHs and therefore there is no real need for legislation to compel SWH installation. "With awareness creation SWH uptake may be expected to improve as a result of natural market forces" (Howard, 2006, p. 113).

2.4.2 Incentives

There is a dire need for incentives to promote SWH in South Africa. The reason is that the SWH systems are typically very expensive and unaffordable to most low-income groups and some middle-income groups. Incentives have to be introduced to either assist with financing the SWH or give relief to those that have already installed the system.

Many countries including "Australia, Austria, Belgium, some Canadian provinces, China, Cyprus, Finland, France, Germany, Greece, Hungary, Japan, the Netherlands, New Zealand, Portugal, Spain, Sweden, the United Kingdom, many U.S. states, and the U.S. federal government provide capital grants (typically 20% to 40% of system cost)," rebates or partial or full tax deductions for SWH investments (Mendonça, 2006, p. 19). The provision of incentives by these countries means that there is a worldwide problem relating to affordability of the SWH. It could also mean that the inhabitants of these countries have little concern for the environmental pollution resulting from electricity generation.

Locally, Eskom announced the expansion of its DSM programme to provide $300 million in financial incentives, towards the installation of one million SWHs over a five-year period from 2008 to 2012 (Du Plooy, 2007, p. 81). The programme offered discounts to all customers who install SWH through an Eskom accredited and SABS approved supplier. Information from Eskom's supplier list shows that the range of the rebate is from R 990 to R 5,073 (Eskom, 2009) and the rebates are dependent on the efficiency of the SWH. For the end user to qualify for the rebate, the SWH should:

- offer a 5 year guarantee;
- the SWH must pass the South African Bureau of Standards (SABS) tests and comply with the South African National Standards (SANS) for thermal and mechanical performance and safety;
- the supplier of the SWH must be registered with SESSA (Eskom DSM, 2009, n.p).

Eskom also has a dedicated SWH call centre dedicated to assisting end users with information relating to SWHs and/or the Eskom rebates. There are currently over 100 suppliers on the Eskom suppliers list.

The Taiwanese government developed a six-year incentive programme commencing in 1986 aimed at developing indigenous and renewable energy sources and encouraging the installation of SWHs. The SWH industry expanded swiftly reaching approximately 60,000 m^2 (in solar collector area) installed per year. The installation of SWHs slowed down during the period 1995 to 1999. The government then initiated another incentive programme that lasted just over four years following the 'Measure for promoting Solar Hot-Water System' programme in 2000. During the latter programme, the State provided financial incentives to the end-users based on the installed area and the type of solar collector. In remote islands, the subsidy was doubled to encourage and promote the installation of SWH. However, very few commercial systems had installed SWHs. In order to qualify for the financial incentive programme, all qualified products, suppliers, installers and manufacturers had to be certified (Chang *et al*., 2006).

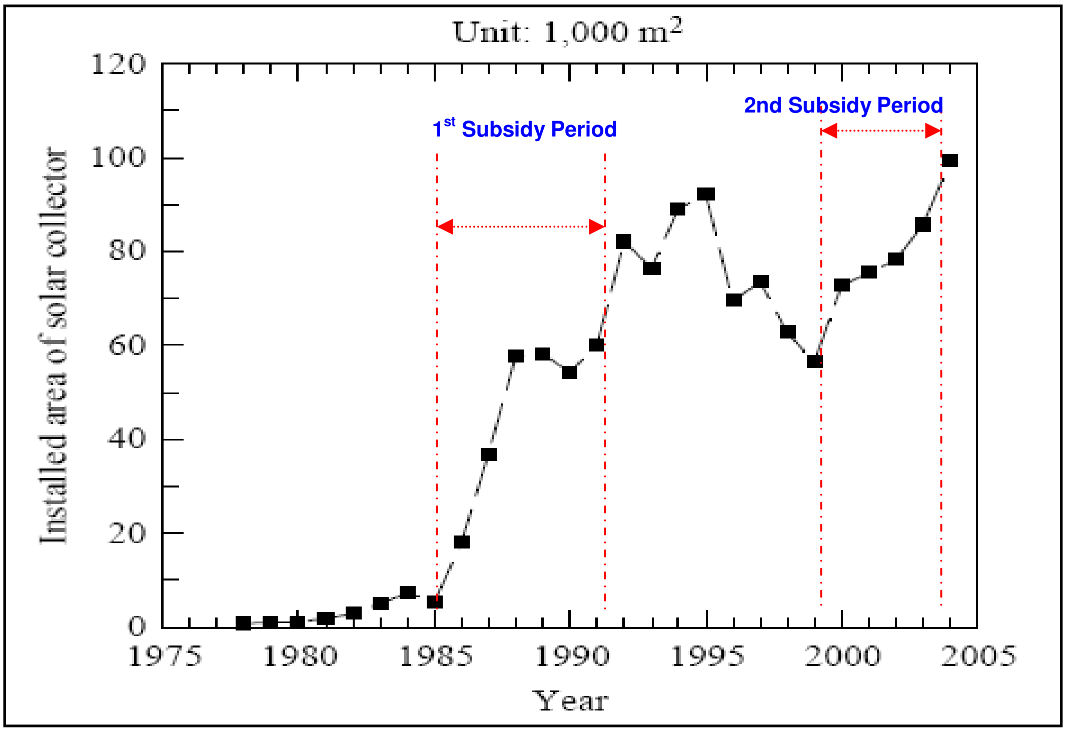

Figure 2.4. Total Installed Area of Solar Collectors in Taiwan

Source: Chang *et al*, 2006. p.1307.

According to Figure 2.4, during the first subsidy from 1986 to 1992 in Taiwan, there was a significant increase in installed SWHs. Once the subsidy was stopped in 1992, old units began to fail and these were not replaced resulting in the installed base to decrease. However, when the next subsidy was introduced in 2000, the installed base began to grow concluding that subsidies did play an important role in the SWH industry in Taiwan. Therefore, the current subsidies offered by Eskom should not be stopped because it is slowly helping the market grow.

The Fiscal Incentive Act of 1974 in Barbados introduced mechanisms such as import tariff reduction and tax breaks including a 30% consumption tax on EWHs that helped to make SWH industry competitive. The Act was the result of the energy crisis in the 1970s. "Barbados' success in the area of solar water heaters has been unique in the Caribbean region, the number of SWHs in Barbados being greater than that of all other Caribbean countries put together" (Refocus, 2004, p. 19). Homeowners gained concessions on their mortgages and the payback period in most cases was under 3 years.

Milton (2006) mentions that close to 33% of homes in Barbados are equipped with SWH systems while in India the technology is commercialized.

India had used a variety of financial and fiscal incentives to promote the use of SWHs. However, the total collector area of SWHs reportedly installed in 2007 was below the expected levels of market penetration due to a several barriers (Chandrasekar and Kandpal, 2003). This raises the question whether financial incentives alone would assist in promoting the technology.

Greece introduced income tax deductions for the purchasers of SWHs in the late 1970s to stimulate the industry. In 1990, various policies and legislation were implemented that helped support SWH technologies. The end user could reduce the purchase costs of the SWH by up to 40% (maximum tax rate at that time) by taking advantage of the tax deduction (Hack, 2006). The initial incentive scheme discontinued in 1991 and from 1995, Law 2364 provided tax exemptions to households purchasing renewable energy products, such as SWHs. The law allowed a 75% tax deduction on the purchase of a renewable appliance (East Harbour Management Services Ltd and Energy Library & Information Services Ltd, 2002). The SWH campaign called the Operational Programme for Energy commenced in Greece in 1994 and provided a total of €140 million in funding for the development of renewable energy. In 2000, a new Operational Programme for Energy commenced and this plan supported "tax exemptions, loans and third party financing for renewable energy in the building sector" (East Harbour Management Services Ltd and Energy Library & Information Services Ltd, 2002, p. 12). The introduction of multiple incentive schemes and policies to promote SWH helped the SWH industry in Greece to become a leader in this technology.

Australia developed the Renewable Portfolio Standard to promote the use of SWH, to reduce the electrical load with renewable energy sources. Users of new SWHs installation could apply for green certificates when these SWHs are used to displace electricity. Green certificates are paper certificates that indicate that the electricity generated is from "green" or renewable energy generating plants and are environmental friendly electricity sources (Refocus, 2004, p. 21). In Australia, electricity suppliers are obliged to purchase or generate a certain percentage of electricity from renewable energy sources and they can trade the green certificates, as an alternative to meet the renewable energy requirement (Refocus, 2004).

Rossiter (2007) mentions that SWHs were being used in Australia prior to support being provided at a national level by Renewable Energy Certificates through a series of uncoordinated and transient State grant schemes. Ledger, Sustainable Energy Society of Southern Africa (SESSA) Chair, is in favour of the Australian system: “A better system,” he says, “would be to adopt the Australian model where the householder is issued a tradable certificate linked to the international price of carbon” (Davie, 2008, n.p.).

Italy offers renewable energy certificates that also apply to SWHs and are so-called ‘white certificates’ (Mendonça, 2006).

Residents in Brazil using solar water heaters receive a 10% rebate on municipal taxes and this rebate increases to 15% if the heaters were manufactured in the city where they live (Jennings, 2007).

Financial incentives introduced in France have had a positive influence on the market for SWHs. The main motivation for the majority of French households that decided to invest in a SWH was the reduction of energy costs, i.e. the monthly electricity and gas-bill (Hack, 2006). This shows that financial incentives can be used to assist as a mechanism to promote and expand the SWH market.

Feldkirch in Western Austria offers a 25% subsidy for the installation of solar water heaters (East Harbour Management Services Ltd and Energy Library & Information Services Ltd, 2002).

The United States has more than five hundred thousand SWHs installed, mostly in single-family homes. These SWHs are mainly used to heat swimming pools. California introduced a bill in 2000 “that provided funds for solar water heating systems” (Mendonça, 2006, p .19). The Solar and Distributed Generation Grant Programme, provides funds up to $750 for SWHs (Mendonça, 2006).

The incentives offered in Hawaii are that residents can already get a handy 35% state income tax credit, in addition to taking advantage of the federal credit of 30% (up to $2,000, which expires at the end of 2009). Several of Hawaii's leading utilities are offering additional incentives worth $1,000 on a new SWH (The Daily Green, 2009).

The introduction of solar energy in Germany showed a 30% annual growth from 1995 to 2001 (Chang *et al*., 2006) and their incentive programme created a substantial impact on the solar energy industry. Gcabashe (2009) adds that a direct grant in Germany, applied over a 12-year period, has led to growth in installation of SWHs from 2% to about 40%. In France, tax deductions over a six-year period led to annual growth of 80% in SWH installations.

According to Holm (2005), long-term government incentive legislation has helped SWHs to thrive internationally in environments where the price of energy is high. However, South Africa has low electricity prices and therefore the incentives have to be very attractive for end users to look beyond the current barriers and utilise SWHs.

There are no financial incentives for SWHs in China yet these have been used in China since the 1970s resulting in China having one of the largest markets for SWHs in the world. The Chinese government only supported research into SWHs at the university level. The deployment of SWHs has been very successful due to the frequent electricity outages and environmental pollution occurring over the last decade in the country. Although China has an abundance of solar energy in many parts of the country, SWHs consist of only 10% of the water heating devices (Roulleau and Lloyd, 2008, p. 1850).
Gcabashe (2009) proposed that cost reductions could be realised by leveraging carbon credits on a programmatic basis under the Clean Development Mechanism of the Kyoto Protocol.

Subsidies may not be always be beneficial in the market. For example, France and South Africa initially experienced problems with installations. Incompetent technicians can easily be the cause of market failure even when subsidies are present (Meyer, 2008c).

Balmer (2006, p. 4) mentions that a blend of various incentives such as “capital subsidies, interest rate subsidies” and “financial incentives” to manufacturers, suppliers and end users have been use in several countries to stimulate the SWH industry. The following points require consideration (Balmer, 2006, p. 4):

- Subsidies should be linked to the price of electricity and that all electricity users should contribute to the cost of changing to renewable electricity. This can be achieved by including the cost of renewable energy into the price of electricity.

- Subsidies should be linked to energy actually produced by the SWH and not to installed capacity since subsidies are set and guaranteed at the outset of the programme.

The suggestion by Balmer (2006) have already been implemented in Eskom. Eskom is also applying for exorbitant tariff increases in 2008, 2009 and 2010, on one hand, and paying rebates for SWHs to purchasers on the other. This means that the funding for rebates has to be recovered in the electricity tariff to enable the organisation to be sustainable. In addition, the value of the Eskom rebate is proportional to the efficiency of the SWH.

The SWH 500 project had identified areas of learning from some of their projects. According to Milazi (2007, n.p):

- incentive schemes should not negatively affect manufacturers;
- some manufacturers who argue that subsidies are not the most appropriate way to engender growth of the SWH market; and
- there should be an effective ‘exit’ plan to ensure sustainability of the SWH industry after the removal of the incentive.

Manufacturers are concerned that subsidies will cause fluctuations in sales resulting in fluctuations in production. These fluctuations are not the ideal climate for any business to operate in as it affects cash flows and employment.

Etzinger as cited in Enslin (2007) mentions that “there may be some form of incentive for households, commerce and industry. Incentives will be for the entire market and not only for low-cost households” (Enslin, 2007, n.p.).

“Subsidies are often considered to be detrimental to fair competition unless there is an open choice in terms of material and installation – without compromising quality” (East Harbour Management Services Ltd and Energy Library & Information Services Ltd, 2002, p. 3). The benefits of subsidies may help one market but destroy another market. Therefore, the consumer should evaluate both electric water heating and solar water heating technologies before making the final decision. However, Tulleth (2008) mentions that subsidies for the manufacturing and installation of SWHs could help create jobs and this subsidy should be included in the existing housing grant for the poor. South Africa has a very high rate of unemployment and if the SWH industry expands, more jobs will be created and this could benefit the economy.

2.5 Technical Standards: An Indirect Barrier

Standards are developed to ensure that the quality and performance of products conform to certain predefined norms. As new players enter an expanding market, the risk of poor quality installations and products is possible. Therefore, it is necessary that mechanisms are in place to ensure quality equipment is supplied and installation standards are maintained to prevent SWH from obtaining a bad image (Howard and Scholle, 2006).

In a project brief, by the Global Environmental Facility, there were no codes of practice for the installation and maintenance of SWHs in South Africa. The report suggested that universal guidelines are essential to improve consumer confidence and the industry’s sustainability. These guidelines could also be used by the SWH industry, plumbers and housing developers, consumers and for small businesses that install and maintain the SWHs (GEF, 1997).

According to the White Paper (2003, p. 34), in order to “promote, enhance and develop technologies for the implementation of sustainable renewable energy, standards governing the design, installation and performance of renewable energy systems have to be delivered, together with a certification process" that verifies that systems adhere to these standards. Dintchev (2004) adds that it is important for SWHs to be tested and certified to gain acceptance and support from the local consumers. Basic rules have to be in place so that products can be compared or measured against there rules to determine their performance.

One of the technical barriers identified in the Namibian research included the absence of commonly accepted norms, standards and codes of practice (Emcon, 2005). Holm (2005, p. 83) had also identified standardisation and testing together with quality assurance and quality management as technical barriers in the solar market survey.

In Morocco, the absence of norms, standards, codes of practice, certification and performance contracts for SWHs fostered competition based on product price and quality. This resulted in low quality (under-performing) SWHs that are currently available on the Moroccan market to consumers. This could result in an under developed market in the long term. There is limited capacity and infrastructure in the private sector for local production, distribution, installation and maintenance of high quality SWHs resulting in the majority of SWHs being imported and the high costs of the product (UNDP, 1999).

According to Holm (2005, p. 32), the findings on standards used by the SWH industry in South Africa revealed that in 2005:

- the SABS mark was not carried by any of the local suppliers;
- only one retailer carried an internationally accepted standard mark and the European Union (EU) keymark;
- there were no local standards for the installation and maintenance of SWHs; and
- there were no certified installation or maintenance human resources.

According to the Eskom supplier list (Eskom DSM, 2009) several systems have obtained the SABS mark of approval. This local approval gives end users the confidence that the SWH has passed the quality management process and will be reliable. It is difficult to ascertain which suppliers have the EU keymark as the EU keymark is not a qualifying factor for the Eskom rebate. A recently published SWH standard outlines the procedure for the installation and maintenance of SWHs.

The European Union (EU) Solar Keymark was the first internationally recognised quality stamp for solar water heaters. The keymark is based on the following:

- "Initial type testing to EN 12975 or EN 12976 standard
- An implemented manufacturing Quality Management System (QMS); and
- An annual review of the QMS and bi-annual product inspections" (Solar Keymark, 2006, p. 3).

When a product has the Solar Keymark, it shows that the environment where the product was manufactured in, conformed to strict quality standards and processes (Solar Keymark, 2006). This is similar to SABS product certification and the SABS quality management process. However, the Solar Keymark is not valid for the Eskom rebate in South Africa. According to Eskom DSM (2009) "an imported system that has been tested overseas, will not necessarily be suitable for South African weather conditions."

This poor perception of standards changed in South Africa in 2006, when the South African Bureau of Standards (SABS) released the South African National Standard, SANS 10106, titled, 'The installation, maintenance, repair and replacement of domestic solar water heating systems' (SABS, 2009b). This meant that the industry had some guidance to install, maintain and repair SWHs. It also created an opportunity for regulation to be introduced and the local mandatory building codes could be amended to include conformance to this national standard.

There have been arguments pertaining to additional barriers being created by national standards. Emcon (2005, p. 22) stated that "national standards are a barrier to free trade and common standards such as International Organisation for Standardisation (ISO) should therefore be adopted as far as possible". However, South Africa has voluntary standards that have been derived from ISO standards that relate to SWH. According to the GEF (1997), "SABS 1307: 1992, SABS 1210: 1992 and SABS 1211:1992, are the South Africa SWH standards (based on ISO standards) applied to the mechanical and thermal performance of SWHs in South Africa." The standards could be incorrectly interpreted leading to potential abuse (GEF, 1997). The 1992 edition of the SABS standards mentioned by GEF (1997) have been revised and contain additional and updated information to protect the industry from poor quality SWHs. The amended standards are listed in Table 2.2 and adherence to these standards is a requirement for the Eskom rebate.

Harris *et al*. (2008) is in agreement with Dintchev (2004) and confirms that one of the main barriers for SWHs is the testing and certification of locally manufactured SWHs. This means that the all SWHs must conform to quality standards developed by the South African Bureau of Standards (SABS). Harris *et al*. (2008) also mentions that the testing facilities and procedures used to test SWHs were insufficient to effectively test and certify the products in the market. This resulted in the "establishment of national standards" (Harris *et al*., 2008, n.p) and the establishment of testing laboratories in Tshwane. The process to certify products should not result in a bottleneck in the supply chain because this hampers the rollout of SWHs in the industry. Reasonable measures has to be taken expedite the certification process and the establishment of a second test laboratory in Tswane will hopefully assist with this.

When Eskom had introduced the rebate for SWHs there were 53 SABS accredited suppliers registered on the programme. Although this list is burgeoning, Eskom has been conservative in selecting and registering suppliers: "Installers must be accredited and all systems must meet the SABS requirements to ensure quality," the utility said in a statement published in the Engineering News (2009). Eskom have been using a number of South African National Standards for calculation of the incentives they offer, as per Table 2.2 below, and currently have over 100 registered suppliers of SWHs.

Table 2.2. Standards Used to Determine Incentives

SANS Number: Edition	Description / Title
1. SANS 1307:2005 (SABS 1307:1992)	Residential solar water heaters
2. SANS 6210:1992 (SABS SM 1210:1992)	Residential solar water heaters - Mechanical qualification tests
3. SANS 6211-1:2003	Residential solar water heaters Part 1: Thermal performance using an outdoor test method
4. SANS 6211-2:2003	Residential solar water heaters Part 2: Thermal performance using an indoor test method

Source: Eskom, 2007. p. 9.

National certification of products is a requirement in several countries in order to qualify for subsidies or tax deductions when purchasing SWHs. Namibia had learnt that a form of certification is necessary in order to ensure that good quality SWHs are imported. With proper certification, consumers are protected from poor quality products and the reputation of the SWH industry remains intact. The quality of the installation is also important to the long-term durability and performance of SWH (Emcon, 2005). Eskom also requires conformance and certification in order for end users to qualify for the rebate.

The SANS 1307 standard, titled, Domestic Solar Water Heaters, has been on the market for several years now with several amendments. The 2009 edition of the SANS 1307 standard covers physical requirements, methods of testing and method of marking the SWH. This standard has 21 other SANS references (SABS, 2009a). This is a strong indication of the comprehensive nature of the standard. According to Sustainable Energy Africa (2007) clients can ensure compliance to the SANS 1307 standard which regulates the quality of SWHs being produced. The SABS also purchased a SWH test rig in 2007 that can accurately test systems against SANS 1307, and manufacturers are becoming compliant against this standard. Although the 2009 edition of this SANS 1307 standard is published, the Eskom rebate calls for adherence to the 2005 edition. Cawood (2007) agrees that the SANS 1307 standard is beginning to be applied throughout the industry in South Africa. This ensures there will be some quality assurance on the SWHs installed in the market. To maintain this quality standard, there needs to be ongoing support and monitoring from SABS, as opposed to once-off testing of a single SWH unit (Moosa, 2007). The stringent requirement to have every unit tested is not preferred by the manufacturers of SWHs. However, this is necessary to prove proper operation of the SWH and protect the reputation of industry. In addition, if the supplier is certified, there is no assurance that every SWH supplied by this manufacturer will be defect free.

In a study to investigate best global practice for SWHs, two types of standards for SWHs were found: the first focused on SWH components while the second on complete systems. The SWH standards applicable to South Africa should be used as a foundation for further development. The investigation team recommended that South Africa "adapt standards to the local situation, and use these standards" because South Africa can "conduct tests adapted to local conditions at lower cost, in a shorter timeframe, without shipping delays and in closer interaction with manufacturers." Initially, the "basic collector performance standards (e.g. based on OG100 or NF EN 12975-2) should be adapted" (Balmer, 2006, p. 3). The OG 100 standard specifies guidelines for certifying solar collectors whereas the European EN 12975-2 standard specifies test methods for solar collectors. There are also international standards such as the ISO 9806-1 and ISO 9806-2 that specify test methods for solar collectors. Locally, the SANS 6211 standard details indoor and outdoor test methods for SWHs and is used as a qualifying test for the Eskom rebate. Standards have been developed for SWHs in the USA, Greece, Australia, Europe, New Zealand and other smaller countries and each SWH is designed for its own operating environment.

Milazi (2007) believes that South Africa should develop its own standards and should amalgamate parts of international standards into local standards where relevant. Australia had already developed the SWH industry and produced a standard: AS 2712 for SWH. An international standard ISO 9459-5 is being developed for SWH (Rossiter, 2007). Although local standards are produced, the general consensus among standardization bodies is to use international standards where applicable or as references to local standards. This prevents duplication of work and barriers to trade as stipulated in World Trade Organization agreement on 'technical barriers to trade' (World Trade Organisation, 2002).

A standard AS/NZS 4234 has been developed in New Zealand so that SWHs "can be tested under standard reference conditions" (Solar Industries Association, 2009, n.p). This standard will provide guidance on system performance. The standard "sets out a methodology for calculating the energy performance of a SWH system under reference conditions in specific climate zones" (Solar Industries Association, 2009, n.p). This is important in certain countries like Australia (where there are four zones) and New Zealand (where there are two zones) for which the SWH performance is measured. Similarly, South Africa has developed its own standard taking into consideration the varying weather conditions.

Some of the successful SWH programmes have been due to standards and specifications. In the United States of America, the Hawaiian Electric Company (HECO) has the largest SWH programme with approximately 20,000 units commissioned between 1996 and 2002. The critical success factor was that systems had to be installed in accordance with HECO's standards, by certified contractors using pre-approved SWHs. Once complete every system had to pass a thorough inspection (Richmond *et al.*, 2003).

The Eugene Water & Electric Board (EWEB) has operated SWH programmes since 1984. However during the 1970s and early 1980s, the reputation of solar water heating suffered because of "unreliable products and poor installations." EWEB's improved this reputation by reviewing its standards and specifications in conjunction with contractors and commenced post installation inspections. Once the new EWEB's standards were enforced, contractors had difficulty initially, but adapted to using the tried and proven technology in executing their jobs (Richmond *et al.*, 2003).

Botswana had learnt that even a high-quality SWH will not operate as specified when poorly installed. This resulted in an on site test method being developed to improve the quality of installations" (Emcon, 2005). The on-site inspection is necessary to ensure that there is no premature failure on the SWH due to poor installation.

Visagie and Prasad (2006) offer criticism on the path of regulation citing that no specific regulation has been introduced for SWHs even though standards have been developed in the industry for over 15 years. In 1990, the Energy and Development Research Centre (EDRC) had recommended that local standards be revised in conjunction with the EU standards. However, due to a weak market and poor SABS performance in this area of standards, this led to stagnation in the implementation of effective national standards. The development of standards during the 1980s could have provided direction to the local SWH industry resulting in standardised units being manufactured and possible cost reduction.

The Solar Water Heating Division of the Sustainable Energy Society of Southern Africa (SESSA) established a new association called Solasure. The focus areas of this division were to examine standards, equipment used for testing SWHs and the quality assurance of products in the SWH industry. The market transformation was to commence at the high to middle-income sector because "that sector is open to innovation and can afford the new technologies" (Visagie and Prasad, 2006, p. 11). It is anticipated that Solasure would endorsed quality products before entering the market. However, SESSA is a non-governmental organisation and the sustainability of its Solasure division is uncertain.

The development of standards is not adequate to regulate the industry. "Ongoing support from SABS is essential to ensure quality standards are upheld" (Milazi, 2007, n.p). Milazi (2007) further mentions that the issuing of SABS certification will provide better quality assurance of the product and the goal of all manufacturers should be to obtain this certification. Etzinger (2008) mentioned that the SWH manufacturers had issues, which Eskom was addressing. "An effective quality standard has to be in place — hence the need for SABS testing" (Davies, 2008, p. 2). Manufacturers of SWHs do not always support the need for standards because conformance to the standards is time consuming and costly which affects the profitability of the organisation. The benefit of having a comprehensive standard in place is that the design of the manufactured product is guided by the standard and the certification test will verify this.

2.6 Insufficient Training Facilities Available

A key part of any SWH installation is ensuring that a trained plumber or installer completes the installation correctly. Therefore, sufficient training is necessary for plumbers and installer to ensure that the SWH supply chain to have no blockages. Due to the low demand for SWHs, there is a perceived shortage of skilled resources to complete installations and maintain installed systems. According to Dintchev (2004) training in the areas of installation and maintenance have not been sufficiently considered and arranged. The International Energy Agency has also mentioned the risk of "how incompetent installers of not fully mature solar products can destroy public confidence, as they did in France" (Meyer, 2008c, p. 49). A further problem with improper installation is the cost involved for rework or repair of the SWH due to poor workmanship. Therefore, training is crucial for the installers of SWHs.

Jones and George (2003) states that training can be achieved by classroom instruction or on the job. Classroom training involves learning the theory through lectures, written material or group discussions. Videos or site visits are used to demonstrate the practical nature of the training by the observation of skilled personnel executing their trade. Formal training is usually conducted by classroom instruction through colleges or universities. 'On the job' is when the apprentice is taught the skill by observing or working jointly with experts. The apprentice gains experience and knowledge that builds competence in the trade.

The SEA (2007) agrees with Dintchev (2004) that training in the area of installation and maintenance is a problem and confirms that the CEF has launched training programmes through various training providers and a registered qualification through the South African Qualification Authority (SAQA) exists. The CEF (2009) adds that a registered training course is accepted by SAQA. The course relates to the installation of SWHs. The training material is designed to assist in the process of training new and current solar water heater. Salgado (2009) confirms that there is currently only one registered training provider for SWH installations.

Ledger, estimates that more than 100 electrical geysers are installed on any working day in Gauteng. "These installations are made by people who learned on the job to do the wiring required" (Davies, 2008, p. 2). This is an example of on the job training occurring in South Africa.

As part of the SWH 500 project, the training challenges have been met by developing a training manual with input from stakeholders. However, there was also a need for a formal qualification to enhance accountability for quality of installation work and establish minimum requirement of expertise. The industry must be able to influence the training programme and the training should be sensitive to the needs of the SWH manufacturer (Moosa, 2007).

International experience reveals that licensing and training of installers ensures that quality installations are done. Inspections are improved when the installer has the necessary training and experience. Thus far, eleven US states have introduced licenses for the employment of solar contractors. Several organizations offer training and utilities typically require training and/or certification for participating contractors. Once the SWH has been commissioned, thorough post-installation inspections are conducted to ensure that systems will operate as specified once installed (Richmond *et al*, 2003).

Various vocational training centres in Namibia offer comprehensive training on the installation of SWHs and practice is “provided both to present plumbing trainees and for upgrading of skills of existing plumbers through public training courses” (Emcon, 2005, p. 45). According to Salgado (2009), Eskom requires approximately 5000 plumbing teams to meet its 925,000 installations by 2013 and currently there are only 100 plumbing teams operational in the South African industry.

Brazil has over five universities and technical schools that offer training in SWH installation to ensure that there are no skills shortages. Rodrigues (2007) as cited in Jennings (2007) acknowledges that the bylaw cannot be enforced unless the training and qualification system is in place (Jennings, 2007). Similarly, South Africa will be faced with a huge demand for SWH installers once the proposed bylaw is promulgated.

The Berlin Solar School promoted training and the exchange of experience by hosting the Solar Energy trade fair for renewable energy and also by lectures, seminars, courses and international conferences (Energie-Cites, 2001). South Africa had also been hosting local renewable energy conferences such as REEEP and seminars that included papers on solar water heating.

France had a very different approach to ensuring that the installers received the required training. The ‘Qualisol Chart’ organisation was formed. Users of SWH qualified for the subsidy only if the system is installed by members of the organisation (Balmer, 2007).

Eskom has already stipulated that the SWH supplier must be registered with SESSA and on the Eskom database in order for the purchaser to qualify for the rebate. In nearly all cases in South Africa, the supplier of the SWH performs the installation as well.

Cyprus established training facilities that increased skills level of technicians and mechanics. Additional training is given to those employed in the solar industry. Almost all installations and services are executed by manufacturers because the experience with retail services was unsatisfactory (Maxoulis *et al.*, 2007).

The Western Cape approached the training challenge by establishing a SWH training facility (Roelofs, 2009). Botha (2008) believes that large-scale youth oriented training programmes are necessary. Using competent and trained resources improves the quality assurance of the installation. The establishment of this facility in the province where the bylaw is going to be implemented will ensure that there are sufficiently skilled human resources to execute installations.

Eskom ensures that the development of skills in the SWH industry is continuous. In order for installers to register on the Eskom database for supplier accreditation, the organisation must provide adequate instruction manuals and must have a training programme in place (Eskom, 2007).

2.7 The Low Price of Electricity Barrier

In several countries, the cost of electricity has influenced the SWH market. The low price of electricity causes EWH to be more economically viable over a finite time period while the high price of electricity is in favour of SWHs. South Africa is an example of a country having low electricity prices for many years resulting in low operational costs for EWHs. Visagie and Prasad (2006, p. 11) mention that there are several entrepreneurs who are trying to expand the SWH market, but “low grid electricity prices” are one of the major impediments to the development of the SWH industry.

In Miami, the government had supported SWHs, and houses that were fitted with SWHs were in high demand. However, cheap electricity was introduced after the war and by the late 1950s, the SWH market was almost dead (Meyer, 2008b).

“The initial capital cost of SWH is high compared with EWH while electricity tariffs are cheap” (Emcon, 2005, p. 4). Studies in Namibia reveal that the price of electricity in Namibia, as in South Africa, are among the lowest in the world, resulting in renewable energy technologies, such as SWH, being unable to compete in the urban sector. Therefore, there is little incentive to conserve energy by using the alternative SWH technology. There have been forecasts by the energy economists that the price of electricity will increase considerably in the future because of the capital investments required for new electricity generation plants in Namibia (Emcon, 2005). Namibia has low electricity tariffs and this resulted in a barrier to the SWH market development. South Africa also has low electricity tariffs and this could also be a reason for the slow development of the SWH industry.

A similar situation had been experienced in Australia when the rollout of SWH commenced. “Because of low energy costs in Australia and particularly cheap off-peak electricity the market for SWH has always been limited” (Rossiter, 2007, p. 6).

Meyer (2008a, p. 44) quotes from the book called the ‘Golden Thread’: “How, time after time, promising developments in solar energy were put aside once cheap energy, often from fossil fuels, became available.” He added that when cheap coal became available in France, it meant the end of promising work on solar energy. The falling fuel prices have been the reason for the termination of solar research in many instances. He further mentions that “the current solar water heating initiative could fail for much the same reasons as those early solar water heating systems did.” Meyer (2008a, p. 46). The earlier period when solar water heating had failed, referred to by Meyer (2008a), is when electricity prices were very low. Therefore, the economics were in favour of EWHs and this had stifled the SWH market. The conclusion drawn from Meyer’s (2008a) finding is that as long as electricity prices remain low, there is the huge probability of the solar water heating market failing.

Dintchev (2004) explains that the low cost of electricity has contributed to the mass implementation of EWHs. Eskom has been one of the cheapest electricity producers in the world. According to the NUS Consulting Group survey conducted in 2007-2008, the price of electricity in South Africa was the lowest from the fourteen countries surveyed (Eskom Annual Report, 2008). There is bias in Figure 2.5 because Eskom is compared against developed countries and developing countries such as Namibia and Brazil also have low electricity prices.

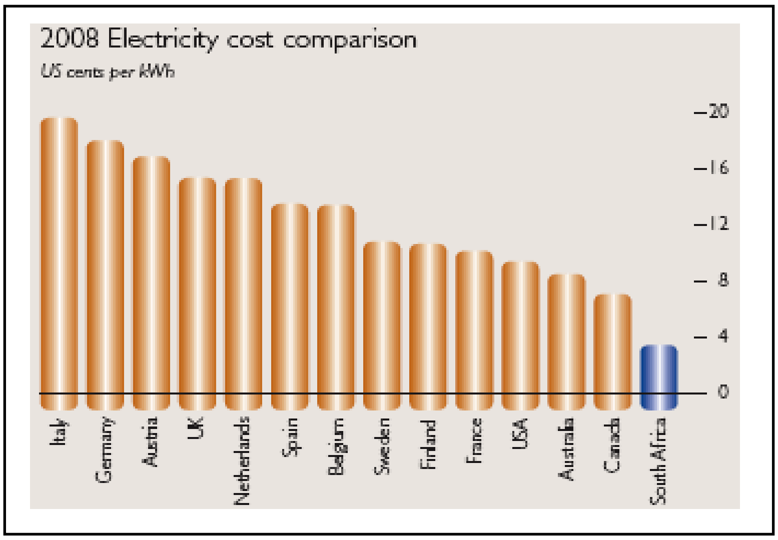

Figure 2.5. 2008 Electricity Cost Comparison

Source: Eskom Annual Report, 2008, p. vi.

The price of electricity in Australia is nearly twice as much as that of South Africa while the price of electricity in Germany and Italy is more than four times the price of electricity in South Africa. If the price of SWHs was uniform across the world, South Africa would not be able to justify a business case for SWHs.

A similar survey was done in 2005 and 2006, and this survey concluded that South Africa had the cheapest electricity amongst the countries surveyed (Eskom Annual Reports, 2006 and 2007).

The low cost of electricity in South Africa, initially began in the 1980s when the utility began its construction programme due to the steady increase in electricity growth. The construction provided a surplus of generating capacity from 1985 onwards. Tariff increases between 30% and 45% in nominal terms per annum were prevalent during the late 1970s. During the 1980s, the tariff increases decreased to between 15% and 23% per annum. Eskom needed to reduce its debt and these excessive tariff increases assisted in providing the necessary revenue to contain the debt within manageable levels. Real electricity prices were reduced during the 1990s as Eskom was left with a surplus of generating capacity that needed to be utilised. Its monopolistic position enabled the utility to increase or decrease prices when necessary, and with the establishment of the National Energy Regulator (NER) in 1995, real electricity prices continued to reduce (Steyn, 2004).

The construction of generation capacity ended in 1990 and Eskom had a surplus of generation available resulting in a substantial electricity reserve margin. Electricity growth continued at varying levels during the 1990s and Eskom forecasted that they would be experiencing capacity shortages after 2005. The mandate to commence with a new construction programme was not successful due to the State wanting to introduce independent power producers (IPPs) into the market. The electricity growth continued to consume the electricity reserve margin and in 2004, Eskom had been given the go ahead to begin construction.

Currently, with rising input costs resulting in the cost of new generation increasing, Eskom is in need of additional capital to continue it expansion programme. Eskom implemented a 31.6% tariff increase in July, 2008. There is also confirmation that Eskom has applied to the National Energy Regulator of South Africa (NERSA) for a multi-year price increase averaging 45% (now reduced to 35% for 2009) over the next 3 years (Eskom, 2009). The effective price increases for 2008 to 2012 are 1,27 x 1,31 x 1,35 x 1,35 x 1,35 is equivalent to 409% of the 2007 price. By factoring this future price increase into consideration, one can expect the SWH market to look more lucrative to consumers.

A mass rollout of SWHs would help curtail the demand for electricity because it is financially advantageous and environmentally beneficial to save electricity. Etzinger (2007) as cited in Enslin (2007, n.p) mentions “that on average it cost R3.5 million to save 1MW, compared with the R10 million it cost to build 1MW” (Enslin, 2007). The investment in energy efficient devices to save energy is more cost effective for Eskom, than to build additional electricity generation plants. Energy efficient devices, such as

SWHs, will reduce the demand for electricity and defer the need to construct electricity generation plants. However, at present, the low price of electricity is a barrier that prevents the financial benefits of SWHs to be quantified.

Milton (2006, p. 2) suggests that governments can influence the market position of SWHs "by manipulating the prices of competing technologies and energy sources." In this case, the price of electricity could be increased. This will effectively provide higher operating costs of EWH resulting in the product not being viable over a period of time. Prasad (2007, p. 11) agrees, "If electricity becomes more expensive it is expected that more people will switch from grid electricity to combined solar-electricity for water heating and invest in SWHs." Eskom has planned above inflation electricity tariff increases for the next three years. This will count in favour of SWHs.

2.8 Key Findings of the Literature Survey

2.8.1 The High Price Barrier

The cost of the SWH varies significantly in different countries. However, in Israel, Greece, India and Turkey, the SWHs are priced comparatively low (Menanteau, 2007). The removal of import duties can be a driver to cost reduction (AMEU, 2008), but this must be on components of the SWH and not on full units. If too many completed units are imported, then the local industry suffers and may have to close down because they may not be able to compete. Therefore, it is up to the State to decide whether it wants to have cheap SWHs or protect job losses in the manufacturing sector.

There is agreement among stakeholders that effective financing mechanisms should be in place to assist customers with the high upfront costs related to the purchase of the SWH (Visagie and Prasad, 2006, Balmer, 2006). These can be in various forms such as lower interest rates, bond extensions and government grants. In India, even though financing schemes were introduced, this did not directly expand the SWH market (Chandrasekar and Kandpal, 2003). However, Australia has had positive results with the introduction of renewable energy certificates. Therefore, in addition to introducing financial assistance, customers must be informed of the benefits in terms of electricity savings (at least 25%) and other environmental benefits.

2.8.2 The Awareness Barrier

Comprehensive awareness programmes have been developed in other countries such as Albania, Austria, Australia, Namibia, Barcelona, Berlin, China, India and Italy to promote SWHs. An awareness programme was introduced into South Africa in the 1980s but was stopped after a few years (Prasad, 2007). Currently, the awareness of SWHs is through the rebate offered by Eskom to potential users of SWHs, the Eskom DSM website and newspaper articles. This awareness information is not satisfactorily disseminated to all consumers. A much more concerted effort is required by the Government to promote SWHs in South Africa. This programme must target all areas, including the commercial sector.

In the awareness initiatives of Namibia, Italy, Berlin and Barcelona, the focus was on taking ownership of solar water heating and promoting it in the best possible way. This included detailed awareness programmes using the internet, short message service (sms), call centres, hosting festival, brochures, campaigns, including recognising solar champions (Energie-Cites, 2001, Mendonça, 2006, Ambiente Italia, 2003). Namibia discovered that the lack of awareness was their largest barrier and implemented solutions to rectify this (Howard and Scholle, 2006).

2.8.3 Legislation

The introduction of legislation could assist in expediting the behaviour change for consumers to recognise and utilise SWHs. This is the case for the Cape Town bylaw to be introduced in 2010. Similar legislation to install SWHs has been incorporated into the building regulations in Brazil to force all new buildings to comply (Jennings, 2007). Other countries such as Barcelona, Israel, Australia and the USA have implemented standalone policies to enforce SWH.

2.8.4 Subsidies and Incentives

Subsidies and incentive mechanisms may be useful but are voluntary. The impact of subsidising the SWH to promote usage may be high in low-income groups and in middle-income groups. Incentives such as income tax deductions may be more attractive to middle and high income groups as these group are liable for income tax payments.

Subsidies have proven successful in countries such as France, United States of America, Austria, Brazil, Greece, Barbados, Taiwan and Barcelona to name just a few. Taiwan's SWH industry benefited from incentives as evident in Figure 2.4. Several of the incentives include a tax deduction of capital expenses towards SWH investments (Refoucs, 2004, East Harbour Management Services Ltd and Energy Library & Information Services Ltd, 2002, Hack, 2006). However, it must be noted that even though China does not offer any incentives or subsidies for solar water heating, the SWH market is quite mature and established (Roulleau and Lloyd, 2008).

Eskom offers rebates ranging from R 990 to R 5,073 to purchasers of SWHs in South Africa. However, the SWH must be certified and offer a 5-year warranty (Eskom DSM, 2009).

2.8.5 The Standards Barrier

Standards play an important role in ensuring that a quality level is maintained. Initially, when a SWH is installed, the customer expects the SWH to function properly and not fail due to poor quality or poor installation. The SABS certification ensures that the SWH is compliant to the SANS 1307 specification. Furthermore, when installation or repair is executed, then this must be done in line with the SANS 10106 standard. Although these standards are non-mandatory, Eskom will not pay the rebate if the product does not have the SABS certification mark (Eskom DSM, 2009).

The European Union Solar Keymark certifies SWHs to the EN 12975 standard and ensures that quality management systems are in place (Solar Keymark, 2009). Yet again, if SWH products do posses the Solar Keymark in the EU or the SABS certification in South Africa, then the customer does not qualify for any incentives.

Several other international standards for SWH are also available. The application of standards ensures quality assurance and protects the reputation of the industry by locking out poor quality products.

2.8.6 Skills and Training

There is a need to have skilled and competent installers of SWH. Many of the installers do not possess formal qualifications and have either learned the skill from a training manual or from skills transferred. Formal qualifications are offered at a NQF level three course (CEF, 2009). The establishment of the Western Cape training centre has proven to be successful and is expected to develop a huge workforce to install SWHs when the bylaw comes into effect (Roelofs, 2009).

Improper installation and maintenance of the SWH can result in premature failure of the SWH and there is a dire need for South Africa to establish more training centres.

2.8.7 The Low Price of Electricity Barrier

In almost all countries that introduce SWHs, the low SWH uptake has been adversely affected by the low electricity prices. The situation is improving as electricity prices begin to increase, allowing the SWH to become more attractive and viable over its life cycle. Milton (2006) suggests that governments can intervene to ensure that competing technologies such as SWHs become feasible. South Africa is expecting massive electricity price increases in the next few years and this is likely to result in a steady development of the SWH industry. It is also more financially beneficial for Eskom to introduce energy efficient measures than to construction additional generating plants (Enslin, 2007).

2.9 Summary

The purpose of this chapter was to review the literature for the seven main barriers identified earlier in the study.

The cost of SWHs differed among the various countries considered. Countries that have a high SWH uptake have comparatively lower priced SWHs. Financing mechanisms have been introduced to assist end users in purchasing SWHs.

Effective awareness campaigns have shown to improve the promotion of SWHs. However, South Africa lacks a comprehensive awareness programme. Legislation has been introduced in several countries to force the installation of SWHs while subsidies are useful to increase demand where prices of SWHs are found to be high.

Standards were introduced to ensure that products of an acceptable quality enter the SWH market. Eskom has offered rebates to end users for SWHs that comply to the SANS SWH standards.

Qualified skills are required to ensure proper installation and the shortage of skills could be addressed by vocational training centres. The low price of electricity has hampered the expansion of the SWH market. However, in South Africa, the price of electricity set to increase substantially over the next 3 years (2010 – 2012). This should encourage consumers to revisit their mode of water heating.

CHAPTER THREE

Research Methodology

This study requires that scientific data be collected and critically reviewed in order to propose a solution to a particular problem. The research methodology used is crucial to arrive at the end solution that can add some value to the world of knowledge. This chapter will discuss the comprehensive research process that is followed in this study.

The chapter describes the research process by Leedy and Ormrod (2005) and Blumberg *et al.*, (2003) and explains how to critically review the literature from primary and secondary data sources., the research approach and methodology using the Research Onion (Saunders *et al.* 2003), methods to address ethical issues, data collection processes and data analysis techniques.

3.1 The Research Process

“Choosing a research design for a study involves selecting the most appropriate methods or techniques to solve a particular problem under investigation” (Anderson and Poole, 2009, p. 22). The method selected is important because if a wrong decision is made, then the entire study can be criticised as being unscientific or illogical.

The research process is usually described as a sequential process that involves several clearly defined steps. Although sequential, the process does not require that each step to be completed prior to moving onto the next step. Sometimes, one may be required to revisit steps, skip steps as research and analysis continues (Blumberg *et al.*, 2005).

The basic research process is shown in Figure 3.1. Leedy and Ormrod (2005) also stresses that a research project does not always follow these steps in exact sequence.

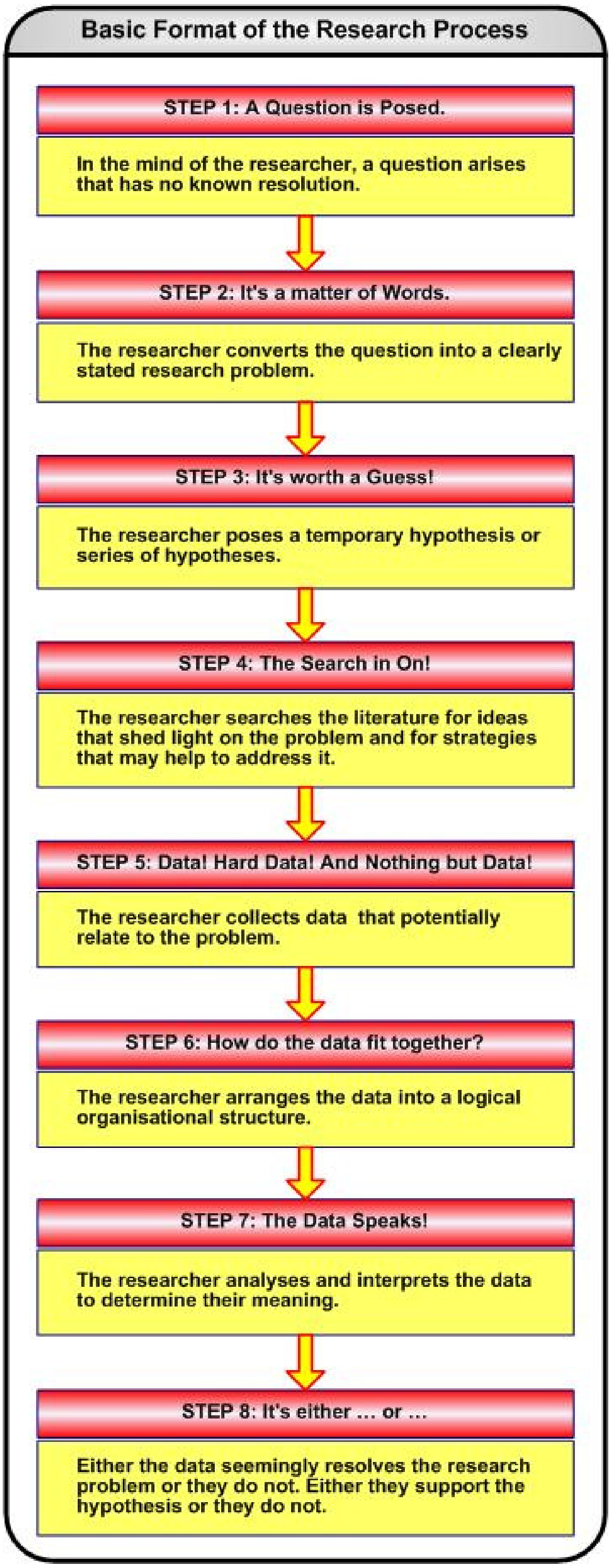

Figure 3.1. The Basic Format of the Research Process

Source: Leedy & Ormrod, 2005, p. 86.

A comprehensive research process is required for one to plan ahead so that the preliminary work for the later stages has been undertaken (Saunders *et al*, 2003).

The following process is proposed and explained:

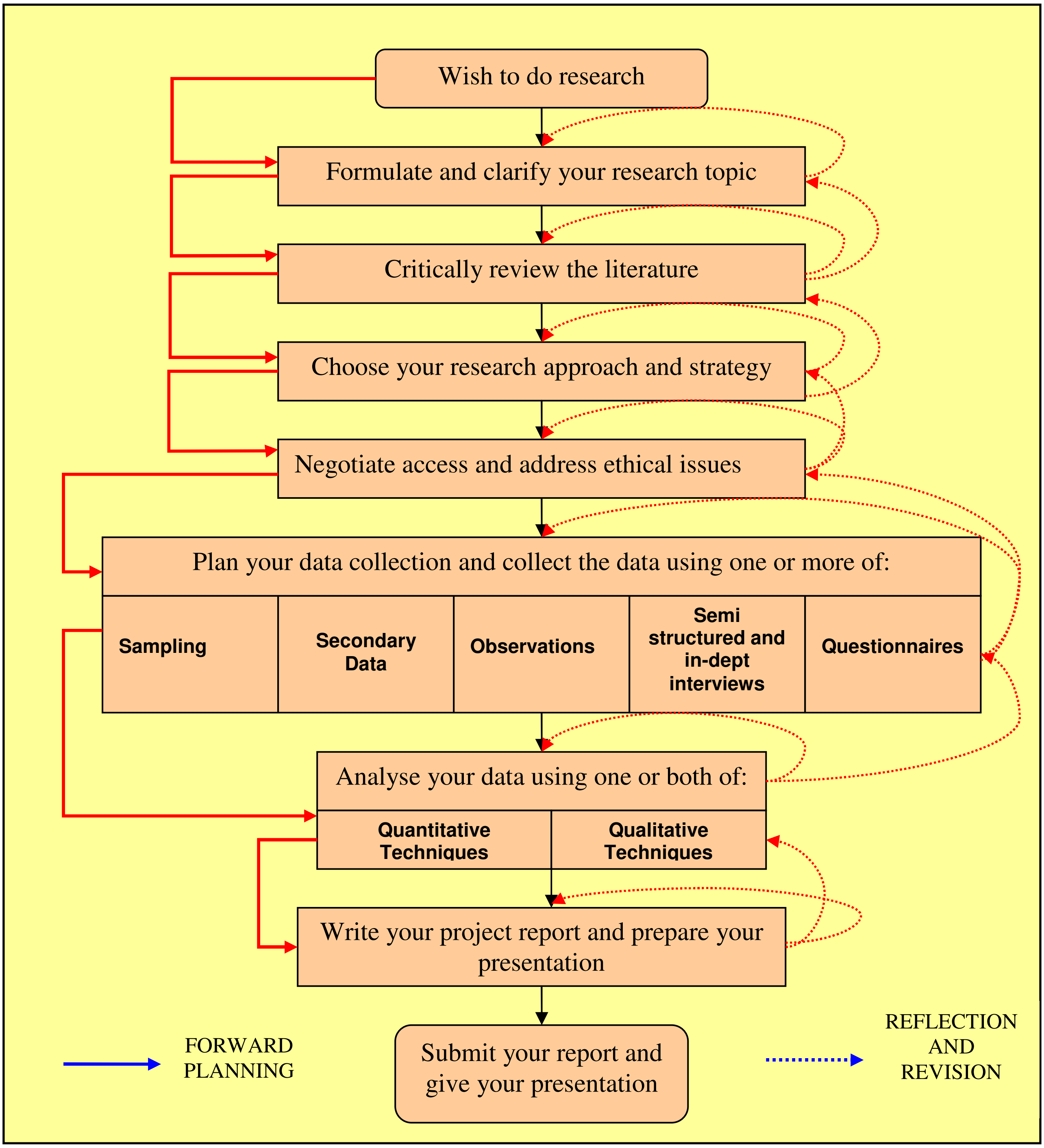

Figure 3.2. The Comprehensive Research Process

Source: Saunders *et al.*, 2003, p. 7.

3.1.1 The Need to do Research

Research is done to obtain a deeper meaning about a specific subject or problem which in this case are the barriers to SWH. Once this study is complete, the researcher can then become empowered to be a future expert in this particular area by providing future solutions to this problem. Problems are encountered daily in the business environment and research in any area is an ongoing process that will continue as the demand for information grows. The study needs to be conducted in a systematic process so that scientific and logical solutions are obtained. If there is no specific solution within the body of knowledge then more extensive research has to be done using practical methods, so that the body of knowledge may be enhanced.

The term 'research' is extensively used and the results of 'research' can be seen everywhere. Almost everyone quotes the term research either to raise a point, sell a product, produce a documentary or just as part of one's speech (Saunders *et al*., 2003, p. 2).

"Research is an organized enquiry that is carried out in order to provide information that can be used to solve problems. Business research is a systematic enquiry that provides information to guide business decisions" (Blumberg *et al*., 2003). Saunders *et al*. (2003) uses the phrase "systematic way" as his definition of research.

Walliman (2001) as cited in Saunders *et al*. (2003, p. 2) argues that the term research is not used in its true meaning and highlights the following ways in which the term is incorrectly used:

- "Just collecting facts or information without any clear purpose;
- reassembling and reordering facts or information without interpretation; and
- as a term to get your product or idea noticed or respected" (Saunder *et al*., 2003, p. 2).

It is for these reasons that a proper research process has to be structured as in Figure 3.2. Therefore, all researchers should follow this process closely to ensure that their findings are valid and scientific. Ghauri and Gronhaug (2002) as cited in Saunders *et al*. (2003, p. 3) suggest that research is based on "logical" relationships and not just beliefs. "These may include describing, explaining, understanding, criticising and analysing" Saunders *et al*. (2003, p. 3).

3.1.2 Formulating and Clarifying Your Research Topic

This section in the process, is the nucleus of the research and is paramount to the success of the study. "To see the problem with unwavering clarity and to state it in precise and unmistakable terms" (Leedy and Ormrod, 2003, p. 49); Researchers get a strong start when they begin with a clear statement and articulate it in such a way that it represents a single goal of the research (Leedy and Ormrod, 2003). It will be pointless collecting all the information, if there is no goal to its collection. Finding a legitimate problem will assist in identifying the area of research. This can be done quiet easily using the checklist provided by Saunders *et al*. (2003, p.16).

- ✓ Does the topic fit the specifications and meet the standards set by the examining institution?
- ✓ Is the topic something with which you are really fascinated?
- ✓ Does your research topic contain issues that have a clear link to theory?
- ✓ Do you have, or can you develop within the project time frame, the necessary research skills to undertake the topic?
- ✓ Is the research topic achievable within the available time? Is the research topic achievable within the financial resources that are likely to be available?
- ✓ Are you reasonably certain of being able to gain access to data you are likely to require for this topic?
- ✓ Are you able to state your research questions and objectives clearly?
- ✓ Will the proposed research be able to provide insights into this topic?
- ✓ Are the findings for this research topic likely to be symmetrical: that is, of similar value whatever the outcome?
- ✓ Does the research topic match your career goals?

Figure 3.3. Checklist for Attributes of a Good Research Topic

Source: Saunders *et al.*, 2003, p. 16.

Figure 3.3 is a checklist that contains attributes that help the researcher ensure that the topic chosen will have a positive outcome. Often, topics that are aligned with the interests and knowledge of the researcher can assist the researcher in identifying gaps and developing expertise in the subject. Anderson and Poole (2009, p.19), have also developed some criteria for selecting a topic and these are very much in agreement with Figure 3.3. Similarly, there are six strategies identified by Leedy and Ormrod (2003, p. 45) to assist the novice and expert researchers.

Once the research problem is identified, the researcher should be able to state the problem clearly and completely so “that anyone who reads English can read and understand it” (Leedy and Ormrod, 2003, p. 47). If this is not done, then the researcher would not be able to align the research with the problem and there will be a mismatch.

The topic of reducing the barriers to SWH is an interesting one that will help the researcher and the organisation that he works for, find possible solutions to the current problem. When the topic is assessed against the checklist in Figure 3.3, a majority of the responses from the researcher are affirmative. This means that the research can continue following the research methodology.

3.1.3 Research Approach and Strategy

Much of the research process involves collecting data that results in an argument answering the research question. Saunders *et al*. (2003, p. 82) describes a research ‘onion’ that has the secondary data in the middle and important layers of the onion need to be peeled away before the central point can be reached.

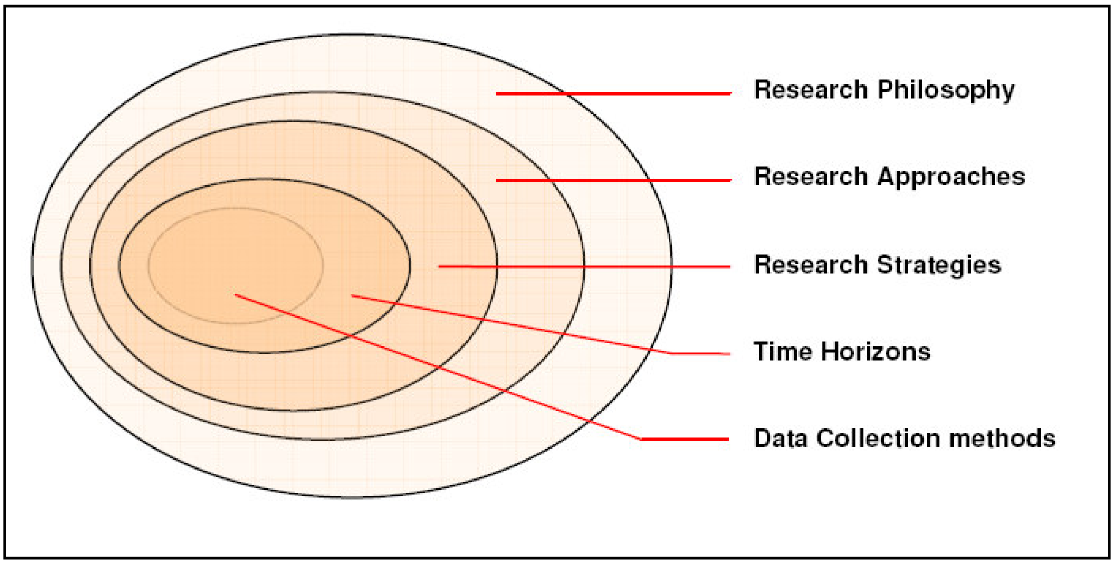

Figure 3.4. The Research 'Onion'
Source: Saunders *et al*, 2003, p. 82.

The first layer raises the question of the research philosophy. Types of these philosophies are positivism, interpretivism and realism. The research does contain a blend of these philosophies.

The second layer describes the research approach that has stemmed from the philosophy. These approaches could either be deductive or inductive. The research follows a predominantly inductive approach, but will apply deductive reasoning where necessary.

The third layer is the research strategy to be followed. This determines whether the researcher is going to use grounded theory, interviews, case studies, ethnography, experiments or surveys. In the current research, grounded theory is used to form the theoretical framework and the interview questionnaires are used to support the theoretical framework.

The fourth layer of the research onion is the time horizons. This research will be a representation of events over a period of time and attempt to seek new insights that allow results to be practically applied to the problem at hand.
The fifth (inner most) is the data collection technique and involves the interview questionnaires to be given to recognised subject experts (Saunders et al., 2003).

3.1.4 Negotiating Access

The data that requires collecting must be accessed from a source. The relevance of the source depends on the research questions, related objectives and strategy. (Saunders et al., 2003, p. 114). Gummesson (2000) as cited in Saunders et al. (2003) describes the 'physical access' as "the first level of access or entry." The level of access can be very difficult to obtain because organisations do not have the time to commit to the researcher's request. This can result in a false start as described by Johnson (1975, as cited in Saunders et al., 2003, p. 114). Once negotiated physical access is achieved, further levels of access are required in order for your research strategy to be realised. Gummesson (2000) sees this as a continuing process and not just a single event. There is also agreement from Marshall and Rossman (1999) on this theory. After physical access, comes cognitive access the researcher must then position himself to reveal the reality of what is occurring in relation to the research being conducted.

Saunders et al. (2003) has identified some strategies to gain access and these are summarised in Table 3.2 below:

Table 3.1. Summary of Strategies to Gain Access

Allowing yourself sufficient time
Using existing contacts and developing new ones
Providing a clear account of purpose and type of access required
Overcoming organisational concerns about the granting of access
Identifying possible benefits of the organisation in granting you access
Using suitable language
Facilitating ease of reply when requesting access
Developing your access on an incremental basis
Establishing your credibility with intended participants

Source: Saunders et al, 2003, p. 118**.**

The entry into organisations is simple and in most cases, the organisations understand the value of the research. However, when questionnaires or interviews are required, then your access has to be at a higher level and this often encounters resistance. This resistance has often to do with time and availability of the respondent and therefore creates unplanned delays which must always be taken into account.

3.1.5 Address Ethical Issues

Ethics is defined by Saunders et al. (2003, p. 129) as "the appropriateness of our behaviour in relation to the rights of those who become the subject of your work or are affected by it." Once the researcher has gained access into an organisation, ethical concerns will emerge. These occur when seeking access, gathering of data, when data analysis is being done and when data is being reported upon.

Informed consent should be sought through openness and honesty and rights to privacy must be respected at all stages of the research. Maintain assurances of confidentiality and anonymity to all participants in order to protect participants.

This author applied for ethical clearance to undertake this study. A copy of the ethical clearance certificate is available in Appendix 6.

When using the internet and email, consider the implications carefully, and avoid this technology to share any data with other participants.

3.1.6 Data Collection

The study will be qualitative and therefore there may be multiple forms of data. Leedy and Ormrod (2003) describes these as observations, interviews, objects, written documents, audiovisual material, electronics documents and any other credible data sources that can assist in answering the research question.

Primary, secondary and tertiary data sources will be used to obtain information on the research question. It is important to gather information from local manufacturers, suppliers, industry experts and other countries to assist in the research.

This study will also involve questionnaires and the data will have to be organised once the responses are received. Although questionnaires are used to support the literature the interview guidelines can reveal a great deal of useful information. Silverman (1993) as cited in Leedy and Ormrod (2005, p. 146) mentions that the researcher can ask related questions to any of the following:

- "Facts (e.g., biographical information);
- Peoples beliefs and perspectives about the facts;
- Feelings;
- Motives;
- Present and past behaviour;
- Standards for behaviour (i.e., what people think should be done in certain situations);
- Conscious reasons for actions of feelings (e.g., why people think that engaging in a particular behaviour is desirable or undesirable)."

The abovementioned points were used in the development of the questionnaire that was distributed to the respondents to collect data. This method of data collection was used because of the time constraints and location of the various industry experts.

The guidelines for conducting an interview as per Table 3.3 were developed by Leedy and Ormrod (2003) and are relevant to this study.

Table 3.2. Guidelines to conducting a productive interview

1. Identify some questions in advance
2. Make you're your interview questions are representative of the group
3. Find a suitable location
4. Get written permission
5. Establish and maintain rapport
6. Focus on the actual rather than on the abstract or hypothetical
7. Don't put words in people's mouths
8. Record responses verbatim
9. Keep your reactions to yourself
10. Remember that you are not necessarily getting the facts
11. When conducting a focus group, take group dynamics into account

Source: Leedy and Ormrod, 2003, p. 147.

Table 3.3 was used as a basis to develop the questionnaire and record the responses from the industry experts. The questionnaires were distributed to the respondents and the responses were consolidated for discussion.

3.1.7 Sampling

It was necessary to tap into the industry to obtain expert opinions relating to the South African perspective on the barriers to solar water heating, An opened ended questionnaire was developed whereby participants were chosen according to the popularity and market share of the organisation they worked for. A consultant, knowledgeable on the subject matter, also participated which broadened the perspective.

Although, an initial sample size of fifteen respondents was chosen to participate in this study, only seven responded. Consequently, only these seven completed questionnaires were used to support the literature. Although some of the participants are involved directly in sales, their portfolio within the respective organisation is broader. Several of the participants have also been involved in national workshops and have thereby been exposed to national issues.

3.1.8 Data Analysis

The data collected has to be analysed so that it can be reduced to a small set of underlying themes. There is usually no 'right' way to analyse data in a qualitative study. The researcher begins with a large body of collected informative and through inductive reasoning, sorts and categorises the data (Leedy and Ormrod, 2005, p. 15).

Saunders et al. (2003) mentions that process of analysing qualitative data is quite demanding and should not be seen as an 'easy option.' Yin (1994) as cited in Saunders et al. (2003, p. 379) refers to those researchers who leave the collected data unanalysed for periods of time because they are unsure of the analytical process required. Leedy and Ormrod (2003, p. 151) also confirms that the data analysis process for a qualitative study is complex and time consuming.

There are a number of reasonably distinct strategies that can be used to analyse qualitative data and Saunders et al. (2003) seeks to identify a number of features of the process involved that are common. The general set of processes involves the following activities:

- "Categorisation;
- 'unitising' the data;
- recognising relationships and developing the categories you are using to facilitate this;
- developing and testing the hypotheses to reach conclusions" (Saunders et al., 2003, pp. 381-384).

Creswell (1998, as cited in Leedy and Ormrod, 2003, p. 151) has described a data analysis spiral that is, in Leedy and Ormrod's (2003) view equally applicable to a wide variety of qualitative studies. With this approach, the raw data is analysed several times using the following steps:

- "Organise the data, perhaps using index cards, manila folders, or a computer database. You may also breakdown large bodies of text into smaller units in the form of stories, sentences, or individual words.

- Peruse the entire data set several times to get a sense of what it contains as a whole. In the process, notes should be made that suggest possible categories on interpretations.
- Classify each piece of data according to some category or theme, or even subcategory or sub-theme.
- Synthesize the data, by integrating and summarizing it for the readers. This step may offer 'prepositions or a hypothesis' that describes the relationships amongst categories or it may "involve packaging the data into an organisational scheme such as a table, a figure, matrix or hierarchical diagram" (Leedy and Ormrod, 2005, pp. 150-151).

In analysing qualitative data, the researcher's biasness and values will inevitably influence the interpretation of the data. Nevertheless, researchers are encouraged to minimize the extent to which prior expectations and opinions enter the final analysis using some or all of the following strategies:

- "Collect two or more different kinds of data (e.g., observations, interviews) related to any particular phenomenon
- Get multiple and varying perspectives on any single issue or event
- Make a concerted effort to look for evidence that contradicts your hypotheses
- State any bias that you may have so that the reader can take this into account when reading the report" (Leedy and Ormrod, 2005, p. 151).

3.2 Summary

This chapter has outlined the research methodology that is used in this dissertation.
A vast amount of insight was gained on how research should be conducted and the necessary processes to follow.

The ethical process involved obtaining consent from Eskom to undertake this study, then obtaining consent from respondents to participate in the study and finally getting ethical clearance from the university to commence with this study. The ethical clearance certificate obtained is in Appendix 6.

The methodology used provided the much needed assistance and guidance required in undertaking this study.

The data analysis techniques described in this chapter have proven to be beneficial to the study. In addition to information from the body of knowledge, seven recognised industry specialists completed open-ended questionnaires that contribute to the findings of this study. It is necessary to compile the data and to understand the viewpoints of authors from the literature reviewed as well as the input from the industry specialists. The results are presented and discussed in Chapter 4. Recommendations are made in Chapter 5.

CHAPTER FOUR

Presentation and Discussion of Results

This purpose of this chapter is to analyse the data gathered obtained from the open ended questionnaires. The chapter describes the expertise of the respondents and presents the collected data. The chapter also explains the costs relating to production, the high price of the SWH and financing mechanisms that could be used in South Africa to assist with payment for the SWH. Methods to raise awareness are suggested and the issue on legislation to assist with growth of the SWH industry is debated. The chapter concludes with a focus on the low price of electricity.

4.1 Respondents and Questionnaires

4.1.1 Characteristics of Respondents

Seven respondents agreed to participate in the study and the characteristics of each respondent are shown in Table 4.1.

Table 4.1. Profile of Respondents

Respondent Reference	**Background**
Respondent 1	SWH Specialist – Import and Sales
Respondent 2	Consultant for Sustainable Development
Respondent 3	SWH Specialist – manufacture, sales and installation
Respondent 4	SWH Specialist – Sales and installation
Respondent 5	SWH Specialist – Import and Sales
Respondent 6	SWH Specialist – Installations
Respondent 7	Researcher – Environmental Technologies

4.1.2 Presentation of Data Collected (Questionnaires)

The data collected from the questionnaires were categorised into the seven themes as identified in the literature review. Each theme is discussed in this chapter under a different section. The relevant data is extracted from the literature review and discussed in conjunction with the responses from the questionnaires (Appendix 4). The discussion on each theme therefore encompasses theory, international lessons and local practise.

4.2 The Cost of Production

If the cost of production of SWHs is reduced then this will naturally be passed onto the end user. According to Eskom, the SWH industry in South Africa "is still characterised by high manufacturing costs and low sales volumes" (Eskom, 2008, as cited in Bega, 2008).

The cost of production is made up of the cost of the components of the SWH, a labour component and a profit margin. Findings in the interview questionnaires reveal that manufacturers are not given any cost benefits or subsidies and therefore cannot reduce costs easily. For example, the consumer gets financial rebates, but the manufacturer gets no incentive whatsoever. When the manufacturer is a supplier as well, then they have to carry the full production, certification and training costs.

Furthermore, there is no room for cost cutting because imported components attract an import duty of 15% (Du Plooy, 2007). Manufacturers generally import SWH components because there is no local production of these components or the locally produced component is priced very high. There are two possible methods to resolve the problems relating to SWH components; either reduce the import duties or stimulate the local industry for the production of SWH components.

Respondents 1, 2, 4, 5 and 6 agreed with the concept that import duties were a significant barrier to entry. The removal of import duties will allow more international suppliers into the country and this will create intensive competition which could drive the price of

SWHs down. However, it is natural for the State to protect its local manufacturing industry and this is one of the reasons why the State has imposed such import duties.

If the import duty for solar water heater components is reduced or scrapped then the price of the SWH could possibly be reduced accordingly. It is not necessary for suppliers to pass this cost benefit to the purchaser but competitive forces may eventually force the retail price of the SWH to be reduced. However, the removal of import duties should strictly apply to components that cannot be locally sourced so that the local industries remain operational and is not disadvantaged. The relaxation of the import duty should also be limited to a period of time (e.g. 3 - 5 years) so that it does not stifle entrepreneurship in the local SWH manufacturing sector. According to Du Plooy (2007, p. 81), China produces cheap SWH components in large volumes.

SABS certification is a current overhead to suppliers and is necessary because the Eskom rebate only applies to certified products (Respondent 3). Selling the SWH without the certification is possible, but risky because end users would require certified products to claim the rebate. Therefore, the certification costs are inevitable in the current environment. Respondent 7 confirmed that the certification cost is a barrier. Respondent 3 suggested that the Eskom rebate be used to subsidize the SWH testing cost. This is a decision that Eskom or its shareholder, the State, has to make.

Another overhead is the training costs. Respondent 3 believed that the training cost should be subsidized rather than the SWH being subsidized. This will help suppliers remove this overhead and therefore they will be able to reduce the overall cost of the product. The cost associated with training can be addressed by the Skills Development Levy and the ESETA in South Africa. Currently, all organizations pay approximately 1% of their salary bill towards this levy (Department of Labour, 2010). Organisations are allowed to claim back their training costs from this levy and this would assist in offsetting the cost of technical training. Training could also be outsourced to facilities that have developed training programmes. The cost of outsourcing training may be lower than undertaking in-house training.

In summary, the cost reductions in manufacturing can be achieved as follows:

Table 4.2. Proposed Methods for Manufacturing Cost Reduction

Associated Cost	**Proposed Cost Reduction Action**
SWH Components	Reduction of import duties for a short period of time. Import cheap components from international markets.
Unit testing and certification	Introduce possible rebates for manufacturers. SABS to reduce or scrap the certification costs.
Training	Possible rebates from Skills Development fund. Outsource training to local institutions. Training subsidies to be provided by Eskom.

4.3 The Retail Price of the SWH

The common solution from the literature review regarding the high cost of the SWH is to provide suitable financing mechanisms to assist the end user. However, comments from Respondents 1, 2, 3 and 7 disagreed that SWHs are priced too high while Respondents 5 and 6 mentioned that the SWHs are only for the middle to high income groups. This means that the SWH supplier is not going to reduce the retail price unless the associated manufacturing costs (as per Table 4.2) are reduced.

A different mindset emerged from Respondent 3, who also, does not believe that high capital expenditure costs are a barrier. The examples used to justify this case are the following: consumers can spend in the region of R 50,000 to remodel their kitchens with no payback but cannot afford a SWH for R 12,000. Consumers are comfortable to spend up to "R 15,000 on a pool heating system also with no payback" (Respondent 3). He further explained that SWHs have no 'appeal' because an individual cannot show it "off to their friends" (Respondent 3). People also take it for granted that there will always be hot water and low energy cost. The notion stated by Respondent 3 indicates that the SWH may only appeal to somebody who has business sense and computes the return on investment. Therefore, the wider public has very little interest in the product because it cannot give them any additional gratification to the normal EWH. A method to possibly overcome this belief is to market the product as a hot water solution that is independent of load shedding or power outages. Load shedding could become more frequent during unplanned outages as Eskom's reserve capacity is decreasing. Consumers would then realise that their SWH is their independent hot water solution.

Respondent 2 mentioned that the high cost of the SWH can be "overcome by market forces." Economies of scale can increase production, which could drive prices down. Greater competition can also be introduced once import duties are reduced and international suppliers enter the market. However, the current demand for SWHs remains fairly low and therefore production cannot increase rapidly. Competition within the industry is already evident with Eskom having more than 100 suppliers on their database.

In summary, the retail price of the SWH is not going to be reduced unless the associated manufacturing costs, as indicated in Table 4.2, decrease.

4.4 Facilitating End User Finance Mechanisms

From the discussion regarding retail pricing, the price of the SWH is not going to decrease, unless the associated manufacturing costs decrease. Therefore, the high price of SWHs will not reduce in the short term. Many households do not have savings or other means to pay the price of SWHs. Therefore, financing mechanisms are required to assist in providing the required capital. Financial incentives such as rebates, income tax rebates and grants will not be covered in this section. Financing mechanisms have been applied in other countries and have assisted end users to purchase the SWH.

Table 4.3 illustrates the monthly instalments (interest compounded monthly) for a range of capital costs. The table has been derived from an empirical study and it is relevant to explain the interest rate subsidy required to assist end users with the purchase (Respondent 3).

Table 4.3. Monthly Instalments for Financing SWHs over Various Periods

Finance Period = 5 years							
	Interest Rate (per annum)						
Capital Cost	0%	5%	10%	15%	20%	25%	30%
R 5,000	83.33	94.36	106.24	118.95	132.47	146.76	161.77
R 10,000	166.67	188.71	212.47	237.90	264.94	293.51	323.53
R 15,000	250.00	283.07	318.71	356.85	397.41	440.27	485.30
R 20,000	333.33	377.42	424.94	475.80	529.88	587.03	647.07
R 25,000	416.67	471.78	531.18	594.75	662.35	733.78	808.83
R 30,000	500.00	566.14	637.41	713.70	794.82	880.54	970.60

The finance period is set at 5 years because this coincides with the warranty period of the SWH. The capital cost range is from R5000 to R 30000 as stated in Etzinger (2007).

The financing method used in Namibia, as in Table 2.1, specifies an interest rate of either 5% or an interest rate equivalent to the prime lending rate less 5%. There is also mention of the term ‘soft loan’ by Respondent 3. This is a loan with very low interest rates being applied. An example of the soft loan is explained below with a fixed interest rate of 5%.

4.4.1 Using an Fixed Interest Rate of 5%

By using a fixed interest rate of 5% as per Namibian commercial finance (Howard and Scholle, 2006), there is greater financial benefit to the end user. The difference in monthly instalments between interest rates of 30% and 5% is 71% for all capital costs, whereas the difference in monthly instalments between 25% and 5% is 55.5% for all capital costs. At R 5,000 capital cost, the monthly instalment equates to R 94.36 and at R 30,000, this monthly instalment is R 566.14 (interest rate fixed at 5% - refer to Table 4.3).

There is greater benefit to the end user in borrowing by using a fixed interest rate of 5%. However, financial institutions may not readily agree to this because of the low prime lending rate and may incur losses when the prime interest rate increases. Some may opt for a 10% lending rate. Another option is to stagger the lending rate commencing at 5% for the first 2 years, then 10% for the next 2 years and 15% for the final year. This will offer some sort of relief for lending institutions in the event that the lending rate rises.

Finance institutions could also play the role of corporate citizens and offer low interest rates for SWH financing because SWHs will help protect the environment by reducing carbon emissions thereby providing sustainability. This will help with marketing and the corporate social responsibility of the institution. However, financial institutions may resist the idea of low interest loans as it will affect their profit margins.

4.4.2 SWH Rentals

Respondent 5 mentioned that "finance houses should establish a rental scheme" to assist end users. Finance houses are experts at financing and this option can easily be done. The cost of renting the SWH is however, dependent on many factors but the most important is the expected life of the SWH. Although some manufacturers offer a 5-year warranty attached to the SWH, the finance house may have to charge an excessive rental amount to recover the full cost of a SWH over the 5-year period. Longer rental periods can be considered but the risk lies in the failure of the SWH after the warranty has expired. Finance houses may not want to execute repairs at their cost. Another factor to consider is long-term leases. There is no guarantee that the household income will be sustainable over a long period and if there is default on rental payments, the finance houses will have to spend on expensive litigation costs to recover rental income.

The Energy Services Company (ESCO) is an energy services company that is registered with the utility to provide energy efficient solutions to all end users. This model could also assist with financing as discussed previously. End users could discuss with ESCOs on what their hot water requirements are. The ESCO then liaises with the customer to finance the SWH and arranges monthly payments for the hot water consumption. The proposed model is where the municipality owns, maintains and replaces the SWH for the customer. The customer in turn pays for this hot water service as a charge on their monthly rates bill (SEA, 2009). The customer may not benefit from switching to the ESCO but the electricity security increases as water heating shifts from EWHs to SWHs. It may be in the interest of the ESCO to offer competitive tariffs for hot water consumption so that it is lucrative for the end user to switch to the ESCO as a service provider.

4.4.3 Insurance Claims

The insurance industry can also be considered as a financing option for SWHs (Respondent 2). End users can liaise with the insurance company to replace their damaged or burst electric water heater (Moosa, 2007 and Botha, 2008). When damage to the EWH has occurred, the insurance company reimburses the equivalent replacement cost of the EWH to the end user. The end user then uses this financial reimbursement to offset the cost of a new SWH. Considering that the replacement cost of an EWH could be in the region of R 7,000, this could assist a R 20,000 SWH quite substantially. Therefore, only R 13,000 would require financing making the SWH much more affordable. Insurance companies could also offer financial services and loan the R 13,000 required, to clients at reasonable interest rates. The only drawback of this option is that the SWH can only be replaced when the EWH fails completely resulting in the electricity saving being deferred.

The cost implication of insurance premiums has to be considered for the insurance reimbursement option. Not all households have household insurance cover and therefore this option is only reachable to some certain households. Considering that South Africa is a country with substantial consumer debt, (partly fuelled by the recent recession), some end users may tend to lapse their insurance policies as a first option to reducing their debt resulting in the insurance reimbursement option not being available to the end user.

4.4.4 Green Bonds

Respondent 7 has mentioned the concept of green bonds being used as a method of finance. According to Respondent 7, “a green bond is a financial mechanism that is used to fund energy efficient products and services.” It is a low risk, low cost bond offered at subsidised interest rates.

Since SWHs are energy efficient products, the bonds can be used for the purchase of SWHs. The green bond is being offered by Eskom and the Development Bank of South Africa. “Green bonds of this nature are being used in other countries, like Canada and the US” and Eskom is busy conducting further research on this instrument (Respondent 7).

The introduction of the green bond could provide the much needed finance mechanism for the SWH industry.

In summary, Table 4.4 shows the mechanisms for SWH financing.

Table 4.4. Finance Mechanisms and the Benefits thereof

Finance Mechanism	Benefit
SWH financed at low interest rate over 5 years	Can be beneficial when electricity prices increase and best return is on high-end (expensive) systems.
Using an ESCO to provide hot water service	Reduced cost of hot water when ESCO rate is lower than equivalent electricity tariff
SWH Rental (from finance house)	Financial benefit to the end user due to lower rental payments. However, it is not a viable option for finance houses
Insurance Reimbursement (claim applicable to valid policy holders)	Assists with some capital but can only be exercised when the EWH fails.
Green Bonds	Low service cost and subsidised interest rates

4.5 Raising Awareness

Households, in general, are not aware of SWHs and therefore do not consider the product as one of their options. Balmer (2007, p.16) has mentioned that, Austria, Australia, China and India have "invested in large-scale public awareness programmes" Although South Africa, wants to promote solar water heating and reduce the greenhouse gas emissions, there have been no intensive awareness raising efforts. The public therefore remains uninformed. Respondent 1 suggests that awareness should begin at schools and newspapers. This is valid because mediums such as the radio and television are not widespread. Children are also more conscious about the environment, as it will be their future. This will prompt them to speak about the carbon emissions and convince their families to change to solar water heating.

Awareness efforts should be getting more aggressive as the electricity demand gradually increases, depleting the already low electricity reserve margins. Efforts should be focused on creating solar champions to drive the technology through government departments, schools, radio and television, print media, exhibitions, conferences and through municipalities.

Respondent 3 argued that SWHs do not have a good enough "business case." That is, the low cost of electricity does not allow payback periods equivalent to the warranty period (5 years) and therefore there is "marginal" benefit (Respondent 3). It is further stated that other benefits, such as "security of energy or environmental motives" (Respondent 3) have to be examined to justify the business case. The power shortages (load shedding) have raised awareness, but not to the expected level. Consumers were asked to reduce their consumption by 10% in 2008 and this impact was poorly seen on the electricity consumption figures, reducing by only 2% (Eskom Annual Report, 2009, p. 46).

Respondent 2 draws attention to increasing awareness by "pre announced higher electricity prices, including externalities." This means that the publicity around the forthcoming electricity price increases could result in the consumer being more responsive because the electricity price increase is going to affect the cost of living and ultimately each household's budget. Many consumers have already been affected by the above inflation electricity price increases of 27% in 2008 and 31% in 2009. Eskom's intended price increase of 35% over the next three years will definitely send a strong signal to the consumer that every unit of electricity energy used is going to add to the electricity bill. Consumers are therefore going to be looking for methods to reduce their electricity bill by reducing their electricity consumption. The obvious answer for many is to look towards other technologies, particularly solar water heating, to provide the electricity savings that are required.

The question of how does awareness need to be created is an interesting one and can be answered by simply looking around you. For example, are you aware of solar water heating? If yes, then did you enquire more about the product or technology? There is common agreement among respondents that the awareness campaigns are lacking and more tactical awareness plans must be devised. Table 4.5 highlights responses on whether there was sufficient consumer awareness of SWHs.

Table 4.5. Summary of Respondents Comments on Awareness

Respondent	**Awareness**
1	No, insufficient education, starts at schools with awareness campaigns as well as marketing campaigns in newspapers.
2	No, Pre-announced multi-year introduction of carbon taxes.
3	No, there is not and it is simply because there is no business case. Who in his right mind will spend 25K on a solar retrofit system if the payback is longer than the warranty period? RE lives between the differential of the capital cost and the savings to be had and as long as the cost of electricity is under priced the business case is marginal, except if you look at the other motives being security of energy or environmental motives.
4	Yes
5	On television many times a day.
6	No, as above a national advertising and awareness campaign is required. However, this must include provision of installers and an increased subsidy.
7	There is a need to have awareness programs at schools and universities on the value of alternative energy.

Respondent 4 mentioned that there is sufficient awareness. The explanation could be because of load shedding and pre-announced electricity price increases.

The subject of climate change is an international concern that requires attention from all individuals living on this planet. Once this culture is inculcated in individuals, the awareness of environmental pollution becomes noticeable. This culture change should be introduced at schools because this period in the individual lives requires compulsory learning. Learners can then share their education with their parents and others who had unfortunately missed the lessons. Therefore, education on climate and the environmental erosion is crucial.

The introduction of carbon taxes would sensitise people to the amount of carbon pollution that is prevalent in the atmosphere (Respondent 2). This means that if end users use electricity that produces carbon gases as a by-product, they will be subjected to these taxes. The so called 'carbon footprint' is also an interesting concept that could create awareness on the detrimental effect of carbon gases. Individuals can measure their carbon footprint by examining all their tasks and measuring the quantities of the carbon gas released by the execution of each of their tasks.

The return on investment on the SWH varies the SWH business case as it is dependent on the price of electricity. In some systems, the return on investment can be 4 years while others systems may take up to 15 years to payback. The consumer cannot decide which option is best for the household and delays this buying decision because of the uncertainty. The financial figures look good but the end user questions the ideal payback period for this type of investment. The majority of suppliers offer a 5-year warranty (Eskom DSM, 2009) on the SWH and claim that it will payback in 5 years. A 10-year warranty is available by some suppliers but at an additional cost. The specified life cycle on some SWHs is 20 years. Therefore, an ideal return of investment period should be between 10 and 15 years. This accommodates premature failure of the SWH and the end user can use the savings obtained after payback, to finance the next SWH.

The media that could be responsible for creating awareness are television and radio broadcasts. Radios consume the lowest amount of energy and are embedded in cellular phones, computers, the internet, flash drives and as portable devices that are sold for less than R 20 in some instances. The end user can easily absorb the information disseminated by the radio and the broadcast is widely available but limited to an audio signal. Television would provide a pictorial broadcast that could show the different types of SWHs, a typical installation and the function of the SWH components to produce hot water. However, the cost of advertising will be expensive and has to be borne by either the supplier or some other stakeholder.

With the power shortages in South Africa almost ceasing, the consumers have resumed old habits by using electricity inefficiently. There is anticipation by Eskom, that the future electricity price increases will a motivating factor to reduce electricity consumption.

4.6 Can a Law Promote Growth of the SWH Market?

The introduction of a bylaw in the City of Cape Town in 2010 is the first step to enforcing the use of SWH. Respondent 1 agrees that a law is necessary to speed up implementation of this technology. This law must be applied to “new buildings, in all public buildings and after a period of 3 or 5 years, in older buildings as well.” Respondent 2 also agrees in principle that a law should be in place and states that the "Barcelona building regulations be applicable to all municipalities." However, Respondent 3 believes that there are other ways to assist the market and says that if a business case cannot be made, then why should consumers be forced to install SWHs that have no financial return to them. A further suggestion is that manufacturers should be forced to start manufacturing "solar ready geysers." Consumers could be forced to make an unjustifiable investment if the bylaw is applied in Cape Town. The purchase of a SWH then becomes an expense that depends largely on the consumer's disposable income. If the consumer cannot afford this expense then they would have to do without hot water, or be fined.

A detailed look at the issues arising from the proposed City of Cape Town bylaw reveals that there is a lack of clarity of certain issues which are bound to cause confusion.

- The 60% of heating requirements would be difficult to measure on new property since there are no electricity consumption records. People's requirements are different, even though they may have the same size house and in the same location. Some prefer heaters while others prefer none.

- The audit on the property is going to cost money. Who will pay the cost of it?

- The bylaw will be applied to properties over R 500,000. There is a vast difference between municipal valuation and market valuation. So which one would apply?

- What happens if the purchaser cannot afford the SWH? Will the cost of the SWH be included before or after the R 500,000 cut off?

Respondent 4 suggested that the bylaw be applied to "all new homes of 350 square meters or more and valued at R 750,000 or more." This recommendation includes surface area as well and may be more relevant because generally, larger homes would have more hot water requirements. The increase of the minimum value to R 750,000 is just as relevant because it targets the higher income groups. Although these recommendations are made, there seems to be no accountability as to who will install the SWH in the home. One assumes that it be audited as part of the building regulations.

The Cape Town bylaw is very similar to the bylaws already implemented in Barcelona and Brazil. Although this bylaw has had success in these countries, the abovementioned issues must be clarified before implementation of the bylaw in South Africa. A shortcoming of the bylaw may be the exemption of the "water used only for industrial purposes in buildings where hot water requirements exceed that which can be reasonably obtained through solar water heating" (Prasad, 2007, p. 14). The term 'reasonably' can always be questioned and end users can use this as a loophole in the bylaw. The bylaw should have rather included that the largest SWH be used to supply the EWH so that some of the water heating is achieved via solar resulting in some energy savings.

In Israel, the State has played a vital role is setting norms for solar water heating. In these cases, SWHs have either been installed by high ranking government officials in their homes or rolled out to all State buildings. This practise, however, has not occurred in South Africa. The government should begin to publicise their intentions to change to solar water heating so that the wider public can follow this lead. Respondent 2 agreed that there is a "lack of leadership" by the Government regarding the issues on SWH (especially in their own buildings). A possible way forward is to target municipalities to change their building regulations (Respondent 2). Even though there will be a possible loss of revenue (Energy, 2008, p. 17), municipalities should begin to see the bigger picture in terms of electricity shortages and environmental concerns and be the champions for solar water heating. The campaign could be even more aggressive and limit new sales and installation of EWHs only to low income households. This would send a clear message to electricity consumers that the State is serious about SWHs. Brazil has more municipalities than South Africa and that country is striding in the correct direction. Visagie and Prasad (2006, p. 19) suggest that "local government will prepare and pass bylaws to make the inclusion of SWH mandatory in new housing and gradually retrofit SWH in old houses."

With regards to the stopping of production of EWHs, the question that arises concerns the financing of the replacement SWH. Moosa (2007, n.p) suggests that partnerships be developed "with the insurance industry to replace damaged EWHs with SWHs."

4.7 The Effectiveness of Incentives

Incentives such as subsidies and income tax deductions have been prominent methods used by other countries. In South Africa, Eskom offers a rebate to attract consumers to the technology. According to Respondent 3, "the hurdles crossed to earn a subsidy far outweigh the value of the subsidy." Respondent 1 and Respondent 2 also shared the same sentiment and echoed the "red tape" involved in obtaining the subsidy. An investigation into the criteria required to claim the Eskom rebate revealed the following:

- The SABS test is an additional expense. Imported products carry the 'solar keymark' which is accepted internationally but they still have to go through these local tests (Respondent 1). The subsidy should be used to reduce the cost of the SABS test (Respondent 3).

- The installation of a timer or load management device is an additional cost borne by the consumer, thereby making the rebate close to zero.

- Very few suppliers can offer a life expectancy of 10 to 15 years. How does one measure this if the comprehensive guarantee is 5 years?

Respondent 1 mentioned that the subsidy was inadequate to drive the change required by end users and should be applied to industrial and commercial consumers. It should also be linked to the size of the collector area. Currently, the rebates value is based on the SWH efficiency as derived from the SABS performance test (Eskom DSM, 2009). Balmer (2007, p. 16) offers a lesson learnt Germany and China. "In countries where the subsidy is calculated based on energy actually produced, there is an active interest for all involved to increase solar energy output, which in turn boosts research and development focussed on the most efficient solution." Once the SWH market is established, entrepreneurs will always be researching and developing more efficient designs.

Respondent 1, also mentioned that the subsidy should be linked to the size of the collector area. Across the world, SWH installation information is usually measured in collector area (m^2). Therefore, the rebate should be linked to the size of the collector area so that the reporting statistics also increases with rebates given.

"There are also no subsidies for companies who want to open up a manufacturing line" (Respondent 1). There is very little opportunity for new entrants to enter the market. This results in fewer suppliers and there could be a limitation on the installation of new units. Eskom has over 100 suppliers registered on their database (Eskom DSM, 2009) and this may be sufficient to provide SWHs to meet the short to medium term demand.

4.8 Standards may be a Barrier

The standards introduced by the SABS are quoted as "being unrealistic and not being applied consistently" (Respondent 3). In order to participate in the Eskom rebate programme, a test certificate from the SABS is required. The certificate verifies the device's thermal and mechanical properties so that Eskom can determine the rebate amount. (Eskom DSM, 2009). There is a bottleneck at SABS when it comes to getting units tested. Furthermore, it seems that for a supplier to make a sale, the SWH requires a test certificate (which comes at a cost to the supplier) yet the consumer benefits from the rebate. Therefore, the process of getting a unit tested is a barrier in itself to the industry.

Respondent 1 mentioned that some imported units came with the Solar Keymark and did not require an additional test. Information in the Solar Keymark brochure (2006) shows that this certification is given to SWHs that comply with EN 12975/76 standard. This is a European Union standard and specific to that environment. Furthermore, the solar keymark process calls for a "suitable quality management system" and not ISO 9001 as does the SABS quality management system. The compliance requirement by the solar keymark for a suitable management system could place products with this certification at a disadvantage when compared to products with an ISO 9001 certification. Due to this shortcoming, SABS and Eskom may not accept the solar keymark certification as a recognised brand.

The issue on mandatory standards does not need much discussion because the rebate offered by Eskom requires mandatory test certification to the SABS standards and this requirement makes the standards indirectly mandatory. End users would prefer to go with systems that offer the rebate because of this financial rebate leaving suppliers with no option but to comply with the necessary standards to receive certification.

4.9 The Skills Shortage Barrier

Training has been identified earlier as a barrier. Previously, training was carried out on the job because there were no official courses. This has been resolved by the CEF and other institutions and SAQA level 3 and level 4 training modules are available. Respondent 1 believed that training should be given "to plumbers and electricians by the Chamber of Commerce, in relation to the solar industry."

According to Respondent 3, there is definitely a lack of installation capacity, citing the need for SWH installation training to be included in the plumbing curriculum. In addition, the "failing Eskom subsidy" should be used to train installers (Respondent 3). Respondent 2 agreed that there is a skills shortage and mentioned that the SETA's should be responsible for training. An action by Visagie and Prasad (2006) calls for "training courses to be set up or expanded by the Energy Sector Education and Training Authority (ESETA)." The training courses should be offered at universities, technical colleges and vocational training centres.

4.10 The Low Price of Electricity Prevents SWH Uptake

The price of electricity in South Africa has been proven to be very cheap when compared with other countries. This low price of electricity has made it difficult for consumers to switch to the substitute product of SWHs because this substitute product requires an upfront capital outlay and the payback period of such an investment is greater than five years. Developed countries generally have higher electricity prices resulting in SWH purchases being easily justified.

Respondent 3 confirmed that "as long as the cost of electricity is under priced, the business case is marginal." A further point raised by Respondent 3, explained the impact of increasing electricity prices. “As soon as the cost of electricity goes up, the costs of raw materials go up and any potential margin or value proposition is destroyed. As long as we live in an environment with import parity pricing for metals and glass, the margin remains low” (Respondent 3). This argument concerning the electricity price is very relevant. Electricity is used intensively in the metal and glass industry. When the price of electricity rises, so to will the price of metals and glass increase. Since metal and glass are components of SWHs, the price of SWHs could also increase. This is contradictory to the belief of many experts who think that increasing, the price of electricity is the solution to SWH uptake. The consumer will be in exactly the same situation as is currently because the electricity price is also related to the cost of SWHs.

The primary reason for the electricity price increases is so that the power utility can be more sustainable and finance its operations. Carbon taxes are said to be introduced soon (Respondent 2) and this will result in tariff increases since the power utility is a major contributor of carbon emissions. The carbon tax, according to the Minster of Energy, “will be borne by the consumers through tariff increases” (AMEU, 2008). The planned carbon tax is 2 cents per kilowatt-hour. This represents an effective price increase of less than 5% and may be inadequate to infuse behavioural changes in end users. However, if the carbon tax is applied in conjunction with the annual electricity price increase the effect may be more profound amounting to 40% (35% + 5%).

Results from a study show that with annual sales of 200 000 units, “at a price of $900 per unit, would create a market of $180 million, producing energy savings to the same value within three years and an energy ‘profit’ from that point onwards” Du Plooy (2007, p. 81). Mass roll out can be easily implemented by Eskom’s finance company (Botha, 2008). As a strategy to increase uptake, Eskom should identify all bondholders of its finance company and target them as their first phase to mass roll out. This would still follow the credit vetting process but Eskom has the influence to offer lower interest rates and get payments directly off the employee’s salary. The risk of non-payment is low and this will assist the market to expand without much effort.

The low electricity price history in South Africa has resulted in end users consuming electricity without any recourse. That is, many end users take it for granted that this source of energy will always be cheap and always be available. However, the spate of load shedding that has occurred in early 2008, may have forced the consumer to rethink about the electricity security. Furthermore, the electricity price increases applied in 2008 and 2009 have been far above inflation. In addition, the recent announcements by Eskom on the planned electricity price increases for 2010, 2011 and 2012 averaging 35% per annum has been subjected to public outcry. End users are beginning to realise that electricity is no longer a cheap commodity that can be used at any time. End users may be searching for cheaper alternatives and solar water heating is one method that will be able to assist offset some of the high electricity bills caused by electric water heating.

4.11 Summary

The characteristics of the respondents are predominantly industry specialists and the method of data collection was questionnaires distributed to industry experts.

The cost of production has a major influence on the price of SWHs and the reduction in import duties and cost of certification can reduce the cost of production. Subsidies given to manufacturers could also be beneficial.

Several methods for acquiring finance have been suggested. However, many are not readily available. The fixed interest rate of 5% for SWH loans may be preferred and can be easily offered by financial institutions.

Each of the identified barriers has been discussed with input from the Respondents. All are valid barriers, whilst the high price and awareness barriers are the most significant.

The barriers to SWH introduced competitive pressures for the SWH industry resulting in the EWH being the preferred choice of technology. These competitive forces must be overcome to enable the SWH to become the preferred choice for water heating.

CHAPTER FIVE

Conclusion and Recommendations

The purpose of this study was to identify the reasons for the resistance experienced in the mass rollout of SWHs by investigating the barriers that were prevalent in the market. The objectives of this study were addressed with relevant literature supported by questionnaires answered by recognised SWH specialists and consultants.

The objectives of this study are as follows:

- to identify the barriers to solar water heating in South Africa; and
- to identify solutions to reduce these barriers.

During the course of the study, the best method for identifying and reducing the barriers was constantly examined. The literature review provided in Chapter 2, has assisted in identifying the barriers to SWH but did not provide sufficient practical solutions to reduce these barriers. Further information was sourced from respondents who answered open-ended questionnaires. The responses from the recognised specialists and consultants were critically analysed and discussed in Chapter 4.

This chapter discusses the findings and provides recommendations to the objectives of the study. The data, time and theoretical limitation of the study are explained and areas where further work may be undertaken are suggested.

5.1 Reducing the Barriers to Solar Water Heating

The barriers identified by Dintchev (2004) were used as a basis for this study and were investigated in more depth in the literature review. Questionnaires were used to supplement the discussion where necessary. The following points describe the barriers identified by Dintchev (2004):

- The high cost of solar water heaters prevents low-income consumers from purchasing SWHs.
- The lack of consumer awareness of the impact of electric water heating on the environment.
- The lack of awareness regarding the potential to reduce energy related costs by using solar water heaters.
- The absence of legislation to facilitate or promote the expansion of the SWH market and technology.
- The absence of compulsory standards for testing and certification of SWHs.
- The shortage of technically trained and competent resources for the installation and maintenance of SWHs.
- The low cost of electricity in South Africa contributes directly to the mass implementation of electric water heaters.

The findings of the study are summarised below and in the Cause and Effect diagram in Figure 5.1.

5.1.1 The High Price Barrier

The high cost required for the purchase of SWHs is not affordable to the majority of low-income households because of abject poverty and absence of any savings. In some low-income households, electricity is available but is not used for water heating. Therefore, the middle to high income sectors should be targeted for solar water heating as these are sectors that currently are using EWHs and may be able to afford SWHs.

The cost of production of SWHs remains high forcing the retail price to be high. Respondents to the questionnaires have mentioned that the high cost of certification, training and import tariffs are significant contributors to the price of SWHs. In addition, electricity prices have a direct impact on the metal and glass prices thereby influencing the price of SWHs (Respondent 3). Rebates to manufacturers are proposed to assist in lowering the retail cost of SWHs.

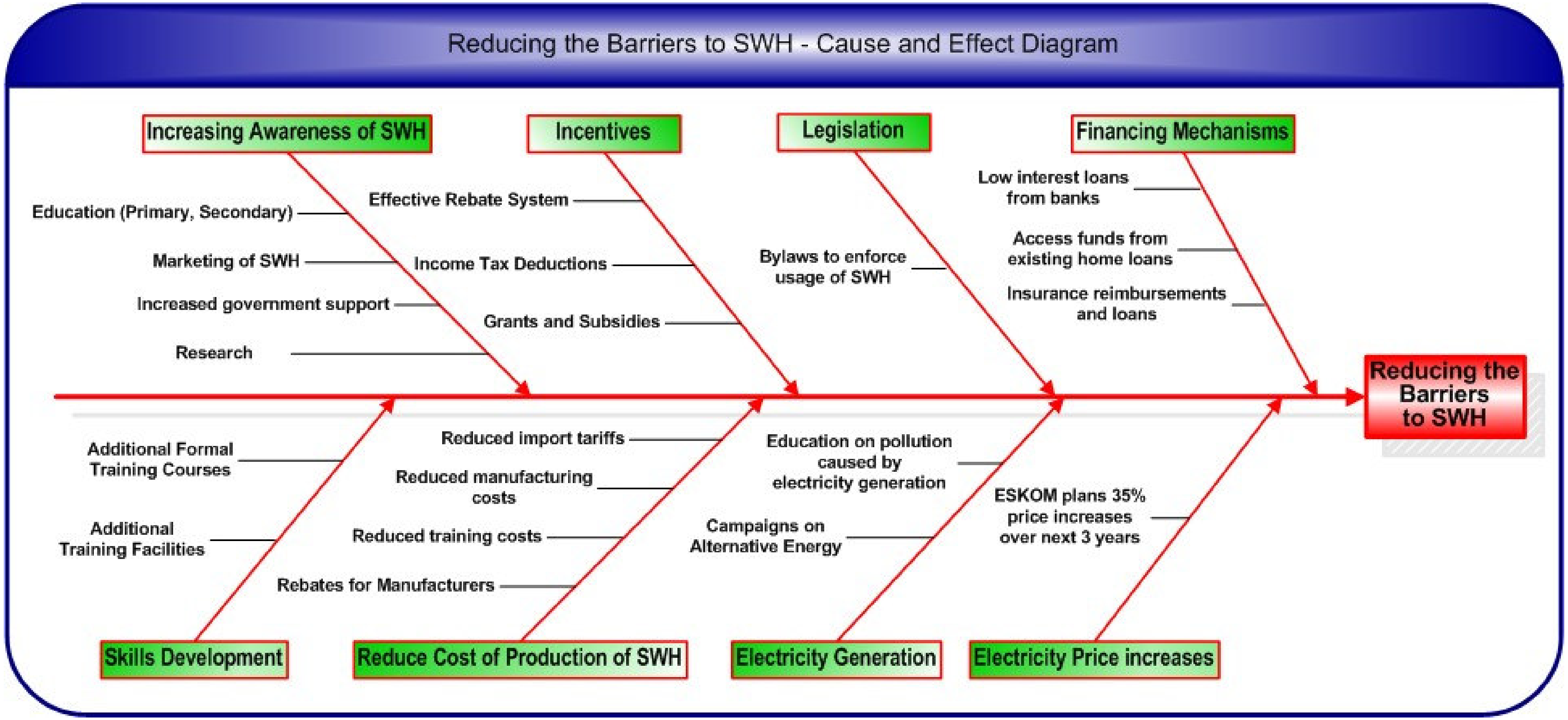

Figure 5.1. Reducing the Barriers to SWH – Cause and effect Diagram

Financing mechanisms should be implemented to assist consumers to pay for the SWH. Although the SWH may only be a more financially viable option in 2012 (due to the increased electricity prices), the end user may not be able to afford the high cost of the SWH and this will impede the SWH market penetration. It is therefore necessary for financial institutions to review their lending policies as far as loans for SWHs are concerned. Additional funds could also be obtained from existing home loans. New loans for SWHs may be offered at low interest rates (proposed to be fixed at 5% or less) to ensure affordability of monthly repayments by the end user, since these loans will be recovered over a shorter period.

The insurance industry can assist insured households to offset some of the capital cost required for the purchase of SWHs. However, this can only occur when the end user is reimbursed for a failed EWH. Both, insurance organisations and consumers must reach an agreement to prevent end users from replacing the failed EWH with another EWH.

Another method of acquiring a SWH without purchase is through municipalities or ESCOs (GEF, 1997). The municipalities can offer hot water services directly or through an ESCO, by purchasing and installing the SWH at the end users home and then charging a tariff for the provision of hot water. However, this tariff must be lower than the equivalent electricity tariff to prevent end users from switching back to EWHs.

The need to provide appropriate financing mechanisms will be necessary once the end user becomes aware of the benefits of the SWH and the need to switch to solar water heating. The recommendation is for the State to liaise with banks to provide low interest rate or subsidised interest rate loans to prospective customers who may want to finance the SWH. The key is having low interest rates so that the repayment is affordable as per Table 4.3. Strategic sourcing partnerships should be established between banks, household insurance underwriters and credible SWH suppliers to ensure that quality products are always installed. The benefits for the banks and insurance companies will be for being ‘good corporate citizens’ who are committed to reducing South Africa’s carbon footprint whereas the end user will be benefit from the energy saved.

5.1.2 The Lack of Awareness Barrier

After a comprehensive literature review and analysis, the following two barriers to awareness were investigated and grouped together as a single barrier. Firstly, there should be awareness regarding the solar water heating technology and secondly, there should be awareness about the environmental impact of electricity generation.

There is agreement by all respondents that South Africa lacks awareness regarding solar water heating, consequently aggressive awareness campaigns are necessary. Articles by Eskom have been published in local newspapers to promote the solar water heating technology. The articles also included information on the potential benefit of SWHs to reduce the energy-related costs. Although these publications by Eskom are advantageous, the respondents have suggested that regular promotion through radio and television would enhance the general awareness of solar water heating.

The technical information on solar water heating published in newspapers can easily be overlooked if the reader does not purchase the newspaper. The audience that newspapers target is also limited. For this reason, aggressive advertising campaigns, incorporating the benefits and electricity savings that may be derived from using SWHs, should be conducted through television and radio broadcasts to sensitise a wider audience. The Government should also embark on intensive campaigns that will bring together the SWH industry which should present road shows, hold public meetings or debates, community fairs and conferences. The Government must be the leaders in this area and show support to this initiative by installing SWHs in all government-owned buildings. In addition to the recently established website on solar water heating, electronic mail (email) and the cellular short message service (SMS) could be used to enhance the promotion of SWHs. As more people are exposed to the information, the demand for SWHs could naturally increase.

Respondents have also identified the lack of appeal of SWHs, insufficient motivation for a business case and the lack of education on the environmental impacts of electricity generation as areas of concern. SWHs could only gain appeal when frequent power outages occur because only then, will the business case look more favourable. Children should be educated on alternative energy sources in schools while adults should be educated through the various media available. Further initiatives are required by SWH organisations to promote and market the product and its immense benefits.

The end user can be proactive and become aware of the solar water heating technology by examining replacement systems, requesting quotations for the installation of SWHs from prospective suppliers and referral by word of mouth. This will prevent complacency among end users.

5.1.3 Legislation

There is currently no legislation in place to compel consumers to conserve electricity or utilise SWHs. Although the City of Cape Town is in the process of promulgating a bylaw for using SWHs in 2010, the impact of this bylaw cannot be accurately determined as yet. The bylaw for installation of SWHs may not be necessary if the water heating industry stops producing EWHs and produces "solar-ready geysers" (Respondent 3). This will result in an automatic phase out of EWHs. However, if a bylaw is enacted, then this bylaw has to provide clarity on many issues identified earlier. There are mixed views among respondents on whether a bylaw is required although the literature has suggested that it has contributed to the sustained development of SWH industries in countries such as Brazil, Israel, Barcelona and Greece. Once the bylaw has been successfully implemented by the City of Cape Town, similar bylaws could be introduced in other provinces.

5.1.4 Incentives and Rebates

Countries that offer rebates, grants and income tax deductions have helped the SWH market to develop. In South Africa, the financial rebate is the only incentive available to the end user. Respondents have highlighted that the process of claiming rebates is too cumbersome, tied up in bureaucracy and is not necessarily beneficial and viable.

The limited testing facility and associated cost of certification, delays the process of claiming rebates, resulting in additional expenses for manufacturers. Consumers have to install additional equipment, such as timers, to qualify for the rebate. The additional costs borne by both manufacturers and consumers render the rebate to be uneconomical since these expenses become significant overheads. The shortcomings, if any, of the solar keymark (European certification mark) should be addressed, so that international SWHs can be eligible for rebates. The Eskom rebate may need re-engineering to be simpler and beneficial to both manufacturers and consumers. However, the current rebate must continue as the re-engineering occurs. Additional income tax incentives should be introduced by the State for the purchase of SWHs. Eskom, benefits by the reduction in electricity demand when SWHs are installed thereby allowing the utility to defer its capital investment in new generating plant.

5.1.5 The Standards Barrier

There are no compulsory standards for SWHs but the Eskom rebate is only applicable to SWHs that have passed the SABS certification tests. The certification test is governed by SABS standards (referred to in Table 2.2) and ensures that the SWH meets operational quality standards thereby building customer confidence in the SWH industry. The SABS mark, although not compulsory for rebate, is an approval of a quality management process that only few manufacturers comply with.

Some of the respondents believed that local standards should be area-dependent because certain requirements do not apply to specific locations. For example, SWHs have to withstand large hail damage, which may not occur in all areas (Respondent 4). This study has found that the current standards have been revised several times by the SABS and are being widely applied in the industry.

5.1.6 The Shortage of Skills Barrier

There is common agreement among respondents on the shortage of skills and training facilities. This is supported by the literature reviewed. Although the skills shortage is not perceived as an immediate barrier, the situation could deteriorate when the demand for SWHs increases. A formal training module has been created that will allow learning institutions to teach the required skills. In addition, the establishment of the Western Cape training facility could provide the necessary trained resources to build capacity for artisans to deal with the SWH demand when the anticipated bylaw becomes effective in Cape Town (Roelofs, 2009).

5.1.7 The Low Price of Electricity Barrier

The findings of the study reveal that the price of electricity is an important factor affecting the expansion of the SWH market. The low price of electricity ensures that the operational cost of EWH remains affordable and therefore the end user is not going to readily switch to the substitute product known as the SWH. The consumer has no control over the price of electricity because this decision is determined by NERSA. However, there is consensus by respondents that the price of electricity should be increased to strengthen the business case for SWHs. This study has shown that electricity prices have increased considerably since 2008 and are planned to continue until 2012. This will increase the price of electricity over four-fold the price in 2007 and 2.4 fold over current prices. This will make the end user more aware of the electricity shortages and contribute to an increase in the operational costs for EWHs, resulting in a stronger business case for SWHs.

A further recommendation is for the State to get more involved in supporting the SWH initiatives of the country and assist in developing the necessary policies to promote and drive the installation of SWHs.

5.2 Limitations of the Study

5.2.1 Limitation of Data

The literature analysed in this research was only a small quantity compared to the vast amount of information available on this topic. One can delve into various areas pertaining to solar water heating, but this study has been limited to the barriers of solar water heating. The literature assessed contained various perspectives on what has been done internationally and there is no certainty that any specific solution will work in the South African environment. Therefore, the literature reviewed has some limitation albeit useful.

There are various dependencies in this study. For example, much of the business case for SWHs depends on the price of electricity which determines the operational cost of the EWH. Although tariff increases are inevitable, the actual value of the increase is debateable. Similar deductions can be made for creating awareness, introducing legislation and providing rebates. The information can only provide past experiences and no future guarantees. However, this stepping-stone is essential to give future direction.

Similarly, the information obtained in response to the questionnaires provided practical information that supported the study. The limitation here was the number of questionnaires analysed. Only seven experts agreed to participate in the study. More respondents would have yielded more perspective.

5.2.2 Time Constraints

The time limitation allowed the study to focus only on a few countries such as Berlin, Italy, Barcelona, Australia, India, Greece, Taiwan, Brazil and Morocco and their successful actions in resolving or reducing the barriers to solar water heating. However, if the author had analysed data from more countries, different approaches may have been obtained that could provide further perspectives.

The time constraints also prevented a detailed financial analysis from being conducted in terms of actual costs of SWHs, return on investment, costs associated with manufacturing, subsidies and rebate amounts and the impact that legislation would have on the economy.

5.2.3 Limitations of Theory on the Topic

The topic relates widely to a variety of barriers in the industry. However, it was necessary to differentiate key barriers from non-key barriers and emphasises the importance of the key barriers in relation to the study. The study focussed on attempting to reduce the barriers rather than remove the barriers. The reason for this was that it might be easier to reduce than remove the barriers. In reducing the barriers, the market is allowed to develop until complete removal of the barriers occurs. In some cases, barriers cannot be removed in the short term and so it is beneficial to reduce the likelihood of occurrence and consequences that these barriers have on the industry.

5.3 Areas for Future Research

Due to the limited scope of this study, there is room to conduct further research. The topics for future research relate directly to each identified barrier. In particular, future research could investigate the financial impact or relationship of electricity tariffs on SWHs relating to the price increases of materials used for the constructions of SWHs. Materials such as glass and metal are generally manufactured by electricity-intensive industries. Therefore, an increase in the price of electricity is going to result in an increase in the price of SWHs.

A study to investigate the cost of removing barriers to the SWH industry could be valuable to the SWH Industry and the State. This would determine the feasibility of reducing or removing each barrier and steer the SWH industry towards the most cost effective option.

Further discussion on the age-old debate of legislation versus market forces is required to conclude whether the promulgation of bylaws for solar water heating is effective. Although bylaws have been successful in developed countries, it will be useful to measure the impact thereof on a developing country such as South Africa.

Finally, manufacturers do not favour the rebate system currently offered by Eskom. A cost benefit analysis may be necessary to determine whether the rebate is achieving its goal of promoting the installation of solar water heaters in South Africa.

5.4 Summary

The high price barrier stems from the high production and certification costs of the SWH. The demand will tend to remain low as many end users cannot afford this initial capital expenditure and there are other competing energy sources that are priced lower than SWHs. Financing methods such as low interest loans, government subsidies, insurance reimbursements and an uncomplicated rebate system could increase the market share of the SWHs.

The lack of awareness of the technology and its associated benefits is also a contributor to the low demand. Extensive promotion of the product and its benefits are required through radio, television and other appropriate media such as electronic mail, short message service (SMS) and social networks so that the wider public can become familiar with the advantages of SWH. Detailed facts comparing the EWH and SWH should be made available for public consumption.

The effectiveness of legislation in South African cannot be determined until it is implemented. Therefore, the success of the City of Cape Town's bylaw on solar water heating could be a learning curve for other provinces.

Incentives such as income tax deductions and grants could positively influence the demand for SWHs.

The skills shortage could be overcome by the formalised training courses that have been developed. Vocational training centre would also be more inclined to offer formalised training courses.

The increase in the price of electricity will occur as the electricity demand exceeds supply. This has already begun, with the massive tariff increases planned for the next three years. SWHs could gain more market share as the electricity savings that SWHs will provide is directly proportional to the price of electricity. However, enhanced awareness, suitable financing mechanisms and worthwhile incentives should be the catalyst that the SWH market requires to grow.

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APPENDICES

APPENDIX 1 Letter Requesting Participation

Sample Template Requesting Participation 3B

UNIVERSITY OF KWAZULU-NATAL
GRADUATE SCHOOL OF BUSINESS

Dear Respondent,

Masters in Business Administration Research Project

Researcher:	JS Naicker	(Tel: 011-651 6846)
Supervisor:	Dr Mihalis Chasomeris	(Tel: 031-260 2575)
Research Office:	Ms P Ximba	(Tel: 031-260 3587)

I, **Jayson Shrinivasan Naicker,** am a MBA student at the Graduate School of Business at the University of Kwazulu Natal. You are invited to participate in a research project entitled **Solar Water Heating: Reducing the Barriers**. The aim of this study is to: Investigate the existing barriers to implementing solar water heating and propose methods of overcoming these barriers.

Through your participation I hope to understand my research from an external perspective. The results of the interview are intended to contribute towards my research and would be used by Eskom to effectively roll out solar water heaters.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this survey. Confidentiality and anonymity of records identifying you as a participant will be maintained by the Graduate School of Business, UKZN.

If you have any questions or concerns about completing the interview or about participating in this study, you may contact me or my supervisor at the numbers listed above.

The interview should take about 45 minutes to complete. I hope you will take the time to complete this interview as your contribution will be valuable.

If permission is granted the UKZN requires this to be in writing on a letterhead and signed by the relevant authority.

Sincerely

Investigator's signature : JNaicker Date : 09/02/2009

APPENDIX 2 Open Ended Questionnaire

QUESTIONS

1. Please state your role in the Solar Water Heating industry? (Manufacturer, Sales, Consumer, Subject Expert, Academic). If Manufacturer or Sales, is your product supplied internationally?

2. Do you think that the high cost of solar water heaters is a barrier to entry? If so, to which income sector and how can this be overcome?

3. Subsidies have been introduced in South Africa. Do you think that these subsidies are sufficient for consumers to change to the Solar product?

4. Do you think that there is adequate consumer awareness on the current electricity shortages and electricity savings? If not, how can consumer awareness in this area be increased?

5. Do you think that there is adequate consumer awareness on SWH and the benefits thereof? If not, how can consumer awareness in this area be increased?

6. Do you think legislation that enforces the use of SWH is a good method to fast track the implementation of SWH? If so, how and to whom should this legislation be applied?

7. Do sufficient certification standards exist in the SWH manufacturing sector in South Africa? If yes, are these standards being widely applied to manufacturers?

8. Do you think that there is a skills shortage in the area of installation and maintenance of SWH? If so, how can this issue be addressed?

9. Are there any other barriers to SWH that you may have identified? Please explain

10. What benefits are there to the consumer using solar water heaters?

11. What limitations are there to the consumer using solar water heaters?

12. Does South Africa have sufficient resources to manufacture and supply SWH should the barriers be reduced? Please explain

13. Are there any barriers preventing international suppliers from entering the South African SWH market? If yes, please elaborate.

14. What do you think are the reasons for SWH having being successful in other countries?

15. Is there any specific solution that can be implemented to greatly reduce the barriers to SWH? Please explain

Additional Comments:

APPENDIX 3 Ethical Clearance Certificate

UNIVERSITY OF
KWAZULU-NATAL

RESEARCH OFFICE (GOVAN MBEKI CENTRE)
WESTVILLE CAMPUS
TELEPHONE NO.: 031 – 2603587
EMAIL : ximbap@ukzn.ac.za

17 APRIL 2009

MR. J NAICKER (951016397)
GRADUATE SCHOOL OF BUSINESS

Dear Mr. Naicker

ETHICAL CLEARANCE APPROVAL NUMBER: HSS/0163/09M

I wish to confirm that ethical clearance has been granted for the following project:

"Solar water heating: Reducing the barriers"

PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years

Yours faithfully

PXimba ....

MS. PHUMELELE XIMBA

cc. Supervisor (Dr. M Chasomeris)
cc. Mrs. C Haddon

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville