A study into the Awareness and Implementation of Energy Efficiency Initiatives in the Retrofitting of Retail Centres in Kwa-Zulu Natal

By

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PREFACE

The research contained in this dissertation was completed by the candidate while based in the Discipline of Construction Studies, School of Engineering of the College of Agriculture, Engineering and Science, University of Kwa-Zulu Natal, Howard College Campus, South Africa. The research was financially supported by Mangosuthu University of Technology.

The contents of this work have not been submitted in any form to another university and, except where the work of others is acknowledged in the text, the results reported are due to investigations by the candidate.

Signed: T. C Haupt

July 2019

DECLARATION: PLAGIARISM

I, Upasna Narain, declare that:

(i) The research reported in this dissertation, except where otherwise indicated or acknowledged, is my original work;

(ii) This dissertation has not been submitted in full or in part for any other degree or examination to any other university;

(iii) This dissertation does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons;

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a. Their words have been re-written but the general information attributed to them has been referenced;
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(v) Where I have used material for publications followed, I have indicated in detail my role in the work;

(vi) This dissertation is primarily a collection of material, prepared by myself, published journal articles or presented as poster and oral presentations at conferences. In some cases, additional material has been included;

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ABSTRACT

This study examines the awareness and implementation of energy efficiency retrofit initiatives in retail centres in Kwa-Zulu Natal. The participants of the study were management of 20 retail centres in and around the Durban area to determine the level of awareness and implementation of energy retrofit options.

The primary objectives of the study were:

- To identify the level of awareness and level of implementation of energy retrofit options in the commercial retail sector;
- To understand the reasoning and benefits of implementing energy retrofit solutions;
- To examine the factors that affect the adoption of energy retrofit solutions; and
- To examine Green Building rating tools and legislation associated with the retrofitting of retail centres.

A questionnaire was used to determine the levels of awareness and implementation of the participants of energy retrofit solutions, as well as to examine the benefits, costs and challenges associated with implementation. The findings of the study indicated there were high levels of awareness of retrofit strategies. Implementation of energy efficiency strategies were slow due to challenges faced by the management of retail centres. Some of these challenges faced by retailers were the high capital costs as well as lack of demand from tenants and customers. Larger retail centres who have overcome these challenges enjoy the many benefits associated with the implementation of retrofit energy efficiency solutions. Benefits received from implementation of energy efficiency strategies were more efficient use of energy, resulting in lower energy bills as well as improvement of public relations and branding.

Further study into the level of benefits received through various implementations of retrofit solutions could provide a detailed mapping of implementation solutions with relation to benefits achieved. Challenges faced by retailers could be extended to challenges faces by building or property owners as well as store managers. Limited reasons were investigated in this study for lack of implementation of energy efficiency

strategies. Further study can be done into more reasons for lack of implementation. Many retailers declined to provide information surrounding the cost of strategies implemented and benefits received, more study can be done surrounding the costs of energy implementation.

Key words: Energy Efficiency Retrofit Strategies, Green Buildings, Retail Centres, Awareness, Implementation.

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DEDICATION

This work is dedicated to Sriti Narain.

She has given me the strength & determination to complete this dissertation.

Table of Contents

List of Tables

List of Figures

CHAPTER 1 - INTRODUCTION

1.1 Introduction

This chapter provides an overview of the study. It introduces the topic of energy efficiency in buildings and its importance for the commercial retail sector in South Africa with particular focus on the energy-efficient retrofitting of existing buildings. The chapter will continue with the identification of the research problem, research questions and the list of objectives that will be investigated. Then, a brief summary of the methodology is provided, followed by the discussion on the significance of the study, ethical aspects, assumptions and limitations of the study. The chapter concludes with an outline of the dissertation including a brief description of each of the chapters.

1.2 Background

Energy management has become a key part of organisational life across all industries (Christina et al, 2015). The demand for energy far exceeds the available supply of energy in most countries (Hedden, 2015; Turner, 2014). This has been attributed to the fact that more than 50% of the world's population lives in an urban environment and it is expected to increase to 70% by 2050 (Turner, 2014). This demand forces consumers to consider how much energy they consume and possibly integrate between various forms of supply and demand side resources (Golove et al, 1996).

South Africa is an energy-intensive country, with mostly coal-generated energy (du Plessis, 2014). The country is one of the largest coal producers in the world, and yet it is short of electricity (Bullock, 2014). In 1998, the White Paper on Energy Policy stated that "by 2007, all current electricity sources in South Africa will be fully utilized" (DME, 1998, page 41). In 2008, energy demand exceeded the supply of energy to the country and rolling blackouts known as load-shedding began (Bullock, 2014). Rolling blackouts are scheduled downtime of electricity for either a scheduled or unscheduled period of time in an area. This is disruptive for the industry and is expensive to recover losses. Continued rolling blackouts have made consumers more aware of the finite amounts of energy available in the country and has started a trend towards a more optimal use of energy (DME, 2009). The use of energy efficiently will contribute significantly in stabilising the country's energy crisis (du Plessis, 2014) by 2030.

Buildings, both residential and commercial have been found to consume between 20-40% of total final energy consumption (Perez-Lombard et al., 2008). The move from old inefficient structures, to more energy efficient buildings has become a growing initiative globally. The public and private sectors in South Africa as well as many other countries have implemented a number of initiatives, legislation and voluntary mechanisms such as green building rating systems for new buildings. Eskom has implemented in South Africa a number of energy saving initiatives that promote the saving of electrical energy as well as educating users about the use of electricity. Also, the Green Building Council of South Africa (GBCSA) was established in 2007 and has implemented initiatives for the promotion of the adoption of green strategies in building projects through the Green Star SA certification. Due to these initiatives, a number of new residential, commercial and industrial developments have implemented these strategies resulting in reasonable energy savings in South Africa (Eskom, 2012). However, the implementation of energy efficiency must be undertaken as a strategic measure to advance sustainable development of the entire built environment. Sustainable development is not only important when looking at new buildings but is imperative to further provide ad-hoc plans and measures to improve the environmental quality and reduce the energy consumption of existing buildings, which in essence represents a much larger percentage of the built environment (Eskom, 2012).

In 2009, the Department of Minerals and Energy (DME) in South Africa released the revised National Energy Efficiency Strategy which proposed an overall 12% reduction in energy demand by 2015 across all sectors. The commercial sector had the highest expected demand reduction at 20% (DME, 2009). However, in 2013 the strategy was abandoned due to the targets being no longer achievable (de la Rue du Can et al, 2013).

The South African government in late 2011 published the SANS 10400 XA that obliges all new and majorly retrofitted buildings to comply with the new energy efficiency requirements stated in the code. The conversion of existing buildings to green buildings is beginning to become a need, more than an optional trend in South Africa. In the last 6 years, 50% more firms in South Africa worked on green building projects and more than half of these projects were retrofit projects (Bernstein, 2013). As load-shedding became a part of South Africans daily routine, more businesses and

individuals look for alternative sources to save energy at lower costs, the use of green technology has become a more attractive option for many (Hedden, 2015).

The commercial sector in South Africa utilizes 10 to 15 % of total energy consumed in the country (Eskom, 2014). According to ESKOM's usage data, the commercial sector in South Africa is seen to have a constant daily usage of energy, irrespective of season or day of the week (Eskom, 2014). This implies that a small change in energy usage, applied over a daily period would yield a significant saving. This could be done through a number of energy retrofit options. Energy retrofit is in fact the preservation and refurbishment of buildings and their continued operation using energy efficient technologies and practises (King, 2015). The primary value this adds to a building is the reduction of operating costs as well as their adverse environmental impact (King, 2015). Another aspect closely related to energy retrofit is Energy Management, which has also become a key aspect across all industries which is proving to have an increasing interest in response to achieving desired carbon emission targets (DEFRA, 2006). Previous studies observed that low to medium cost interventions might bring energy savings of 25% or more for this sector (Reynolds, 2007). The need for further research and data that can foster the implementation of strategies for improving energy efficiency in existing commercial buildings has therefore become evident in South Africa.

Among commercial buildings, the retail sector and particularly shopping malls play a significant role for global energy consumption in the country. This is due to the high levels of energy consumed by these types of buildings. The trend towards density of the retail spaces into shopping malls is increasing and South Africa has the 6th highest number of shopping malls in the world (Prinsloo, 2013). The retail sector offers a great potential for energy savings as retail stores have many similarities, and strategies can be implemented across all stores. If energy retrofit is implemented as a combination of awareness, technology, social behavioural patterns, as well as managerial initiatives, it might lead to truly efficient retail retrofit (Langner, 2013).

This study will therefore investigate the awareness and implementation of retrofit energy efficient strategies for existing commercial retail buildings in South Africa and possible challenges that are faced by industry for this implementation.

1.3 Problem Statement

The largest overall energy savings in the building sector can be achieved by the retrofit of existing buildings. This makes the study of retrofit within existing buildings and particularly commercial buildings and malls a high priority for the reduction of energy consumption and conservation (Martin, 2013). With South Africa having the 6th highest number of shopping malls in the world, the retrofit of commercial retail building will play an important role in the future of energy preservation in the country. Skills and technologies can be implemented for the benefit of all parties involved.

The South African retail sector urgently requires strategies to improve its energy efficiency. However, the lack of experience as well as the lack of information and research data in the country about the implementation of strategic energy retrofit options into retail buildings can hinder the sector from achieving this target.

1.4 Research questions

This study intends to answer the following research questions:

- What is the current level of awareness and implementation of energy retrofit options in retail centres in South Africa?
- What are the reasons for and benefits received through the implementation of energy efficient options in retail centres?
- What is the level of awareness and implementation terms of green initiatives and tools in retail centres?
- What factors influence the adoption of energy efficiency initiatives?

1.5 Objectives

The study is oriented to achieve the following objectives:

- To identify the level of awareness of retail management and the level of implementation of energy retrofit options in the local retail sector.
- To understand the social, environmental and other possible reasons for and benefits that have been associated with the retrofit of retail spaces
- To examine Green Building rating tools as well as legislation locally and abroad for energy retrofit in retail buildings.

- To investigate the critical factors that affect the adoption of strategies and regulations for energy retrofit of the commercial retail sector in Kwa-Zulu Natal.

1.6 Research Methodology

To achieve the objectives set out by the study, the research approach to be used will be qualitative and quantitative. The study will use qualitative and quantitative methods such as questionnaire surveys.

The research methodology shall make use of the following:

- Data collection will be done using a questionnaire survey of managers of a selection of shopping malls in KZN;
- Analysis of the data collected will be done using SPSS Version 25 and MS Excel
- Analysed data will be correlated to the literature review

1.7 Ethics in Research

The ethical clearance application process of the University of KwaZulu-Natal and of the codes of conduct expected to be followed in terms of data collection and protection of the participants will be strictly adhered to during the study. The study will be approved by the relevant Ethics Committee of the University (Annexure D).

The research to be carried out by the study involves human participation and desk research. For the empirical research sufficient consideration will be instituted for the complete well-being of the participants. All participants will be required to sign an informed consent form stating their awareness of the study and that they will be participating in the study voluntarily. All information to be provided by the participants will be kept confidential and will not be used for any commercial purposes. The study

will not violate any rights of any participant involved. No participant of the study will receive any benefit or be put at any risk as a result of the study. Quality assurance will be adhered to through the quality of data capturing and the accuracy of calculations.

1.8 Assumptions

The following assumptions were made for this study:

- It is assumed that all respondents of the questionnaire survey were truthful in answering the survey questions.
- It is assumed that data collected were representative of an important sector of shopping malls in South Africa and, therefore, the results can be generalised to other malls due to the common nature of the problem, energy management and retrofit issues.
- It is further assumed the participants approached have sufficient knowledge to provide accurate and reliable information.

1.9 Limitations

The study is subjected to the following limitations:

- The study is confined to the province of Kwa-Zulu Natal, due to time and travelling constraints.
- The sample is limited to mall management, in their personal capacity as managers of their respective retail centres.
- The study focuses only on energy efficiency in the public areas of retail spaces

1.10 Delimitations

The following delimitations in terms of the topic of the investigation applies to this study.

Green buildings are generally assessed on the basis of various environmental impact categories, which all contribute to the environmental impact of a building. Energy is just one of these. This study is limited to the assessment of energy efficiency and relevant energy management issues, in the light of the current energy situation in South Africa, the growing demand for energy and the lack of knowledge surrounding

this topic. The other environmental impact categories are outside the scope of this study.

1.11 Importance of the study

The demand for energy in most countries far exceeds the available supply of energy (Hedden, 2015; Turner, 2014). Added to this, more than 50% of the world's population is moving into an urban environment (Turner, 2014). This means that the pressure on the world's electricity demand is in no way going to decrease.

It has been found that buildings consume between 20-40% of total final energy (Perez-Lombard et al., 2008). Energy Retrofit refers to the addition of new systems or upgrade of existing systems to make a building more efficient. Together this means that the upgrade of older systems to more energy efficient ones will contribute to the reduced use of energy by a building.

This study investigates the importance of this subject in commercial retail buildings, and more specifically shopping malls. As retail centres contribute to approximately 15% of the consumption of total final energy, it is expected that a reduction in energy consumption of commercial retail buildings can reduce the pressure on the grid significantly. The study will make recommendations that are expected to decrease energy use and increase savings of energy, preserve the environment as well as promote changes in managerial and behavioural patterns towards energy efficiency. These aspects are critical for a future more sustainable development of the South African built environment.

1.12 Study Outline

The structure of the document is as follows:

Chapter 1: Introduction

This chapter introduces the thesis and gives the reader the background information to the study. It explains the current situation faced by energy consumers in South Africa and outlines the problem to be investigated. It describes the delineations and details of the study, which are formulated through the problem statement, research questions, hypotheses, and objectives, importance of the study, assumptions and limitations.

Chapter 2: Literature review

This chapter focuses on the review of the literature on the topic of energy retrofit of buildings, particularly the commercial retail sector. It analyses the research topic in detail, compares the current study to other similar studies as well as provides valuable information to make the study concrete and factual. It provides the reader with a clear understanding of the topic, the study and its relation to South Africa as a country.

Chapter 3: Literature Legislation

This chapter examines the various legislation available globally and locally regarding Green Buildings. It further investigates the global and local Green Building Rating Tools and the councils that implement them.

Chapter 4: Research Methodology

This chapter explains the methodology used to carry out the study. It includes the theoretical background to the methodology design, the specific processes followed in carrying out the research, particularly the methods used, selection procedure for determining the sample, the types of questions, as well as the means of data collection. In addition to this, the methods of data analysis are examined and discussed in relation to the study.

Chapter 4: Data Analysis and Results

This chapter will examine all the results found from the questionnaire, and thereafter be analysed and interpreted. The responses shall be documented to establish the strength of the data collected. The analysis shall further lead to possible recommendations and conclusions included in the last chapter.

Chapter 5: Conclusion & Recommendations

This final chapter reviews the objectives of the study as well as its scope in line with the hypotheses and determines if the results found meet the criteria of the study. The major findings from data analysis and interpretation are summarised to formulate conclusions and recommendations for further studies. The chapter is concluded with

further research opportunities based on the research that has been undertaken in this study.

1.13 Chapter Summary

This chapter is an introduction to the study. It has summarised the background about energy efficiency in existing buildings and the research problem that gave reason to this study. Relevant research questions, hypotheses and objectives have been identified. A summary of the methodology that has been used to achieve the objectives has been provided. This chapter has also discussed the importance of the study, its main assumptions and limitations, and has highlighted the structure of the document which provides a guide to the upcoming chapters.

Chapter 2 will focus on a thorough literature review of previous studies on the topic that has been investigated.

CHAPTER 2 – LITERATURE REVIEW

2.1 Introduction

The purpose of the literature review is to investigate the theoretical framework available concerning energy efficient solutions in the commercial retail sector. The literature review will highlight the level of awareness and implementation of various energy retrofit options in the commercial retail sector as well as the importance of energy efficiency socially, environmentally and financially.

The review will continue to investigate retrofit construction projects in terms of energy efficiency as well as analyse and detail the costs, benefits and challenges experienced in the industry with regards to various energy efficient solutions in the commercial retail sector.

2.2 Energy Efficiency in the Built Environment

Buildings consume 33% of global energy and contribute to 15% of global greenhouse gas emissions. According to the Climate Change Initiative in 2006 by the United Nations Environmental Program; buildings can account for up to 80% of carbon dioxide emissions. This makes the built environment a critical part of the climate change problem as well as a part of the solution (Hoffman & Dreyer, 2013; Wafula & Talukhaba, 2010, Dangana, et al., 2012).

Globally energy efficiency represents a potential reduction of greenhouse gases by 40%. This can be reduced at an approximate cost of less than R 575 per metric ton of carbon dioxide. For many governments this is an attractive upfront investment that not only pays for itself over time, but also reduces cost of energy and increases the energy productivity of the economy. Governments that have found to be focused on energy efficiency save current jobs, create more jobs and most importantly reduce domestic dependence on foreign suppliers thereby reducing carbon emissions related to energy usage (McKinsey & Company, 2010).

Energy efficiency is an activity which contributes to an efficient use of resources. It is guided by policies and decision-making drivers globally (Rosenburg, et al., 2011). According to Sebitosi (2008), these drivers lean towards energy security, environmental conservation and climate change mitigation.

Interest by governments in energy efficiency is not new; companies, governments and consumer groups have been working towards powering the economy activity with decreased energy demand (McKinsey & Company, 2010). Developed countries have established policies to increase energy efficiency in the commercial sector, residential sector, industrial sector, transportation systems and even electrical generation and transmission (Sebitosi, 2008).

According to International Energy Agency (2010) energy efficiency governance is the combination of legislative frameworks, funding mechanisms, institutional arrangements and co-ordination mechanisms which together support the implementation of energy efficiency strategies, policies and programmes (International Energy Agency, 2010). While there have been many barriers and challenges faced in the implementation of energy efficiency strategies, a clear success has been seen in the adoption of energy saving appliances in many developed markets such as A+ rated kitchen appliances such as fridges, dishwashers and washing machines for example. The increase in competition for global energy supplies, spiking oil costs, the increasing pressure placed on aging energy infrastructure continuously awakens awareness towards energy efficiency and its many quarters both publicly and privately. (McKinsey & Company, 2010).

Part of the solution is the implementation of energy efficient technologies and systems to reduce the greenhouse gas emissions of these buildings. Greenhouse gas emissions are the gases released by the construction and operation of a building into the atmosphere. These gases absorb infrared radiation and is trapped in the earth's atmosphere resulting in a contribution to global warming (https://www.livescience.com/37821-greenhouse-gases.html). Energy efficiency is the implementation of energy saving techniques by stakeholders involved in design, construction, owning and occupation of buildings. Some stakeholders however still regard energy efficiency as a costly and risky investment (UNEP, 2009).

2.3 Retrofit construction

What does the term energy retrofit or green retrofit mean, why is it so important and why should everyone be conforming to it? The term energy retrofit, or green retrofit refers to the maintenance and preservation of buildings, and their continued operation, using energy efficient technologies (King, 2015). The value of retrofitting is in the

reduction of operating costs relating to energy, heating and cooling and in the reduction of environmental costs such as carbon emissions (King, 2015). The main purpose of a retrofit is to reduce environmental impact of a building through the reduction of energy and resource consumption, emissions of air and water pollutants, waste generation and noise (Ardente, et al., 2011).

It is expected that cities in the 21st century are to be greener and smarter. Green buildings reduce waste, save energy and conserves natural resources. A 'green' building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on the climate and natural environment. Arguably, green buildings preserve precious natural resources and improve the quality of life of everyone (Ibid, 2011).

There are a number of features which can make a building 'green'. These include:

- Efficient use of energy, water and other resources;
- Use of renewable energy, such as solar energy;
- Pollution and waste reduction measures, and the enabling of re-use and recycling;
- Good indoor environmental air quality;
- Use of materials that are non-toxic, ethical and sustainable;
- Consideration of the environment in design, construction and operation;
- Consideration of the quality of life of occupants in design, construction and operation; and
- A design that enables adaptation to a changing environment.

Any building can be a green building (https://www.worldgbc.org/what-green-building), however a smart building integrates a building technology system with construction and operational efficiencies as well as enhanced management and occupant functions (Sinopoli, 2007). It is any structure that uses automated processes to automatically control the building's operations including heating, ventilation, air conditioning, lighting, security and other systems. Smart buildings use sensors,

actuators and microchips, in order to collect data and manage it according to the functions and services that are needed. These automated processes help owners, operators and facility managers improve asset reliability and performance, which reduces energy use, optimizes how space is used and minimizes the environmental impact of buildings (https://www.rcrwireless.com/20160725/business/smart-building-tag31-tag99).

The concept of sustainability is a global issue comprising of studies on people, the environment and society and the relationship between them. (Ghaffarian Hoseini, et al., 2013; Dangana, et al., 2012).

Most existing buildings were not designed to be energy efficient. The implementation of a retrofit with effective products, technologies and systems can result in significant energy savings (Wafula & Talukhaba, 2010). The designing of an effective building retrofit requires a thorough understanding of solutions involving planimetric and volumetric changes as well as how to reduce the use of obsolete building elements (Ardente, et al., 2011). The understanding of these concepts further strengthens the link between sustainability and green retrofit. Current buildings that encourage energy efficiency in their use and existence, make the building more sustainable in the environment, as well as for the users of the building (King, 2015). ‘Sustainable’ or ‘green buildings’ are buildings that give importance to environmental, social and economic aspects (Dangana, et al., 2012)

Smart buildings are buildings that are considered to be intelligent and are electronically enhanced and integrated. Elements and systems such as sensors, integrated management systems, communications infrastructure, controls and energy management devices are used to control various systems within the building as well as the exterior of the building. Implementation of these types of technologies in existing buildings helps building owners and facility managers with the management of their retrofit energy efficient options (Vandepool, 2011). The United States (US) Department of Energy says buildings are estimated to account for up to 38% of greenhouse gas emissions, while 40% of total energy used in the US is consumed by buildings. It has also been found that 42% of this energy used in buildings is wasted in heating and cooling spaces that do not require it (Lockwood, 2008). A survey done in 2007 stated that “8 out of 10 professionals incorporated some level of sustainable design in recent

design or renovation projects" in the US, showing that energy retrofit has been a growing trend and professionals have been incorporating it into their designs (Lockwood, 2008, p5). In 2012, Al A'ali (2012) reported that Bahrain's Central Municipal Council would be implementing laws to reduce all types of pollution and increase green zones and plantations. The new legislation would require all building owners except residential owners to abide by international environmental standards on lighting, noise, air-conditioning and ventilation, heating, building materials, electricity, pavement and emissions (Al A'ali, 2012). In Australia, the Commercial Building Disclosure (CBD) programme came into effect on the 1st November 2010. The programme requires that owners of Australia's large commercial office buildings provide energy efficiency information to all potential buyers or lessees. Even the UK government in 2010, committed £7 million to upgrade energy efficiency systems in homes by 2020 (Ma, et al., 2012).

Although retrofit construction is a growing trend, stakeholders have few resources to value local retrofit. These resources include government incentives, the general lack of commercial retrofit data, the nature of commercial building contracts such as lease agreements and the financing of retrofit options in the industry (Benson, et al. 2011).

2.4 Retrofit in commercial buildings and commercial retail buildings

The negative impacts of commercial retail buildings on the environment include natural resources use, material use, energy consumption, greenhouse gas emission and waste. With the growing world population and rapid economic growth (26% over 2017/2018 period), the demand for high performance 'green' or sustainable buildings is becoming increasingly important in the retail industry (Dangana, et al., 2012; Tan, et al., 2019). Commercial buildings in European Union countries are responsible for significant consumption of energy which is used mainly for heating, cooling and lighting. Due to real estate being a commodity that is seldom renewed, current trends suggest the retrofit of old structures to improve the energy efficiency. Architectural renovation allows the improvement of building envelopes and energy supply systems (Aste & Pero, 2012, Tan, et al., 2019).

According to the World Green Building Trends, Smart Market Report, 2018, which surveys over 60 countries, indicates the reviewed countries as having an increasing number of green building trends (Lockwood, 2008; McGraw Hill, SmartMarket Report, 2013; Rosenburg & Winkler, 2011).

2.4.1. The United States

The United States commercial sector spends more than $100 billion on energy each year, according to the U.S. Environmental Protection Agency (2010). Energy efficiency upgrades therefore hold a great amount of opportunity for individual buildings to achieve substantial savings both long term and short term (Siemens, 2010). In 2006, the US buildings accounted for 35% of the nation's greenhouse gas emissions, with as much as over 70% in some cities like New York and London. Existing buildings in the US outnumber new buildings more than 100 to 1 (Lockwood, 2008).

2.4.2. The European Union

The EU, has implemented the EU framework directive on energy end-use efficiency and energy services (2006/32/EC), which states that all EU member states are required to adopt a National Energy Efficiency Action Plan. This directive impacts on commercial retailers materially, as the directive specifies binding energy standards to commercially used buildings. For example, Spain has responded to the directive by making it mandatory for all new commercial building projects to use renewable energy (European Retail Forum, 2009).

2.4.3. Australia

Another country that has made a large number of efforts towards energy retrofit is Australia. In 2010, 28% of the country's existing commercial buildings were accounted for as retail buildings. It was found that due to the cheap energy prices available in Australia, most buildings were built inefficiently and equipment was energy intensive. Some of the measures implemented for the reduction of energy usage included: Retrofit lighting; retrofit electronics, retrofit elevators and appliances; retrofit water heating; retrofit insulation; retrofit equipment, retrofit refrigeration, and retrofit cooking. Energy waste reduction was also implemented to reduce the amounts of energy consumed. It was found that should these measures be implemented, it could save the Australian economy up to 1 billion Australian Dollars across the entire retail sector (Climate Works Australia, 2011).

2.4.4. New Zealand

A conventionally built supermarket in New Zealand has a combination of features that result in excessive energy consumption. Supermarkets in New Zealand nationally consume approximately 600kWh / m² per annum of energy. The reasons cited for this is that stores are designed to maximise sales and minimise initial costs. In Australia and New Zealand, non-domestic refrigeration consumes approximately 4% of all energy consumed. Two of the main problems in this supermarket related to badly designed refrigeration placement and usage as well as uncomfortable lighting levels. A barrier that was found was a perception that putting doors on refrigerators decreases sales. Two major retrofit initiatives were implemented at this supermarket, one being the introduction of natural lighting, and the second being the introduction of doors on refrigerators. Through this retrofit, energy consumption had decreased by 36% as well as the stores sales have increased by 6% in the same period (Dazeley, 2012).

2.4.5. Kuwait

In Kuwait, a national program has been implemented to improve energy efficiency in new buildings and in existing buildings. Krarti (2015) has summarised this program into its 3 levels:

Level 1 of energy efficiency retrofit program - To achieve this level, buildings are required to undergo a basic energy audit, and implement basic low cost energy efficiency measures such as: installation of programmable thermostats, use if CLF or LED lighting and weatherization of the building to reduce air infiltration. Documented studies and case studies on residential, commercial and governmental buildings show an average of 8% of estimated savings from the implementation.

Level 2 of energy efficiency retrofit program – To achieve this level, buildings are required to undergo a standard or level 2 energy audit and implement energy saving measures such as improvements to the building envelope as well as the use of energy efficient cooling systems and appliances. It was found that up to 23% of savings can be achieved for all building types.

Level 3 of energy efficiency retrofit program – to achieve this level, buildings are required to undergo a detailed energy audit and implement a wide range of measures such as window replacements, cooling system replacements, the use of variable speed drivers and installation of daylighting controls. It was found that even though deep retrofits are costly, savings exceeded 50% (Krati, 2015).

Al-Anzi (2007) conducted a survey of 9 commercial buildings (6 office buildings, 2 bank headquarters and 1 multi-purpose building) in Kuwait City to assess their energy consumption. It was found that the average commercial building consumption in Kuwait is 383kWh/m²/year while the US consumption for a typical high rise office building is 375 kWh/m²/year, in Australia it is 254 kWh/m²/year and Hong Kong 292 kWh/m²/year (Krarti, 2015).

It was found through energy building simulations and energy auditing that peak electricity demand is due to air-conditioning. Kuwait Government has implemented energy reduction strategies such as free cooling during winter (economizer cycle), reduction of operation of the air-conditioning system, turning off lighting during non-occupancy hours as well as de-lamping. This was estimated to have used approximately 26% less energy. Further implementations of energy saving techniques included reduction of cooling supply, one hour before occupancy period; improved controls during occupancy period with regards to changing temperatures and air flow rates as well as turning off non-essential lighting fixtures; thirdly de-lamping of spaces where excess illumination was observed. These small changes have amounted on average to about 30% worth of savings. These strategies were also implemented in a large mall in Kuwait of 170 000m². Before implementation, the mall consumed 84 000MWh/year. Once these strategies were implemented, the annual estimated savings in energy usage amounted to almost 12% (Krarti, 2015).

2.4.6. South Africa

In South Africa, a number of commercial retail retrofits can be found. Firstly, the Victoria Wharf at Cape Town's V&A Waterfront. The shopping complex is approximately 47 000m^2 and comprises of about 400 retailers. The operations manager at the mall, in the timeframe of 2009 – 2012 invested 22 million in making the mall more energy efficient. He stated the reason for the change was due to two main reasons, one was for financial gains and the second was the influence of consumer expectations. They upgraded chillers and their HVAC systems. They further implemented more energy efficient escalators as well as their irrigation systems. These few changes saved the mall enough energy to power 80 000 homes for 1 month (Earthworks Magazine, 2012).

In 2009, an upmarket shopping mall in Johannesburg, Sandton City, was described as a ‘thinking city’, a complex thriving on socioeconomic complex with a conscience. This came about as Sandton City was rapidly growing and many expected energy usage for the area to increase drastically. Centre Manager of Sandton City at the time had responded to the statement as follows: “Despite the increases in size, capacity and traffic, we are using less electricity now than we were five years ago, this is due to a carefully planned energy conservation policy” (Nisbet, 2009: p53).
A study done within the retail sector has recognised the potential for a sustainable transformation. Evidence from the study suggests that retail outlets that provide fresh air, natural light and have water and energy efficient solutions in place attract more customers, generate greater sales and retain more productive staff (Jordan, 2013). Nicola Douglas, CEO of the Green Building Council of South Africa, said case studies done in other countries have shown that by and large, tenants prefer green buildings which generally have more natural light, more fresh air and less ‘sick building syndrome’, it helps firms increase staff productivity by up to 15%, thanks to fewer sick days and for this reason tenants are prepared to pay premium rentals for a green building” (Nisbet, 2009).

Recently, a large and prominent property developer in South Africa, Growthpoint, also decided to contribute to energy efficiency. Growthpoint has a large number of commercial as well as residential buildings in their portfolio. They invested 40 million Rand in the conversion of inefficient lighting to energy efficient lighting in all 157 of their properties. This investment has benefited the electricity grid by decreasing their use of energy by 591 Megawatts (23 million units of electricity) by one property developer alone (Lux Review, 2014).

2.5 Costs and benefits of retrofit

The energy infrastructure of a building is seldom upgraded after the initial construction, however some of the benefits associated with retrofitting include the increase of property values, reduced electricity costs as well as rental premiums may seem appealing to both tenants and property owners (Hoffman & Dreyer, 2013). Benefits identified by Nicol include efficient resource utilisation, improved indoor air quality, potential alignment with a green rating system and meeting international energy efficiency standards, some insulation from electricity price increases and finally the label of 'Being Green' as a developer or owner (Nicol, 2007).

Improving the performance of an existing building is critical. The operating costs are expected to decrease from green retrofits. Table 1 shows by how much owners of buildings expect operating costs to decrease within the first year of the retrofit and again 5 years from the retrofit in percentage categories. More than 60% of the respondents expect at least a 10% decrease in costs within the first year of operations.

Table 1: Table showing expected decrease in operating costs from the retrofit of a building

	More than 15%	11% - 15%	6% - 10%	5% or less	None
2012 – within 1st year	24%	17%	27%	30%	2%
2012 –within 5 years	42%	20%	23%	14%	1%
2015 – within 1st year	21%	19%	28%	30%	2%
2015 –within 5 years	34%	28%	21%	15%	2%
2018 – within 1st year	24%	19%	26%	28%	3%
2018 –within 5 years	40%	21%	23%	15%	1%

Source: (Dodge Data & Analytics, SmartMarket Report, 2018, p38)

Table 2 shows the expected payback period for green retrofits globally. Countries with the lowest median payback of 4 years include: Brazil, Colombia, UAE and Saudi Arabia. On the other hand, Brazil, India, Singapore and South Africa have payback periods of 5 years. The country with the highest payback is the UK with 12 years. More than 60% of the respondents have a median payback of 4 years.

Table 2: Expected Payback Period for Retrofit

	More than 10 years	6 – 10 years	3 – 5 years	1 – 2 years
2012	15%	42%	37%	6%
2015	16%	37%	39%	8%
2018	18%	35%	39%	8%

Source: (Dodge Data & Analytics, SmartMarket Report, 2018, p39)

Climate Initiative 2006, indicates that buildings account for 80% of CO2 emissions making buildings a critical part of the energy problem as well as solution (Wafula & Talukhaba, 2010). Most developed and developing countries have taken steps to reduce the building sectors GHG emissions, but due to a number of barriers there is a limited impact on overall emissions (Hoffman & Dreyer, 2013). These barriers come in the form of unknown and perceived costs and risky investment options as well as lack of practical knowledge in implementations of energy efficiency measures.

A study done in the UK, used a focus group of six retailers which considered cost of a driver and barrier for the implementation of green retail solutions. Costs were perceived as a driver for retailers as a means to reduce operating running costs. The implementation of newer technologies however posed more of a barrier than a driver due to the lack of substantial evidence with regards to payback periods, cost benefits and potentially had higher capital investment due to the nature of the energy efficiency products (Dangana, et al., 2012).

A study done on European shopping centres attribute legal and economic issues with the implementation of energy retrofitting. It was found that effective communication

between stakeholder groups, the shopping behaviour of consumers, as well as legal and economic actions can become direct drivers for the implementation of energy retrofit. Legal and economic drivers that were found to influence the adoption of energy retrofitting include: for the customer, the price of goods and free parking within the centre; for the tenant, sales maximisation and profits, rental costs, billing systems as well as the leasing length and the implementation of green leases; for the owners/managers of the centre, high occupancy of the centre, the implementation of building codes and practises as well as the increase of property values; and finally for the community the revenue brought in and job creation form an integral part the implementation of energy retrofit (Haase, et al., 2015).

Table 3: Expected business benefits of building new green buildings and retrofitting old buildings in various countries

	New Green Buildings			Green Retrofit		
	Decrease in Operating costs for first year	Decrease in Operating costs over 5 years	Payback time (years)	Decrease in Operating costs for first year	Decrease in Operating costs over 5 years	Payback time (years)
UK	8%	32%	11	9%	16%	8
Norway	3%	9%	9	7%	12%	8
Germany	6%	13%	8	9%	14%	8
Singapore	9%	16%	7	9%	14%	6
UAE	4%	12%	6	4%	7%	6
South Africa	7%	33%	7	12%	37%	5
Australia	8%	14%	9	8%	14%	7
Brazil	8%	14%	4	8%	13%	4
US	11%	28%	7	11%	14%	4

Source: (McGraw-Hill Construction, SmartMarket Report, 2013)

It can be seen in Table 3 how costs decrease relatively quickly over the 5-year period with payback times varying. The range of decreasing costs over the first year is from 3 % to 11% with the range after five years being 9% to 32% with a mean time of 7.5 years as a payback period. This translates to a major savings of an average of 15% if the building was built green. The range of decreasing costs for a retrofitted building is from 4% to 11%, with a range after 5 years being from 7% to 37% with a mean payback period of 6.2 years. This translates to a saving of 23% in 6 years. It is noteworthy to

see that South Africa is leading in the decrease of costs over the 5-year period, inferring South Africa has a high ability to become green and to start with the retrofit of older buildings to make them more energy efficient.

The increase in asset value is an important benefit in the retrofit of a building, which cannot go unnoticed. A study done by Dodge Data & Analytics (2018), shows the difference in opinion between the building owners and architect/contractors opinion regarding the increase in asset value of a building once a green retrofit has been implemented. Table 4 shows the expected increase in asset value from a building owners' point of view as well as from the architect/contractors point of view for 2018.

Table 4: The expected increase in asset value from a green retrofit

	More than 10% increase	6% -10% increase	5% or less	No increase in building value
Owners	14%	27%	53%	6%
Architect/Contractor	34%	28%	23%	15%

Source: (Dodge Data & Analytics, SmartMarket Report, 2018, p40)

In Table 4, 94% of owners in 2018 believe that their building value increased due to a green retrofit compared to 85% of architect/contractors. It should be noted however that architects were more optimistic than owners by 20% when asset values were expected to increase above 10%.

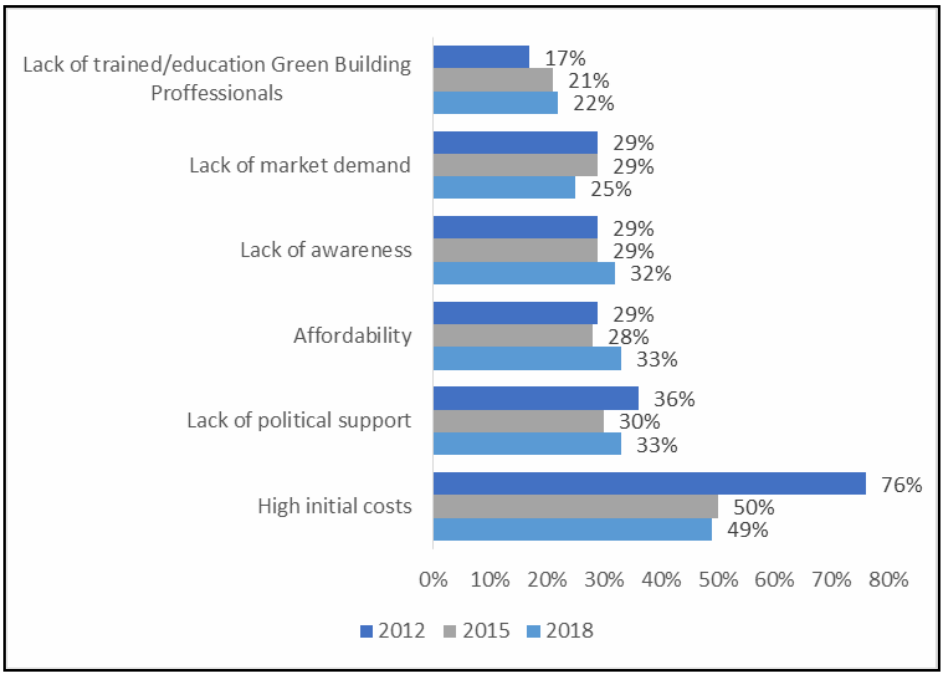
As with all programs, as there are costs and benefits, a number of barriers or challenges are encountered when implementing energy efficiency solutions.

2.6 Barriers and challenges of retrofitting

Barriers or challenges are problems that are encountered in the implementation of a program. These can be internal or external and can be specified to one sector or could be generalised across all or most sectors.

2.6.1. Globally

The bar chart shown in Figure 1 shows the barriers faced globally in the implementation of green building initiatives. It can be noted that in 2012 high initial costs played a major challenge in the implementation process, but has since then come down by more than 30% from 76% to 49%. Lack of trained professionals, lack of awareness as well as affordability has grown as challenge faced globally. Whereas lack of demand, lack of political support and high initial costs have decreased to some extent. (Dodge Data & Analytics, SmartMarket Report, 2018, p14.)



Source: (Dodge Data & Analytics, SmartMarket Report, 2018, p14.)

Figure 1: Barriers faced when implementing energy efficiency

2.6.2. The European Union

The EU have found their external barriers to be the lack of sufficient incentives or rewards for the implementation of energy efficiency. There also seems to be some conflicts surrounding the payment of the incentive, does the tenant pay or does the landlord. The EU further has an excessive amount of administration for constructional changes, making procedures long, tiresome and time consuming, which has led many to be discouraged. Some EU countries have started setting up financial incentives, however due to the nature of these incentives, they are not suited to the smaller business owner. Therefore in most cases, the investment mostly exceeds the benefit. Internally EU countries have found that a holistic approach is required for energy

efficiency, however technicalities and knowledge is sometimes limited and final decisions do not always lie with the person wanting to implement the changes, but with a board or an owner of a retail outlet (European Retail Forum, 2009).

2.6.3. United States

The United States have been implementing energy efficiency strategies since 1980, and have achieved a significant decrease in energy consumption per unit of floor space. Energy consumption has decreased by 21% in commercial sectors as well as decreased per dollar of gross domestic product by 41%. The US has categorized their challenges of implementation into 3 sub categories namely, structural, behavioural and availability. Structural barriers include the split of incentives between parties, the owner expecting to leave before payback period as well as incidental costs and various taxes. Behavioural barriers include the risk and uncertainty faced when implementing energy efficiency strategies, the lack of awareness of information along with the practises which prevent the savings being captured. Availability barriers include the combination of efficiency saving and costly options, limited capital and product availability as well as lack of proper installers and operators. These barriers were overcome through four main solutions; namely information and education – which sought to increase awareness and knowledge surrounding energy use and options available, secondly, the use of incentives and financing – these options included grant availability for implementation and tiered pricing structures for efficient solutions. The third solution offered was the use of codes and standards which formed a mandate to increase the use of energy efficient options. The last option available to overcome the challenges faced when implementing energy efficiency strategies in the involvement of a third party. This required the involvement of a private company, utility or governmental agency to support the users measures to use energy efficiency strategies (Granade et al. 2010).

2.6.4. United Kingdom

In a study done in the UK, retailers identified four categories of barriers. The first category referred to legislation. The policy is considered uncoordinated and inconsistent due to its lack of understanding and method of maximization of the available incentives. Retailers reported they require a simple, consistent policy framework that provides details and methods to reduce emissions

and promote sustainable buildings. The second category referred to are the costs associated with implementing strategies. Retailers require professionals to advise and guide retailers with the necessary advice to make a decision to meet their demands and promote sustainable buildings. The third category referred to the roles and responsibility of energy efficiency. Retailers suggested that landlords and tenants come together to become more aware of new strategies and make decisions that benefit both the parties in the process of becoming sustainable. It was also noted that retailers seeking to be more competitive in the supply chains were actively involved in the processes related to becoming aware and implementing strategies. The final category identified by retailers as a barrier was the use of technology. The uncertainty surrounding the future prices of energy, risks associated with new and unfamiliar products and technology that is available for implementation as well as the lack of skilled labour to implement and install these technologies posed a substantial barrier in the implementation of sustainable building practises (Dangana et al. 2012).

2.6.5. Australia

ClimateWorks Australia (2011) finds barriers to be opportunities. They have spilt these opportunities into 3 non-price categories: Capital constraints and investment priorities; Market structure and supply constraints; Information gaps and decision process. Capital constraints and investment priorities cover access to capital, long payback periods and investment prioritizing. Market structure and supply constraints entails transaction costs, split incentives and contract structures (ClimateWorks Australia, 2011).

2.6.6. Brazil

In Brazil, a developing country part of the BRICS group, two engineering schools were retrofitted and a number of barriers were diagnosed such as: Lack of financial incentives for reducing building maintenance costs; lack of indicators for sustainable building evaluation; high capital investment; technical level and innovation among architects, designers, and engineers; communication break-down between team members; lack of literature on green buildings; sustainable techniques and materials are not readily available; lack of skilled and specialized jobs in green constructions and lastly a cultural barrier of resistance to the change to sustainability (Kasai & Jabbour, 2014).

2.6.7. South Africa

Nicol (2007) has identified a barrier known as the Property Sector Barrier in South Africa. Property barriers are associated with the sector. Each sector has its own set of barriers with regards to the implementation of initiatives. The commercial sector is no different. If in the commercial sector the owner and beneficiary of the building is the same, it is easy for the owner to implement changes and receive the benefit thereof. However, the reality is that most commercial buildings have tenants, and the implementation of initiatives require the co-operation of the tenant and in most cases, involves also facility managers and property managers which add to the complication. This makes implementation more costly and challenging (Nicol, 2007). According to Golove and Eto (1996) the following factors affect the implementation of green buildings: misplaced incentives, financing, market structure, regulation, custom and information.

2.7 Chapter Summary

This chapter explored energy efficiency in the built environment with relation to the awareness and implementation of energy efficiency strategies and their various roles and value added. The chapter then examined the implementation of energy efficient solutions either in new buildings or to retrofit older buildings globally as well as on a local level. The chapter continued to investigate examples of the effect energy efficiency strategies had on various costs incurred by all stakeholders, benefits received from the implementation of energy efficiency strategies as well as the barriers or challenges faced with the implementation of green initiatives, more especially energy efficiency strategies at a global level and South African level in retail centres. It can be seen that in both developing and developed countries there is legislation and some implementation of energy retrofit solutions being used to make buildings efficient. The level, intensity as well as amount of resources spent in the process all vary based on the countries need and economy. South Africa can implement some of the ideas used by Australia and other developed countries, but level of implementation and available resources in country dependent.

The next chapter reviews various Green Building Rating Tools and Legislation both globally and locally.

CHAPTER 3 - LEGISLATION AND RATING TOOLS FOR GREEN BUILDINGS AND ENERGY EFFICIENCY

3.1 Introduction

The purpose of this chapter is to highlight the use of legislation and rating tools as a means to create awareness and support the implementation process of creating green buildings using energy efficiency strategies.

In this chapter it is important to note the use of various terminology. Legislation is a law or set of laws that is implemented and enforced by government or parliament. Rating tools are a set of assessment tools used for measuring various stages of a construction project. A green building is a building that by its design, construction and operation reduces or eliminates the negative impacts on the environment, and can be extended to creating a positive impact on the climate and natural environment. Energy efficiency is one of the many features that contribute to making a building green.

Using these terminologies, this chapter will investigate the various options available to retailers to become either energy efficient or to make their retail centres green buildings.

3.2 Green Buildings

According to the World Green Building Council: “a ‘green’ building is a building that by its design, construction and/or operation, reduces or eliminates the negative impacts and can create positive impact, on our climate and natural environment” (World Green Building Council, 2019). Green buildings preserve natural resources and improve the quality of life” A green building is defined as: “A high performance property that considers and reduces its impact on the environment and human health. A green building is designed to use less energy and water, and reduce the life-cycle environmental impacts of the material used. This is achieved through better design, material selection, construction, operation, maintenance, removal and possible reuse of refuse” (Yundelson, 2008, p13).

In the UK, the green building movement started in the 1960’s and 1970’s through counter-cultural movements concerned about resource use, environmental damage, wastage and energy intensity of conventional building methods. (Gibbs & O’Neill, 2015). There are a number of ways to make buildings green. Some of the methods

include maximising inbuilt technologies and natural efficiencies by making new and renovated buildings more comfortable and less expensive to run. Further methods include the efficient use and reuse of water, generating minimal waste and promoting a general health and well-being within the built environment by improving indoor air quality, using natural lighting as well as creating built environment that fits into the natural environment (World Green Building Council, 2019).

Implementing strategies have a cost associated to it. In return some of the benefits one can expect to receive once implementing strategies is the improvement in the environment. Implementing strategies that create or make buildings green can reduce and even eliminate the strain placed on natural resources and can in turn start generating its own resources and energy. There are also a number of economic and financial benefits that are associated with implementing green strategies which include cost savings in the form of lower water and electricity bills, lower construction costs with higher building values as well as better occupancy rates for building owners along with lower operating costs (World Green Building Council, 2019). Dodge Data & Analytics found in 2016 that building owners reported a 7% increase in asset value in their green building as opposed to a traditional building (Dodge Data & Analytics, 2016). Further to the environmental and economic benefits that are a given, social benefits that can be felt due to the implementation of green strategies include better brain function, better sleeping and a generally more productive life. The American Academy of Sleep Medicine found that employees in offices with windows sleep an average of 46 minutes more per night (American Academy of Sleep Medicine, 2013). Further to this, better indoor air quality has been found to improve worker's performance by up to 8% (Park & Noon, 2011).

3.3 The World Green Building Council

The World Green Building Council is a global network of Green Building Councils who transform the places that living, working, playing, healing and learning occur. The World Green Building Council was established to co-ordinate the efforts of each regions efforts towards green buildings. The tools used for rating green buildings are similar in structure, but take into account the various climatic conditions, local conditions and building regulations of the region it applies to. The purpose of the Green

Building Council is to adapt to the changing climate through reshaping the way we grow and build buildings, therefore enabling people to thrive both today and tomorrow.

The World Green Building Council takes pride its mission statement: “We take action”, to empower communities to drive change and commit to creating green buildings for everyone around the world.

There are three main goals of the World Green Building Council to achieve by 2050:

- To limit the global temperature, rise to 1.5 degree Celsius;
- To reduce the building and construction sectors CO_2 emissions by 84 gigatonnes; and
- To ensure all buildings are net zero emissions (https://www.worldgbc.org/our-mission).

To create a green building, or make a current building green, there are two main routes that can be used. One can either use legislation, which is laws put in place to make buildings green, or alternatively, one can investigate voluntary tools such as rating tools available in ones’ country, to suit the country’s climate.

3.4 Green Building Rating tools

A rating tool is used to assess both the ‘Design’ and ‘As Built’ phases of a building or refurbishment. A different rating tool is used for different types of buildings (Green Building Council of South Africa, 2010). A general structure that is found through the rating tools is covered by the Australian Green Building Council. (Zuo J & Zhao Z-Y, 2014)

3.4.1 The purpose and aims of a rating tool

The Green Star Technical Manual for Retail Centres v1 (2010), states the purpose for the tool is to validate the environmental initiatives of a building during the construction phase, during refurbishment phase or during procurement phase of the building (Green Star SA, 2010).

The rating tool is aimed at:

- Encouraging the implementation of new technology;
- Reduction of environmental impact of development through direct and indirect initiatives;
- To encourage new approaches to designing and constructing buildings and rewarding the best practice;
- Ensure effective design strategies are implemented without overlay od operational management and user behaviour; and
- Allow different designs to have their environmental initiatives fairly benchmarked.

3.5 International Green Building Rating Tools

Rated Green Buildings are ranked in different countries according to each country's Green Building Rating (GBR) tools. Green Building Rating Tools are defined as "tools that examine the performance or expected performance of a 'whole building and translates that examination into an overall assessment that allows comparison against other buildings" (Fowler and Rauch, 2006, p3). Table 1 shows a few of the most widely used rating tools internationally, the categories evaluated as well as the rating levels used.

3.5.1. Australia

Green Building Council is home to the Green Star Australia; an internationally recognised sustainability rating system. There are four Green Star rating tools available for certification. The four tools cover design, construction and operation of buildings, fit-outs and communities. The Green Building Council of Australia promotes productive, liveable, sustainable and healthy cities; resilient communities, deliver and facilitate a low carbon, high performance built environment as well as raise minimum standards through the National Construction Code.

The Green Building Council works with three main spheres in Australia to transform the built environment in Australia; the Local government, State and Territory government as well as Federal government (https://new.gbca.org.au/advocacy/).

3.5.2. United Kingdom

Building Research Establishment (BRE) is a centre of expertise for the construction industry providing research, consultancy and information services to customers worldwide since 1990. It is based in The United Kingdom and has developed the governments Best Practice program. BREEAM is a sustainability assessment method for master planning projects, infrastructure and buildings. It recognises and reflects the value in higher performing assets across the built environment lifecycle.

BREEAM is a certified rating reflects tool that reflects the performance achieved by its stakeholders as measured against a standard and its benchmarks. BREEAM addresses influential factors such as low impact design; carbon emission reduction; design and durability and resilience; adaptation to climate change and ecological value and biodiversity protection (https://www.breeam.com/).

3.5.3. United States

United States Green Building Council is home to LEED. LEED is the Leadership in Energy and Environmental Design, which is a rating system that can be used worldwide since 1998. The framework of LEED is to create a healthy, highly efficient and cost saving green building. LEED buildings save energy, water, resources and generate less waste and support human health. LEED buildings tend to attract tenants due to lower operating costs and further boosts employee productivity and retention of employees.

LEED promotes a higher resale value on properties, healthier indoor spaces, lower use of energy, water and other resources as well as enhances your brand. LEED has five rating tools that rate a building, design and construction of buildings; operations and maintenance; interior design and construction; neighbourhood development as well as homes. (https://new.usgbc.org/leed).

Table 5: International Rating Tools

Country	Rating tool	Categories	Rating levels
Australia	Green star	9 categories – management, indoor environmental quality, energy, transport, water, material, land use, emissions, innovations	1 – 6 stars where 4 star is best practice, 5 star is Australian Excellence and 6 star is World Leader
United Kingdom	BREEAM – Building Research Establishment Environmental Assessment Methodology	9 categories – Management , Energy, Water, Materials, Pollution, Waste, Health & Wellbeing, Innovation	Pass, Good, Very Good, Excellent and Outstanding
United States	LEED – Leadership in Energy and Environmental Design	Various categories under different tools	Certified, Silver, Gold, Platinum

The building is assessed by, assigning points to these individual categories and combining the points. The overall performance is then rated and the building is assigned an official Green Star Rating (Fowler and Rauch, 2006).

3.6 International Green Building Legislation

"Around the world, green building is accelerating as it becomes viewed as a long term business opportunity" (SmartMarket Report, 2013, p5). According to the Smart Market

report released in 2013 in the United States, architects, engineers, contractors, owners and consultants expect to implement more green strategies in their work significantly by 2015 since 2013 (McGraw Hill Construction, 2013).

Rosenburg (2011) discussed the successful implementation of energy efficiency policy in Japan, USA, European Union as well as China and Brazil. Japan has implemented standards for energy consumption in the industrial, transportation and building sectors. Japan placed emphasis on innovation of new technologies, concrete as well as creating an established regulatory environment (Sebitosi, 2008; Rosenburg & Winkler, 2011). The USA has adopted many federation laws in the years 1975 – 1980 consisting of educational efforts, financial incentives as well as a standardized set of energy efficiency standards. Legislation supporting the implementation of energy efficiency has been established with relation to household, commercial and industrial equipment, building energy codes as well as utility based energy efficiency programs and policies. This further encourages the promotion of being energy efficient (Gellar, 2006). One of the programs driven by a number of states on the USA is the ENERGYSTAR labelling program, which was initiated in response to the 1992 Energy Policy Act as part of a voluntary program to encourage consumers to choose energy efficient products (Gillingham, 2006).

In the EU, the EU Action Plan for Energy Efficiency, 2006 aims at the reduction of energy consumption and elimination of energy wastage, specifically in energy intensive sectors such as buildings, manufacturing energy conservation and transport. This applies to all buildings constructed, rented, sold or accessible to the public with the attempt of increasing awareness of buyers and tenants about energy efficiency and to increase the pressure for energy efficient buildings (Rosenburg & Winkler, 2013). The 2012 Energy Efficiency Directive 27 created a set of binding measures to ensure the EU reaches its 20% saving of the Unions's primary energy consumption energy efficiency target by 2020.

The Directive requires all EU countries to use energy more efficiently at all stages on the energy chain from production to final consumption. The Directive is to be provisioned into all EU countries national laws by 5 June 2014. These measures ensure energy savings for consumers and industry alike (European Union, Energy Efficiency Directive (2012/27/EU), 2012). With the implementation of the directive,

retail energy sales companies are expected to achieve 1.5% energy savings per year through energy efficiency measures. Savings can be achieved through improvement of heating systems, installing double glazed windows or insulating roofs. The public sector should purchase energy efficient products and services. The directive expects all EU governments to carry out energy efficient renovations on at least 3% of the buildings they own/occupy by floor area (Energy Efficiency Directive (2012/27/EU), 2012).

3.7 South African Green Building Rating Tools

3.7.1. Green Building Council of South Africa

Green Building Council of South Africa (GBCSA) was formed in 2007, with the vision to lead the transformation of South African property industry to ensure that all buildings are designed, built and operated in an environmentally sustainable way that will allow South Africans to work and live in healthy, efficient and productive environments. The GBCSA has developed four Asset Rating Tools for buildings to be sustainable and efficient as well as an operational rating tool known as a Benchmarking Tool. These tools allow a buildings performance to be compared to a national level of performance in terms of consumption of resources (Braune, 2011). The tools used by the GBCSA are also still voluntary in South Africa. Nicola Douglas, the CEO of the Green Building Council of South Africa says “tenants prefer green buildings which generally have more natural light, more fresh air and less ‘sick building’ syndrome” (Nisbet, 2009). BREEAM, a legislative tool in 2009, had rated 110,808 buildings, while at the same time LEED a voluntary tool had only rated 1,823 buildings (https://www.bsria.co.uk/news/article/breeam-or-leed-strengths-and-weaknesses-of-the-two-main-environmental-assessment-methods/).

Voluntary Green Building Rating Tools comprises of a rating system used to compare all buildings in terms of attributes associated with the building. The main objectives of a Green Building Rating Tools are to promote integrated thinking, increase awareness and reduce the environmental impacts of buildings (Green Star SA, 2010).

Figure 2: Process to use South African Green Building Rating Tools

Source: (Green Star SA, 2010)

This process is followed for two certified rating tools: Design Rating (assesses environmental impact of prospective developments based on design, tender drawings and specifications) and As-Built Rating (assesses environmental impact of developments based on as built drawings and commissioning records) (Green Star SA, 2010).

The Green Building Council of South Africa developed Green Star SA, and is based on Green Building Council of Australia's Green Star Rating System to provide the commercial property industry with an objective measurement for green buildings and to recognise and reward environmental leadership in the property industry. According to the SmartMarket Report 2013, the most important reason cited for implementation of Rating Tools was the provision of marketing and competitive advantage (67%) and the creation of a better performing building (69%) (SmartMarket Report, 2013).

For new buildings and major refurbishments, there are 4 rating tools available: Office V1.1, Retail Centres V1, Multi Unit Residential V1 and Public & Educational Buildings V1. Certification for these tools are 4 stars: Best Practice, 5 stars: South African Excellence and 6 stars: World Leadership. In August 2014, the Green Building Council of South Africa launched its first rating tool for existing buildings. The rating tools for new buildings and major retrofit buildings only focused on 2% of buildings in South Africa, whereas the Existing Building Performance Rating tool focusses more on ongoing building operations and management.

This tool focusses on the remaining 98% of buildings in South Africa. The Existing Building Rating Tool has a rating system of 1 – 6-star certification, where 1 – 2 represents "On the journey to a better, greener building" while 3 represents "good practice", 4 stars represent "best practise", 5 stars represent South African Excellence

and 6 starts represent “World Leadership”. This tool caters for existing office buildings, retail buildings and public assembly buildings (Wilkinson, 2014).

This rating tool was designed specifically for portfolio managers, facility managers and tenants. A tenant is considered a key player in a buildings operations (Wilkinson, 2014).

The first Existing Green Building Rating was given to Black River Office Park by the Green Building Council of South Africa. The park received a 5 star rating. Some of the green initiatives untaken include the largest rooftop Photo Voltain System, which procduces electricity from sunlight. It produces 1.9GWh of electricity a year. It reduces the peak demand for electrity by 18%, and is the first commercial project to be allowed to feed into the grid and be paid for it. Energy efficient lighting has been installed in all common areas of the building, and with a a joint tenant financial initiative, being implemented in tenants premises. Initiatives also included managing ecologically friendly gardens, recycling of waste, the improvement of indoor air quality, a change in glazing of shopfronts for a better working environment. Awareness and education around green inititatives, the use of environmental friendly cleaning agents, the implementation of storm water management as well as hard services played an important role in the building achieving its 5 star rating (Wilkonson, 2014).

Victoria Wharf in April 2015, was awarded the first shopping centre in South Africa to have a 4 star ‘Existing Buildings’ rating reflecting the high level of environmentally friendly and sustainable operating efficiency. Some of the initiatives implemented in the building include, lighting control, electrical sub-metering, high performance chilled water plant and the use of natural lighting (Retailer News obo V&A Waterfront, 2015).

3.7.2. ESKOM’s Demand Side Management

Eskom produces approximately 95% of South Africa’s energy. Of this more than 70% of the energy produced is generated from coal (Matjila, 2014). Eskom then sells 42% of this energy to Municipalities, 7% of the energy to the commercial sector, 25% is sold to industries ad 14% to the mining sector. 6% of energy produced is sold internationally with 1% used by the railage system.The last 5% is sold to the residential sector (Matjila, 2014). In 2013, Intergrated Demand Management (IDM) was introduced in South Africa. The purpose of the IDM was to act as the facilitator between

Eskom and the market as well as to be Eskoms primary energy efficiency adviser (Pienaar, 2014). IDM offered the consumer a Standard Product Program to support energy efficiency. The programe provided rebates to consumers that replaced inefficient strategies with energy efficient equivalents. The technologies being promoted included the use of energy efficient lighting, energy and water efficient shower heads as well as efficient use of heat pumps (Eskom, 2014). Some of the other incentives Eskom offered to consumers were: Kitchen Savings, Office savings, Commercial Savings as well as Savings for heat pumps and downlighters.

Pick n Pay started in 1967 with 3 stores and has grown to a national and international brand of 1,500 stores. In August 2010, Eskom registered Energy Services Company, Lighting Innovations and Pick n Pay came together to reduce the retailers consumption of energy. In a supermarket, lighting is responsible for approximately 17% of energy consumption. Pick n Pay assessed and changed light fittings in 97 of its outlets. This led to a 20% saving of approximately 568MWH a month. This further translated to an approximately R1.5 million saving in lighting costs a year for Pick n Pay (Eskom IDM, 2010). The investment by Pick and Pay was recovered within two years through electricity savings.

3.8 South African Green Building Legislation

South African Green Building Legislation comprises of the Energy Efficiency Strategy of South Africa 2005, SANS 50001:2011, SANS 204 and SANS 10400-XA.

3.8.1. Energy Efficiency Strategy of South Africa

The Energy Efficiency Strategy in support of the 1998 White Paper on Energy Policy was published in 2005 by South Africa's Department of Minerals and Energy. It set a national target for energy to have improved by 12% from the base year of 2000 to 2015. The expected reductions per sector indicate by how much the sector can reduce their energy consumption.

- Industrial and mining sector – 15% reduction;
- Commercial and Public Building Sector – 20% reduction;
- Residential sector – 10% reduction; and
- Transportation sector – 9% reduction;

The vision of the strategy mentioned in the DME, 2005 is: “To encourage sustainable energy sector development and energy use through efficient practises, thereby minimising the undesirable impact if energy usage upon health and the environment, and contributing towards a secure and affordable energy for all” (DME, 2005, p4).

The goals of the Strategy are divided into three groups namely Social Sustainabilty, Environmental Sustainability and Economic Sustainability to which the vision is achievable. These goals are depicted in Figure 3.

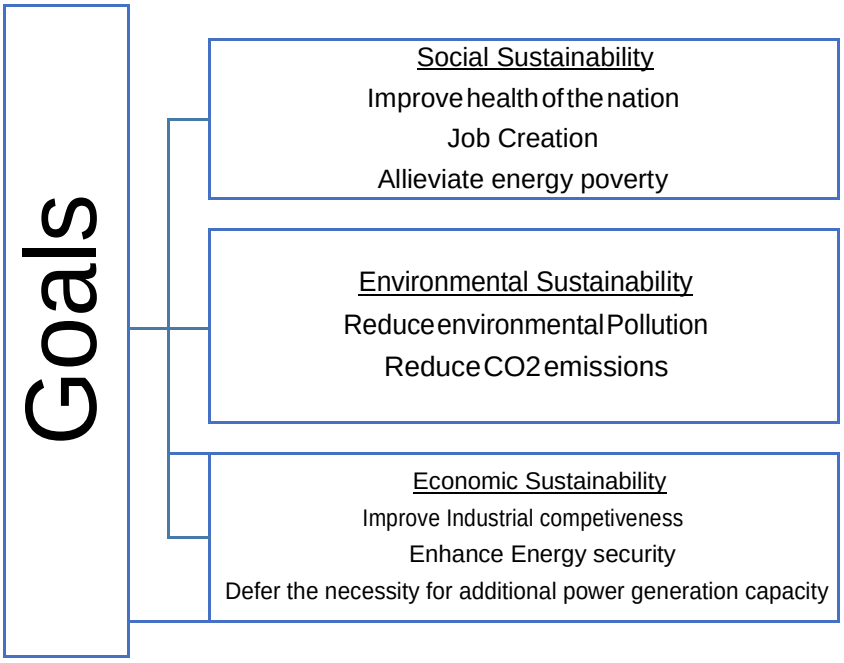


Figure 3: Goals of the Energy Efficiency Strategy of South Africa

3.8.2. SANS 50001: 2011

SANS 50001: 2011 is a national standard which is identical in implementation to ISO 50001:2011. It is an energy management system used and adopted by South African Building Standards with the permission of the International Organization for Standardization (SABS, 2011, p2).

World energy consumption has doubled in the last 40 years and projected to increase by further 30% by 2040. Added to this energy usage forms 60% of greenhouse gases emissions which contribute to climate change (International Energy Agency, World Energy Outlook, 2017).

SANS 50001:2011 defines energy efficiency as the ratio or other quantitative relationship between an output of performance, service, goods or energy, and an input of energy and provides as an example the conversion efficiency, energy required or energy used, the output or input; the theoretical energy used to operate or the energy used to operate (Du Plessis, 2015). The National Energy Act 34 of 2008 (section 1) defines energy efficiency as the economical and efficient production and utilisation of an energy carrier or resource. (Du Plessis, 2015)

Prior to the August 2011, South Africa had no mandatory regulations governing the use of energy in the country (Reynolds, 2012). SANS 204 was passed in August 2011 and SANS 10400 XA was passed in November 2011. These are currently in use in South Africa for all new building projects and alterations which require new building plans to be passed.

3.8.3. SANS 204 – Energy Efficiency in Buildings

SANS 204 came about as a result of South Africa's electrical needs. The Department of Minerals and Energy (DME) set out energy efficiency targets in 2003 which required a code to be established for energy efficiency in buildings. SANS 204 is a voluntary National "Standard specifying the design requirements for energy efficiency in buildings and of services in buildings with natural environmental control and artificial ventilation or air conditioning systems" (SANS 204:2011, 2011, p3). SANS 204 contains performance levels that are higher than SANS 10400-XA and defines minimum requirements to achieve a 3-star Green Building Rating (Reynolds, 2012).

The SANS 204 has 6 main sections namely; Site Orientation, Building Orientation, Building Design, Building Sealing, Services (Lighting and Water) and Mechanical Ventilation and Air Conditioning. These 6 sections are divided into three 3 parts; Part 1: General Requirements, Part 2: Natural Ventilation and Part 3: HVAC services (SANS 204:2011, 2011).

The aim of the SANS 204 is not to produce a green building, but to produce an energy efficient building (Barker, 2009).

3.8.4. SANS 10400-XA – Energy Use in Buildings

In November 2011, South Africa's first compulsory national standard for energy efficiency for passed, the SANS 10400 part XA. The SANS 10400 had 20 sections, the 21st section was added as part X, for Environmental Sustainability, which has a subsection part XA for Energy Usage in Buildings. The part XA of the SANS 10400 contains 4 sections for which there are recommended and prescribed standards for the regions of South Africa.

The four sections covered in the SANS 10400 XA for energy usage in buildings are: Hot water supply; Energy usage and building envelope; Design assumptions and Building envelope requirements. These requirements for the various climatic regions in South Africa are covered in this document (SANS 10400-XA: 2011).

This standard is compulsory to all new buildings and all buildings with alterations that require approval of building plans as well as all 'occupied' buildings (Reynolds, 2012).

3.9 Commercial Sector

The commercial sector in South Africa only demands between 10-15% of the total energy consumed, however savings in this sector can be most significant as compared to the other sectors. Research has shown that low to medium cost interventions can exceed 25% of savings, while a further 4% can be achieved through managerial and behavioural interventions (Reynolds, 2007; Government Gazette, 2009). According to Reynolds, legislation is regarded as a "broad brush" statement, and the stakeholders require "recipes" to achieve it. Standards are therefore the "recipes" for stakeholders to follow to achieve building energy efficiency (Reynolds, 2007).

The commercial sector is made up of office buildings, retail buildings, hotels, restaurants, schools, hospitals and community centres. The two largest consumers of energy are HVAC systems and Lighting as seen in the Figure 4.

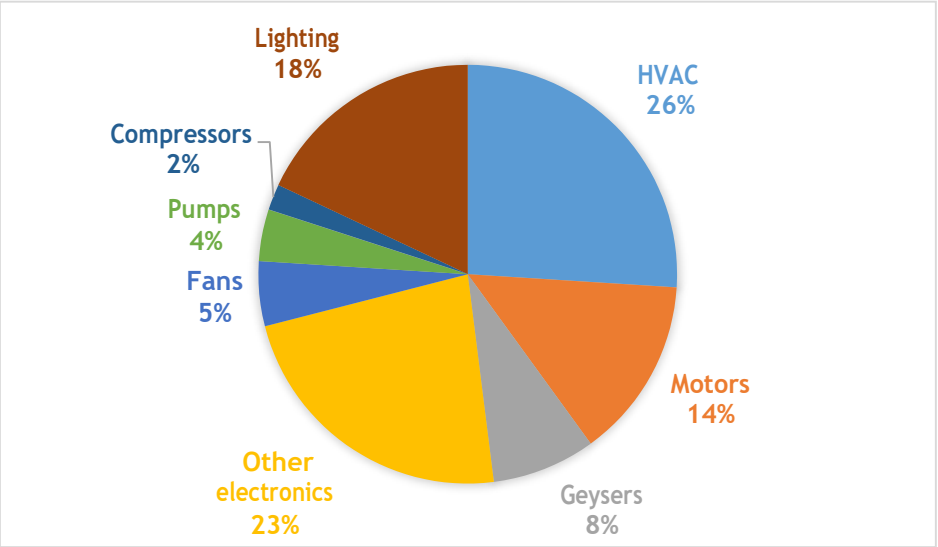


Figure 4: Commercial End User Consumption of Energy

Source: (Eskom, Integrated Demand Management, 2014)

Eskom Integrated Demand Management (2014) has described the culture of becoming energy efficient in a commercial setting in three steps namely 1st Behavioural Changes – through the creation of awareness and understanding of energy efficiency; 2nd Operational Measures – through the implementation of equipment and technologies that make the commercial environment more energy efficient; and 3rd Systems and technologies – through the installation of efficiency upgrades and retrofits.

A study was done on 11 commercial buildings in South Africa by Eskom Integrated Demand Management in 2011. Three of the commercial businesses implemented significant energy retrofits. The remaining 8 were not included due to not having implemented significant retrofit options. They changed old florescent lighting to LED alternatives and changed a resistive geyser to a modular energy efficient heat pump system.

The Table 6 shows the outcome of the retrofit.

Table 6: Analysis of costs for commercial building retrofits

	Capital Cost	Annual Cost Saving	Simple Payback Period
A	R 286 801.20	R 91 347.93	3.2 years
B	R 668 950.00	R 225 000.00	3 years
C	R 280 000.00	R 180 000.00	1.5 years

Source: (Eskom Integrated Demand Management, 2011)

Table 6 shows that the capital cost is not directly related to the payback period or savings. It is seen buildings 'A' and 'C' have similar initial costs. However, the savings and payback periods are almost double the other.

3.10 Commercial Retail Sector

A commercial retail centre is a centre that has more than one retail business or tenant; has common areas and has a shared building infrastructure between tenants (Green Star Retail v1, 2010). Retail centres are required to accommodate varying needs of the varying tenants, for example, hairdressers require a large amount of water, while restaurants require large amounts of energy. Retail spaces also take up a large surface area as compared to office spaces. Retail centres are generally open longer hours as compared to fixed office hours, therefore using more energy and water. These factors make it difficult to make a retail space green, however it is not impossible, a thorough audit through the retail centre will be able to indicate where energy can be saved (Robinson, 2007). Examples of these can be seen in the United States and Australian Markets.

3.10.1. The United States

In the US, Retail buildings account for 13.5% of US commercial space and retailers spend approximately $ 21 billion on energy purchases a year. Retailers Industry Leaders Association have identified six categories in retail centres that can be used to achieve an approximate $3 billion in energy costs. They have further broken down these categories into varying levels of implementation for easy access for the user. In

the United States in the retail sector, lighting accounts for 17% of energy use; HVAC accounts for 47% and refrigeration accounts for 7%. Table 7 indicates five levels of implementation across six major building performance areas (RILA, 2015).

Table 7: Levels of energy saving initiatives within Retail Centres

	Starting level	Standard	Excelling	Leading	Next practise
Lighting	Periodically review of lighting options	Use of fluorescents for interior lighting Occupancy sensors Centralized control and monitoring	Implementation portfolio wide rollout Retrofit site, sign writing with LEDs and occupancy sensors	Daylight harvesting strategy Building and space design to limit lighting and use	Integrate lighting with other energy consuming systems
HVAC	Periodically review of HVAC options	Use higher efficiency HVAC units Quality maintenance program	High efficiency replacement/retrofit options Evaluate HVAC tonnage on heat loss/gain through calculations	Active HVAC tracking program	Integrate HVAC with other energy consuming systems
Refrigeration	Awareness of refrigeration systems	Use of doors on 80% of low temp fridges Use products with ENERGY STAR Rating Routine cleaning	Use of doors on 100% of low temp fridges Use of doors on 50% of medium temp fridges Relocate compressors for minimum waste heat issues	Use of doors on 80% of medium temp fridges Anti-sweat control on all fridges	Pilot stores for natural refrigeration or alternatives
Energy storage, generation, demand	No energy storage, generation or demand	Some renewable energy	Testing possibility of solar, wind, gas	Onsite renewable energy sources	Developing renewable energy cooperatives
Energy Management Systems	Basic alert system Track energy usage per store	Review control set points	Implement EMS within portfolio	Incorporate tools for energy reduction Use ISO 50001	Vertical integration of EMS data, benchmarking and analytics
Plug load management	Identify and investigate high plug load consumption	Install, monitor and control devices	Track device usage	Request energy saving equipment from vendors	Work with vendors to develop energy efficient technologies

Table 4 shows the starting phase as a continuous review of currently implemented strategies. The second phase shows the implementation of basic strategies, while the

third, fourth and fifth stages show further implementation, major retrofitting and the integration of systems within a building (RILA, 2015).

3.10.2. Australia

The Green Building Council in Australia found that retail outlets that provide fresh air, natural light and are water and energy efficient are more attractive and generally achieve higher sales as well as have more productive staff. The Council found that a Green Star Certification increased sales at the till, attracted more customers, maintained staff complement for longer, saved money and resources, reduced their environmental footprint and realised higher building returns (Green Building Council of Australia, 2013).

3.11 Chapter Summary

This chapter reviewed Green Building and Energy Efficiency policies globally as well as locally. The World Green Building Council mediates and supports Green Building Councils around the world in their initiative to create sustainable buildings to support the changing climate. International Green Building rating tools are used to support legislation in some countries as well as form part of voluntary rating tools in others. International rating tools further support the creation and implementation of rating tools in South Africa. South Africa currently only has voluntary rating tools; however, some rating tools have informed mandatory legislation in South Africa. The chapter further investigates rating tools for the commercial sector and implementation of various rating tools in the commercial retail sector both internationally and locally.

The next chapter describes the research methodology of the study.

CHAPTER 4 – RESEARCH METHODOLOGY

4.1 Introduction

The research methodology can be described as the blueprint to achieving the objectives and answering questions that have been raised by the study (Cooper et al., 2005). The research methodology outlines the approach to the study. It is a systematic investigation towards the advancement of knowledge (Fellows & Liu, 2008). Knowledge is always incomplete due to gaps and unresolved problems that occur in the search for answers (Ormrod & Leedy, 2005). The resolving of these problems and filling of gaps in the research is found through the various techniques, methods and procedures available through research design (Rajasekar, 2006). The organization and analysis of these methods in a formal, descriptive manner is known as the methodology (McGloin, 2008). To achieve accurate results for this investigation, potential methods of analysis have been investigated and a suitable method or combination of methods have been used to collect data for research.

South Africa has the 6th highest number of shopping malls in the world, with Kwa-Zulu Natal having the largest mall in Africa, Gateway Theater of Shopping with 460 stores (Earthworks Magazine, 2012). The commercial retail sector requires energy efficiency strategies to be implemented in existing buildings to reduce the consumption of energy and promote energy savings. The primary focus of this investigation is to determine the level of awareness and level of implementation of energy efficiency strategies in retail centers. Investigation was also done regarding the costs, benefits and challenges faced in the process of implementing these energy efficiency strategies at retail centers. Awareness of rating tools and systems by retail center facility managers were also investigated.

4.2 The Research Process

The research process is shown in Figure 5.

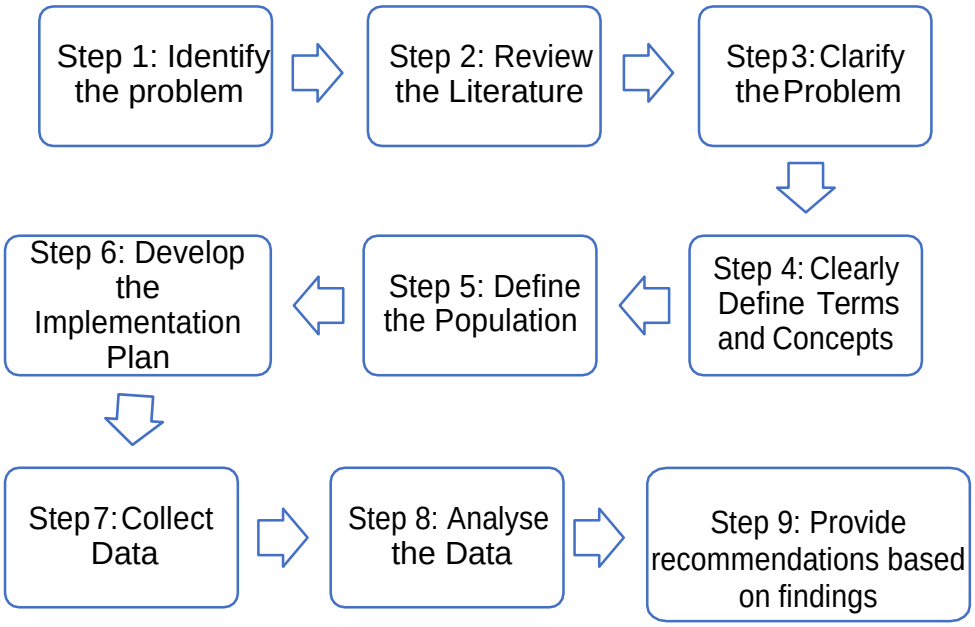


Figure 5: The Research Process

Source: (Blankenship, 2010)

The first step in the process is to identify the problem. The research problem serves as a focus for the study. The research problem is a statement about an area of concern or a troubling question that occurs in theory, literature or practice. The problem introduces the context and provides a possible framework for reporting results (Castellanos, 2008).

The second step is to review the literature. This activity is an ongoing process throughout the study, however during this step in the process, the researcher must critically analyze the literature related to the research problem (Naoum, 2006). The reviewing of various literature from various sources provides the researcher with previous studies and creates a foundation around the problem area (Blankenship, 2010).

The third step is to clarify the problem. Once the literature has been reviewed, the researcher may find the initial problem stated is too broad and needs to be narrowed into a scope for the study. During this step in the process, the purpose of the study is defined and becomes more narrowed and focused (Ibid, 2010).

The next step requires terms and concepts to be set out and defined. Many terms have different meanings and the intent of the term in the study must be expressed by the researcher to ensure the reader understands what the study is about (Ibid, 2010).

The literature review of the study investigates a number of concepts that led to the production of the instrument. Energy efficiency in the built environment refers to the demand and supply of energy to a building. A building is defined and categorized by its use. This study explores the built environment in terms of commercial retail buildings. These are building classified as retail outlets for consumers to purchase goods and services. Buildings are divided into two sectors, namely existing buildings and new buildings. This study investigates existing retail buildings and its use of energy.

When an existing building is being upgraded or renovated, it is regarded as a retrofit building. Reasons for the retrofit of a commercial retail center vary, however this study investigates the retrofit of a retail center for implementation of energy efficiency solutions or as a means of making a building ‘green’.

A “Green Building” is regarded as a building that considers the impact the building has on the environment around it. It preserves the natural resources around it and decreases its negative impact on the environment. The study further investigates the costs, benefits, barriers and challenges faced by commercial retail buildings during the implementation of energy efficiency option.

Lastly Legislation and Rating Tools play an important role in the process of making a building ‘green’ or energy efficient. Rating Tools are created to promote efficiency in the various categories within the tool, energy being one of the categories. Legislation is a supporting mechanism, implemented by governments, used to encourage and reward the implementation of strategies that improve the economy and the built environment respectively.

The next step is to define the population of the study and focus on a specific group of people, facility or operation. The research problem and purpose will assist the researcher in defining the population. The purpose for defining a population or

sampling a group of people ensures the study is manageable in terms of time and resources available (Ibid, 2010).

The sixth step requires an instrument to be developed, which serves as a 'road map' for the study. It defines how, when and where data is to be collected as well from whom data is required. The instrument further specifies, who will collect the data and how will the data be analyzed. A step by step plan is formed on how the data will be collected, analyzed and interpreted (Ibid, 2010).

The seventh step is the actual collect of data according to the plan in step six. The data collected provides the information required to answer the research question. Data is collected by means of a survey questionnaire, through observations or even from other literature sources. Once data is collected the final step is to analyze the data. The data is required to be analyzed to answer the research question. Analysis is carried out statistically and results are summarized in a method to answer the research questions and research problem. The analysis is then concluded to provide quality, valuable and useful information that can be used in the field of research (Ibid, 2010).

4.3 Research Design

A research design is dependent on the researcher and the research problem as well as the data that the investigation is required to collect, analyze and interpret (Omrod & Leedy, 2012). The choice of research design is important as it influences the outcome of the study. Some of the underlying factors that determine which research design is most suitable for the study include:

- Study Design: Pre-experimental, Experimental or Quasi Experimental;
- Access to Respondents: Requires permissions of individuals or groups;
- Types of Data: Case Studies, Quantitative, Qualitative or a combination of all three;
- Sampling Process: Individuals in a role within a group, Group members, Primary group, secondary group or tertiary group, or even national group;
- Sample Size: Single or a few cases (small or large sample size);

- Data Source: Original data to be collected, archived data; and

- Data Gathering Method: Direct observation, interviews, questionnaires

Source: (Miller & Salkind, 2002)

Table 8 shows the characteristics and outcomes achievable through different options of research design.

Table 8: Characteristics and Outcomes of Research Design

Type of Research Design	Characteristics	Outcomes
1 Descriptive Survey a. Cross Sectional Study b. Longitudinal Study	Obtained by interview or questionnaire Requires effort to procure 100% of sample	Sizable volume of information can be classified by type, frequency and measures of central tendency Data analysis can be done for relationships Standardized data can be compared over time intervals
2. Sample Survey	Deals with fraction of total population Sampling methods can be used to provide sample representative of the total	Data analyzed as relationships between two variables, multivariable analysis may use factor analysis, Matrix analysis and multiple discriminant analysis Qualitative and quantitative data is analyzed with parametric and non - parametric methods
3. Field Studies	Primarily investigates processes and patterns of a group or institution Emphasis is placed on social structures	Greater control is achieved by focusing on a subgroup of larger population Used more for hypothesis testing not survey data
4. Case Studies	Intensive analysis on single phenomenon Analysis on individuals or studies to gain insight Discovery of features, traits and groups of uniformity	Provides insight into relationships Concepts can be tests Cases can be coded and statistical tests run to provide associations between variables

Source: (Miller & Salkind, 2002)

4.3.1. Quantitative research design

The use of quantitative research method is for the determination of relationships between independent variables in the population. This quantitative research is descriptive and the data collected is through the use of structured element of a questionnaire survey.

A survey, is a method of collecting information from a large sector of the population (Malhotra & Grover; 1998). There are thus three distinct characteristics identified when using this method of data collection; one: surveys collect information in a structured format; two: they require a standardized information in order describe variables; and three: the information collected is a sample of a portion of the population which creates a generalization across the population (Malhotra & Grover; 1998). One of the main advantages of surveys is that one can obtain data from a significant number of respondents who are geographically dispersed at a reasonable cost (Smartt & Ferreita, 2013). Literature that uses questionnaire surveys as a means of data collection, do so as questionnaires provide a reasonable amount of reliability and validity (Strange et al, 2003). Saunders et al (2012) identifies this surveys as the best way of collecting quantitative data as all the respondents are asked to answer the same questions. This provides an efficient and controlled means for collecting responses from a large dispersed population (Saunders et al, 2012).

4.3.2. Qualitative research design

Qualitative method of research is used due to its purposive sampling method. Purposive sampling entails the choosing of informants due to their important characteristics based on the study (Leedy & Ormond, 2012). According to Leedy and Ormrod (2012), a standard set of questions is prepared by the interviewer and forms a structured interview, when a more semi structured interview is used a standard set of questions are used, however a small number of questions are individually tailored for clarification purposes and to reveal deeper reasons to the interviewees reasons for their answers (Leedy & Ormond, 2012).

An interview method of collecting data becomes both qualitative and quantitative for a researcher. In terms of the quantitative aspect of the interview, the information is from a reliable source and in terms of qualitative aspect it is pure and free from deformation.(Marvasti, 2010).

4.3.3. Mixed Method Design

Mixed method design involves the analysis of qualitative and quantitative data separately as well as combined. The analysis of the two types of data collected and the combination thereof results in the determination of an interpretation and conclusion. Generally, quantitative methodologies yield factual data while qualitative methodologies validate and detail the research. Each of the results cannot produce what the other produces, however the combination of the two creates reliability in the study as well as balances the study. This type of research culminates and is known as triangulation and further substantiates the study in this case takes the form of case studies (Creswell, 2010).

Mixed method research focuses on collecting, analyzing and mixing both qualitative and quantitative data in a single study. This method also creates and provides a better understanding of the research problems and data than either of the two methodologies provide on its own (Strentz et al, 2012). The multi method system does not require different sets of data collection, it is collected in the same time frame during the investigations; thus the deployment of both qualitative and quantitative data collection at the same time does not restrict any of the findings of the study. The use of scientific language and well as simple language is also made possible with the use of this method making it easier for everyone taking part to understand.

When doing research, it is very unlikely to use only one method of research methodology, however there is usually one methodology that dominates and usually creates a more convincing conclusion for the researcher; which is triangulation (Vaivio & Siren, 2010).

4.4 Population and Sampling

4.4.1. Population

The population is the target group which is identified by the study to which the instrument is administered, data collected and analyzed. This data subsequently should answer the research questions and research problem outlined in the study. A sample is considered to be a representative group of the population, as the entire population cannot be surveyed (Grey et al., 2007). Figure 6 shows a method on how a sampling plan is chosen.

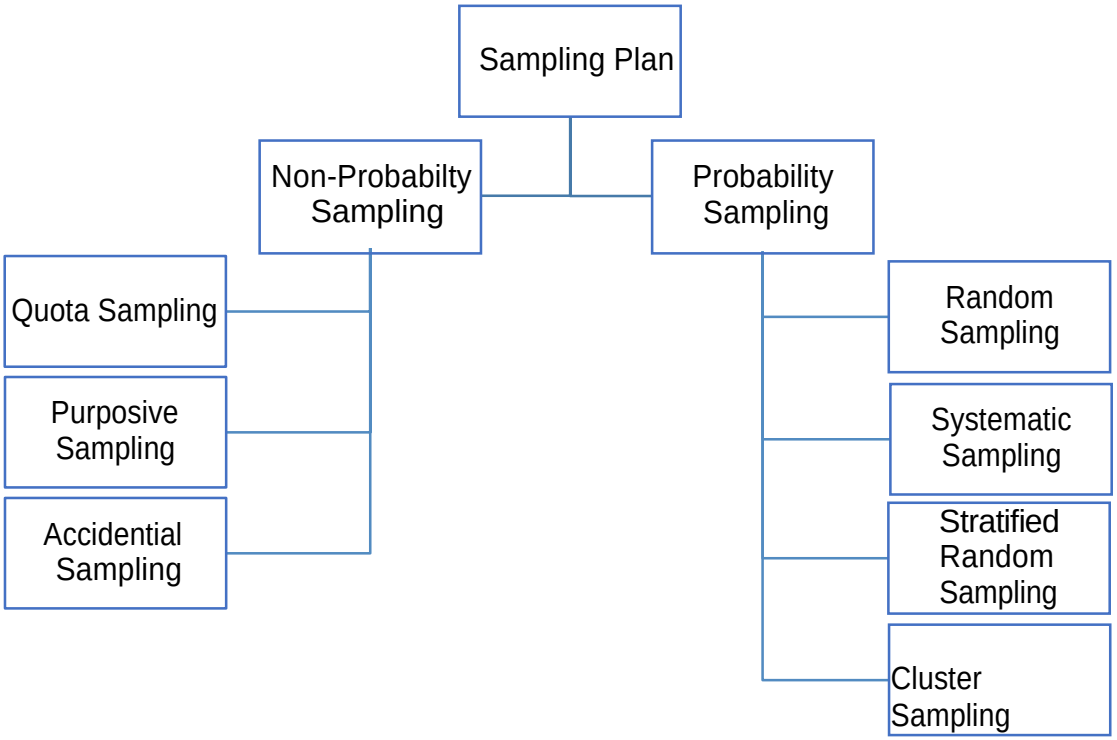


Figure 6: Sampling Plan for Population

Source: (Grey et al., 2007)

4.4.2. Sampling

There are two types of Sampling Methods, either Probability Sampling or Non-Probability Sampling.,

4.4.1.1 *Probability Sampling*

Probability sampling allows for any part of the population to be included in the sample.

4.4.1.2 *Random Sampling*

Simple random sampling allows for each element of the population having an equal chance of being included in the sample. Random sampling establishes parameters of a population and statistics can be produced through the sample. The sample produced a standard error which is an estimation of the sample variation from the population. This type of sampling also produces homogeneous factors within the sample which may represent the population (Grey et al., 2007).

4.4.1.3 *Systematic Sampling*

Systematic sampling is a step above random sampling, where every “nth” unit from a starting point is selected as part of the sample. This is known as a selection interval that divides the population into a desired sample size (Ibid, 2007).

4.4.1.4 *Stratified Sampling*

Stratified sampling divides the population into two or more sections and further sample either through random sampling or systematic sampling methods (Ibid, 2007).

4.4.1.5 *Cluster Sampling*

Cluster sampling would be used where it is not possible to determine a complete population. Cluster sampling first chooses a group or sample of respondents, and then further applies random, systematic or stratified sampling to the group or cluster population (Ibid, 2007).

4.4.1.6 *Non Probability Sampling*

Non-probability samples allow us to approximate the results should the whole population have been sampled with a margin of error (Ibid, 2007).

4.4.1.7 *Accidental Sampling*

Accidental sampling is the process of obtaining data from whoever is passing by at the time of data collection. There is no reliability basis when using an accidental sampling method (Ibid, 2007).

4.4.1.8 *Quota Sampling*

Quota sampling is done by screening potential respondents by means of a desired characteristic. One of the main advantages of quota sampling over accidental sampling, is a specific section of the population is included in the sample (Ibid, 2007).

4.4.1.9 *Purposive Sampling*

Purposive sampling is a judgmental type of sampling, where the sample is 'handpicked' from certain groups or individuals based on their association to the topic of the study (Ibid, 2007).

Probability sampling was used under which, stratified random sampling was used to determine the sample of the population to be used. There are over 1400 retail centers in South Africa with approximately 180 retail centers in Kwa-Zulu Natal. Within these 180 retail centers the population size of the sample of 96 retail centers fall within a 100km radius of the CBD of Durban area.

4.5 Sample Size

Sample size refers to the size of the sample as a percentage of the population. Sample size can be determined when three conditions are fulfilled: identification of specific population parameter; a reasonable split on the question; and how to specify the result (Grey et al., 2007). Sample size is further determined by either a probability or non-probability method of sampling (Naoum, 2006).

Using a normal distribution curve, a confidence interval level of 90% and marginal error of 10%, the sample size was calculated to be 40. Thirty questionnaires were sent out via email or hand delivered, however only 20 completed questionnaire responses were received, representing a response rate of 50%. The expected response rate for email (postal) questionnaires is between 25%-35% (Fellows & Liu, 1997).

4.6 Instrument development

Instrument development is the term used for a research measurement device such as a questionnaire or survey. The instrument used is based on the research question and research objectives of the study as well as the outcome required from the instrument.

The instrument needs to be usable, valid and reliable. The usability of an instrument is determined by the ease at which the instrument is administered to the participant as well as scored and interpreted by the researcher. Validity refers to the extent the instrument measures the subject of the study. External validity is tested by the generalization of the sample to the population. Content validity refers to the level of appropriateness of the content of the instrument and is assessed through the required outcomes of the question. Finally, reliability of the instrument is determined through the consistency of answers. Internal consistency of answers is measured using the statistical measure of Cronbach's Alpha (Denzin & Lincoln, 2005).

The reliability coefficient, Cronbach Alpha, was calculated for the 6 constructs (sections) of the instrument testing the level of internal reliability. All constructs had reliability coefficients greater than 0.80 indicating good internal consistency. Three of the six constructs had excellent internal consistency with high reliability with coefficients greater than 0.90.

4.7 Development of a Questionnaire

The use of questionnaires in research is a reliable source of collecting data. Respondents can answer the questionnaire in privacy and can spend maximum time thinking about the questions and answers which add validity to the study (Ormrod & Leedy, 2012).

Questionnaires make use of open ended and close ended questions as well checklists and rating scales such as the Likert 5-point system to answer questions. The use of open ended questions allows for a qualitative aspect of research to be implemented and further allows for statistical data to be drawn from the questionnaire. Closed ended questions are less demanding in the respondent and provide accuracy from the sample (Ormrod & Leedy, 2012). Rating scales allow the participant to express both direction and strength of their opinion about a topic or statement (Garland, 1991).

Multiple choice options – Multiple choice options allow the participant to choose a best fit option that applies to them. It further allows for more than one correct answer, thereby making the study more reliable.

Tick Box Tables –Tick Boxes allow for exploratory research without the use of an open ended question; thereby gaining information from the participant that is usable and comparable in many different ways.

Open ended questions – Open ended questions generally start with how, why, what, when and where. It gives the respondent an opportunity to provide their opinion on the subject. The opinion can be given in unlimited detail and generally comes with unanticipated conclusions, complex issues as well as reveals the respondents' logic, creativity, process and even frame of reference. With this however comes a large level of insignificant detail, as well as some respondents provide highly articulate answers which become difficult to analyze statistically. A greater amount of time, effort and thought is required to answer these type of questions, which can sometimes prevent the questionnaire from being answered (Copeland, 2017).

Closed ended questions – Closed ended questions usually start with can, did, will and have and allow the respondent to provide a factual answer "yes", "no" type of answer and allows for greater accuracy in the study. These types of questions are easier and quicker to answer as well as to analyze. These type of questions do not allow the respondents to give their opinion or prior knowledge when answering questions. Questions can be misinterpreted and sometimes wrong information given. Respondents are also sometimes forced to give simple answered for complex questions (Copeland, 2017).

Likert Scale is a type of close ended question which forces the participant to choose an option that best suits them. A neutral point is also created to allow the participant to not feel too pressured into answering the question should it not apply to them. It further allows a participant to have a strong opinion as well as no opinion on a particular topic or question.

4.8 Reliability of the Questionnaire

All questions have been developed through extensive research and study on the topic and with the guidance of previous successful questionnaires as well as the guidance of a supervisor (SmartMarket Report, 2013; Lockwood, 2008); thus making it reliable in source. To further maintain reliability within the study, all questions shall remain constant throughout the study and shall apply to all participants under any

circumstance. All the terms for the study shall be clearly explained before the participant fills the out the questionnaire. All participants shall be made aware of the costs and benefits incurred by completing the study.

4.9 Ethical Considerations

It is made clear to all participants of this study that they shall receive no benefit and face no risks from participation of this survey or interview respectfully. The study is entirely voluntary and participation poses no advantage or disadvantage to the participant. The study has been approved by the University of Kwa-Zulu Natal's Research and Ethics Committee (Approval number: HSS/1334/015M) can be found in Annexure D This information was made available to respondents on a form of informed consent that was attached to every questionnaire that was sent out.

4.10 Confidentiality

Confidentiality – All efforts and precautions are made to ensure all personal information of the respondents are kept confidential.

4.11 Instrument Design

The instrument design for this study is questionnaires. The respondents for the study are retail centers facility managers. The instrument was developed to address the objectives of the study namely:

- To identify the level of awareness of retail management and the level of implementation energy retrofit options in the local retail sector;
- To understand the social, environmental and business reasons and the benefits associated with the retrofit of retail spaces;
- To examine the best practices locally and abroad for energy retrofit in retail buildings in order to understand the adaptability in the local context; and
- To investigate the critical factors that affect the adoption of strategies and regulations for energy retrofit of the commercial retail sector in Kwa-Zulu Natal.

The instrument contained 6 sections:

- The profile/demographics of the study;
- Awareness of energy efficiency strategies;
- Implementation of energy efficiency strategies;
- Social, Environmental and Business reasons for the implementation of energy efficiency strategies;
- Benefits and Challenges from implementation of energy efficiency strategies; and
- Awareness of rating tools and regulations

Section 1 contained open ended questions which were factual in nature. Section 2 – 5 of the instrument used the Likert 5 point rating system which ranged from 'Strongly Disagree' to 'Strongly Agree'. Section 6 also used a Likert 5 point rating system, but ranged from 'Very Poor' to 'Very Good' and described the awareness level of the participant with regards to the rating tools and legislation. An optional Section 7 was available with optional questions for respondents who could provide further information to the questions presented previously. The instrument is attached as Annexure B

4.12 Instrument Administration

A number of retail centers in the greater Durban area of Kwa-Zulu Natal were contacted requesting participation in the study. An email with a cover letter and a body explaining the details of the study, including the purpose as well as details of the researcher, supervisor and university was sent. The respondent's anonymity and time taken to complete the survey was also mentioned. Follow up emails and phone calls were made on a weekly basis to remind the respondent to participate in the study.

4.13 Collection of Data & Analysis

There are a number of ways, both structured and unstructured, to collect data using the instrument developed. Four of the most popular methods used is:

- Face to face interaction for either interview or questionnaire completion: entails a standard schedule for each respondent, where questions are asked in the same order and have the same wording (Kabir, 2016);

- A telephone interview: is similar to a face to face interaction, but occurs over the phone. It is generally regarded as a cheaper alternative to a physical face to face interaction (Kabir, 2016);

- A postal (email) of the questionnaires: these are a widely used form of collecting data, where respondents indicate their answers through tick box system or using a level of agreement scale (Kabir, 2016); and

- Informal face to face interviews: occurs as a natural unstructured conversation about the topic of the study. They are often recorded or notes are taken during the conversation (Kabir, 2016).

There is no clear, single best way to collect data. It is dependent on the research questions, the instrument and respondents chosen in the sample. The main aim between all methods of data collection is the validity and reliability of the information received through the instruments (Sapsford & Jupp, 1996).

Desk Study was done through the analysis of Journal Articles, Legislative documentation, Eskom policies and programs as well as in-depth investigation into international and local rating tools and legislative policies.

4.14 Data Management

Electronic questionnaires are to be sent via email. Incomplete and unclear copies shall be discarded once this submission is complete. All physical and electronic copies of received data is to be stored on an external device within the School of Engineering, Howard College, UKZN, and discarded after 12 months by appropriate means.

All data received shall not be shared with any third party. All personal information shall not be disclosed in any form, under any circumstance to any third party and shall further not be mentioned anywhere in the final report submission.

4.15 Analysis of Data

Raw data does not arrange itself. Raw data needs to be categorized and results compared. Data processing is the translation of raw data to a form of words or numbers that can be analyzed. The procedure is useful when there are large numbers of respondents. The data analyzed can further be presented in the form of charts, tables

and graphs. Once raw data is categorized and placed in a workable format, relationships, correlations and inferences can be drawn. This is known as the interpretation of data.

The data was captured using IBM SPSS version 25. The data was coded and statistical testing was performed. The statistical tests run using Descriptive Statistics were frequency distributions providing the mean, median, standard deviations as well as maximum and minimum values for nominal data. Factor analysis and reliability coefficients were calculated along with the mean and standard deviation for each construct containing scale data. This information was used to rank strategies and indicate the level of importance between items.

4.16 Chapter Summary

This chapter provides a blueprint for the research methodology to be undertaken in this study. It describes the process followed from inception of study to the conclusion of the study as well as all the steps in between. It shows the various types of research designs that are available and the ones adopted in the study. It examines a number of population and sampling methods that are available and provides reasoning for the choice of methodology for the study. The chapter goes on to discuss the instrument, its design, creation, implementation and analysis as well as some form of interpretation of analysis.

The next chapter provides the data analysis and its interpretation as well as how it relates to the study.

CHAPTER 5 – ANALYSIS OF DATA

5.1. Introduction

The following chapter contains the research findings from the data collected. The raw data was coded and input into IBM SPSS Statistics version 25 (Statistical Package for Social Sciences) Software. The chapter is divided into six sections.

Raw data that is collected has little meaning, until subjected to some form of analysis. The data has been coded to describe and analyse the responses of the participants in the study. Only once this analysis has been correctly interpreted can conclusions, correlations and relationships between data be shown.

5.2. The Research Instrument

The research instrument refers to the means used to collect data from respondents for research work. The technique used for this study was a questionnaire survey which consisted of six sections namely: Demographics of the study; level of awareness of energy efficiency strategies; level of implementation of energy efficiency strategies; the reasons for implementation of energy efficiency strategies, as well as the challenges faced and benefits received during the implementation of energy efficiency strategies. The questionnaire survey also investigated the level of awareness of energy efficiency Regulations and Rating tools available to the commercial retail industry.

The sample targeted for data collection was management of retail centres in the geographical area ranged from the Kwa-Zulu Natal North Coast to Kwa-Zulu Natal South Coast, and included Durban Central and its surrounding areas.

5.3. Analysis of Data

5.3.1. Section 1 – Profile of the study participants

The designation of the respondents is shown in Table 9. It is evident that 80% of the participants were Facility Managers.

Table 9: Designation of participants

Designation	Number of respondents	Percentage
Facility Manager	16	80
Property Manager	3	15
Centre Manager	1	5

A Facility Manager is a professional focused on the efficient and effective delivery of support services to the organization it serves. A facility manager should be able to coordinate the demand and supply of facilities and services within the organization on a private and public level.

Property Manager is a professional charged with operating a real estate property for a fee, when the owner is unable to personally attend to details.

Centre Manager oversees the daily activities of a centre. The centre manager would be responsible for the security as well as financial and operational matters that arise during the daily occurrences at a centre.

From Table 10 it is evident that there was a median of 81 stores per retail centre ranging from a minimum of 14 to a maximum of 460 stores per centre. It is also evident that the median age of the retail stores in the sample was 19 years ranging from a minimum age of 1-year-old to a maximum age of 60 years old.

Table 10: Number of stores and age of retail centres

	Median	Minimum	Maximum
Stores in the retail centre	81.00	14.00	460.00
Age of retail centre	19 years old	1 year old	60 years old

5.3.2. Reliability of scales

The Cronbach Alpha reliability co-efficient was used to measure the internal consistency of the various scales used for various constructs in the study. Cronbach's alpha (α) was developed in 1951 by Lee Cronbach and the co-efficient measures the reliability or internal consistency of a Likert scale survey. In Table 11 the rule of thumb to interpret the strength of the reliability of the scales is shown.

Table 11: Rule of thumb for interpreting Cronbach's alpha reliability co-efficient

Cronbach's alpha	**Internal Consistency**	**Level of Reliability**
α ≥ 0.90	Excellent	Highly reliable
0.90 > α ≤ 0.80	Good	Moderately reliable
0.80> α ≤ 0.70	Acceptable	
0.70 > α ≤ 0.60	Questionable	Low reliability
0.60 > α ≤ 0.50	Poor	
α ≤ 0.50	Unacceptable	

Source: (Tavakol, 2011)

Table 12 shows the Cronbach alpha reliability co-efficient for each construct.

Table 12: Reliability co-efficient of Constructs

Construct	Reliability Coefficient	Level of internal consistency	Level of reliability
Level of awareness of energy efficiency strategies	0.949	Excellent	High
Level of implementation of energy efficiency strategies	0.861	Good	Moderate
Business, Social and Environmental Reasons for the implementation of energy efficiency	0.944	Excellent	High
Challenges faced in the implementation of energy efficiency initiatives.	0.808	Good	Moderate
Business Benefits received from implementing energy efficiency	0.869	Good	Moderate
Awareness of Rating tools and Regulations	0.976	Excellent	High

Table 12 shows that all constructs have acceptable internal reliability since their respective reliability co-efficients were greater than 0.70. Three constructs have an excellent internal consistency with high reliability (co-efficient > 0.90). The remaining three constructs have a good internal consistency with moderate reliability (co-efficient > 0.70 < 0.90).

5.3.3. Analysis of constructs

The following sections analyse the responses of participants using a 5-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. For interpretation purposes, the reported mean scores are categorised as shown in Table 13.

Table 13: Interpretation of Scales

Interval	Importance Level
< 1.67	Low (L)
> 1.68, < 3.33	Medium (M)
> 3.34	High (H)

5.3.4. Section 2 – Awareness of energy efficiency initiatives

Participants were presented with 13 energy efficiency strategies and requested to indicate their level of agreement using a 5-point Likert scale of agreement where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. Their responses ranked by the mean scores are shown in Table 14.

Table 14: Awareness of energy efficiency strategies in retail centres

Energy efficient strategy	Mean	Standard Deviation	Agreement level	Rank
Lighting changed to LED	4.40	1.05	High	1
Energy Efficient HVAC systems	4.30	1.03	High	2
This mall is actually energy efficient.	4.30	1.13	High	3

Energy efficient strategy	Mean	Standard Deviation	Agreement level	Rank
Natural lighting and Ventilation	4.25	1.16	High	4
HVAC Preventative Maintenance	4.20	1.44	High	5
The Facility Management of this mall is aware of energy efficiency.	3.90	1.07	High	6
Upgrading appliances to green star rated appliances	3.90	1.25	High	7
Sequencing of energy usage through Energy Management Systems	3.90	1.37	High	8
Thermal insulation of building	3.80	1.32	High	9
Energy efficiency is a key driver to running an efficient mall	3.75	1.25	High	10
Change in glazing	3.75	1.41	High	11
Solar water heating	3.65	1.57	High	12
The mall has energy efficiency strategies in place	3.05	1.47	Medium	13

The findings in Table 14 show that respondents reported high levels of agreement of awareness of 12 of the 13 energy efficiency strategies with mean scores ranging from 4.40 to 3.65. They were highly aware of artificial lighting changed to LED's with the highest mean of 4.40. Other strategies that they were well aware of included the use

of efficient HVAC systems (mean = 4.30), malls running energy efficiently (mean= 4.30) and the awareness of natural lighting and ventilation (mean = 4.25). The strategy that respondents were least aware of was whether the retail centre had energy efficiency strategies in place (mean = 3.05). This finding is worrisome as 80% of the respondents were facility managers who did not know whether their mall was running efficiently or not.

Awareness surrounding lighting and HVAC is regarded as most important by the respondents of the study. It is also the starting point of many retrofit options and rating tools. It is expected that these two items have the highest awareness level.

5.3.5. Section 3 – Implementation of energy efficiency initiatives

Participants were presented with 11 energy efficiency strategies and requested to indicate which of these strategies were implemented in their centres using a 5-point Likert scale of agreement where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. Their responses ranked by the mean scores shown in Table 15.

Table 15: Implementation of energy efficiency strategies

IMPLEMENTATION	Mean	Standard Deviation	Agreement level	Rank
Artificial Lighting Systems	4.00	1.03	High	1
HVAC System	4.00	1.30	High	2
The Facility Management of this mall implements energy efficiency solutions	3.90	1.29	High	3
Energy efficiency solutions have been implemented through regular maintenance	3.85	1.27	High	4

IMPLEMENTATION	Mean	Standard Deviation	Agreement level	Rank
Implementation of Natural Lighting through more windows/doors	3.85	1.42	High	5
Energy efficiency solutions have been purposely implemented through interventions	3.60	1.39	High	6
Refrigeration Systems	3.35	1.27	High	7
Building fabric (thermal insulation)	3.35	1.27	High	8
Building Envelope	3.30	1.13	Medium	9
Glazing / double glazing	3.25	1.29	Medium	10
Water heating System	2.55	1.23	Medium	11

The findings in Table 15 show that respondents had high levels of agreement about the implementation of 8 out of 11 energy efficiency strategies with a mean range of 4.00 – 3.35. Participants agreed the most important strategy being implemented is the use of efficient artificial lighting systems and the use of efficient HVAC systems (mean = 4.00). They also highly agreed about the implementation of natural lighting as well as implementing strategies through a maintenance process (mean = 3.85) as opposed to implementing strategies purposely or through an intervention (mean = 3.60). Implementing strategies with relation to the building envelope (mean = 3.30) and glazing / double glazing (mean = 3.25) had medium level of importance. A strategy that is seldom implemented and a strategy that ranked lowest with medium level of importance by mean 2.55 is the implementation of a water heating system.

According to a number of studies that have implemented basic to advanced strategies, the starting point for any retrofit is the change in lighting systems as well as the implementation of natural lighting and upgrade or maintenance of the HVAC system. For a shopping mall there is very limited use of hot water, therefore the reason for low

implementation of water heating systems as well as the medium importance level can be attributed to the minimal requirements of hot water in a retail centre.

Table 16: Costs and benefits from the implementation of energy efficiency strategies

	Median	**Minimum**	**Maximum**
Initiation of retrofit options from 2019	2.00 years	0.50 years	12.00 years
Approximate Cost to Retrofit	R7 000 000.00	R2 400 000.00	R150 000 000.00
Estimated Payback Period	5 years	3 years	15 years
Expected Value Increase	20.00%	2.50%	30.00%
Actual Value Increase	15.00%	2.00%	30.00%

Table 17: No of stores and Approximate Cost to implement energy efficiency strategies

	No of stores				
Approximate cost	0-50	50-100	100-150	150-200	>200
R2 000 000 - R5 000 000	2	2			
R5 000 000 - R10 000 000	1	1			
>R100 000 000			1	1	1

Table 18: Implementation costs per store

Mall	No of Stores	Cost	Mean Cost/Store
1	460	R 120 000 000,00	R 260 869,57
2	160	R 150 000 000,00	R 937 500,00
3	118	R 12 000 000,00	R 101 694,92
4	112	R 2 400 000,00	R 21 428,57
5	100	R 7 000 000,00	R 70 000,00
6	53	R 5 000 000,00	R 94 339,62
7	45	R 3 000 000,00	R 66 666,67
8	39	R 2 500 000,00	R 64 102,56
9	14	R 8 000 000,00	R 571 428,57

From Table 16 it is evident that the period since the centre was last retrofit was a median of 2 years ago. The minimum period that a centre was last retrofit was 6 months ago and the maximum period was 12 years ago. Participants had a median expectancy of 20.00% increase in property values ranging from a minimum of 2.50% to 30.00%. However, their actual building values only increased by a median of 15.00% ranging from 2.00% to 30.00%. The approximate median cost to retrofit a retail centre was R7 000 000, however participants responded with an extremely wide range of costs for retrofitting a building ranging from R2.4 million to as much as R150 million indicating that the size of the mall may have played an important role in the cost of retrofitting as seen in Table 17. Table 18 further shows that the cost of implementation is not necessarily related to the number of stores at the retail centre, but rather to the cost related to the implementation of energy efficiency strategies in the retail centre. All retail centres have varying levels of energy efficient strategies in place, with some costs indicating a complete retrofit while some indicate a partial retrofit and the remaining indicate a retrofit in stages over a prolonged period of time.

5.3.6. Section 4 – Reasons for Implementation of energy efficiency initiatives

Respondents were presented with 28 reasons for implementation of energy efficiency strategies within their retail centres and were requested to indicate their level of agreement with these reasons using a 5-point Likert scale of agreement where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. Reasons were made up of 3 categories namely business reasons comprising of 18 reasons, social reasons comprising of 5 reasons and environmental reasons comprising of 5 reasons. Their responses were ranked by the mean scores and shown in Table 19, Table 20 and Table 21.

Table 19: Business Reasons for the implementation of energy efficiency strategies

Business reasons	Mean	Standard Deviation	Agreement level	Rank
Refurbishment of building	3.85	1.35	High	1
Increasing running costs	3.85	1.50	High	2
Lower operating costs	3.80	1.36	High	3
Internal corporate commitment	3.65	1.31	High	4
Higher building values	3.55	1.32	High	5
Ethical and environmental responsibilities	3.50	1.38	High	6
Limitations in South African supply of electricity	3.40	1.43	High	7
Environmental regulations	3.35	1.42	High	8
Owner/management demand	3.25	1.52	Medium	9
Local competition	3.25	1.37	Medium	10
Social responsibility	3.20	1.28	Medium	11

Business reasons	Mean	Standard Deviation	Agreement level	Rank
Branding and public relations	3.20	1.44	Medium	12
Client demand	3.15	1.50	Medium	13
Market demand	3.10	1.29	Medium	14
Market transformation	3.05	1.23	Medium	15
New regulations	2.90	1.25	Medium	16
Global competiveness	2.80	1.20	Medium	17
Tenant demand	2.45	1.23	Medium	18

The findings in Table 19 show respondents reported high levels of agreement with 8 of the 18 business reasons for implementation of energy efficiency strategies (mean = 3.85 – 3.35). Refurbishment of a retail centre was the business reason with highest agreement (mean = 3.85) as well as a continuous increasing of running costs within a retail centre (mean = 3.85). The remaining 10 strategies received medium levels of agreement. These strategies included owner/management demand and local competition (mean = 3.25); with social responsibility and branding/public relations (mean = 3.20). The lack of demand from tenants of the retail centres (mean = 2.45) had the lowest level of agreement. This finding suggests that tenants are either unaware or unconcerned about the implementation or benefits of energy efficiency strategies.

Business reasons for the implementation of energy efficiency strategies which rated low in the study were the clients demand as well as environmental regulations.

Table 20: Social Reasons for the implementation of energy efficiency strategies

Social Reasons	Mean	Standard Deviation	Agreement level	Rank
Promotes greater health, environmental quality and well being	3.90	1.12	High	1
Encourages Sustainable building practices	3.75	1.37	High	2
Supports local manufacturers of energy efficient products	3.35	1.31	High	3
Increases worker productivity	3.30	1.22	Medium	4
Promotes the aesthetics of the building	3.00	1.49	Medium	5

The findings in Table 20 show participants reported high levels of agreement with three of the five social reasons for the implementation of energy efficiency strategies. The social reason with the highest level of agreement was the promotion of greater health and environmental quality (mean = 3.90), while the two lowest ranked reasons with medium importance were the increase of worker productivity (mean = 3.30) and to improve the aesthetics of a retail centre (mean = 3.00).

Over 70% of respondents in a global study, World Green building trends, in 2012 and 2018 showed that the most important social reasons for retrofitting a building with green strategies is to promote the health and well-being of the occupant or user as well as encouraging sustainable business practices. The same was found in this study.

Table 21: Environmental Reasons for the implementation of energy efficiency strategies

Environmental Reasons	Mean	Standard Deviation	Importance level	Rank
Lower greenhouse gas emissions	4.40	0.82	High	1
Reduction in energy consumption	4.30	0.98	High	2
Protecting natural resources	4.20	1.06	High	3
Reducing wastage of natural resources	4.15	1.04	High	4
Improving indoor environmental quality	3.85	1.27	High	5

The findings in Table 21 show that participants reported high levels of agreement with all five environmental reasons for implementation of energy efficiency. The environmental reason with highest agreement level for retrofitting a retail centre was to lower greenhouse gas emissions (mean = 4.40), while the environmental reason to improve indoor air quality (mean = 3.85) ranked the lowest.

Of all the reasons, the top three ranked reasons were environmental reasons, namely to reduce greenhouse gas emissions (mean = 4.40); to reduce energy consumption (mean = 4.30) as well as to protect natural resources (mean = 4.20). The lowest ranking items for implementation of energy efficient strategies were tenant demand (mean = 2.45), global competitiveness (mean = 2.80) and new regulations (mean = 2.90). These items were found to be the reasons that were least popular for the implementation of energy efficient resources. The reduction of energy consumption was expected to be the environmental reason with most importance. According to this study, the lowering of greenhouse gas emissions was rated as the most important.

Results were found to be very encouraging as the overall top ranked reasons for implementing energy efficiency strategies were not for business; but for environmental and social reasons.

5.3.7. Section 5 – Challenges faced during the implementation of energy efficiency strategies

Participants were presented with 7 possible challenges faced during the implementation of energy efficiency strategies within their retail centres and were requested to indicate their level of agreement using a 5 point Likert scale of agreement where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. Their responses were ranked by mean scores as shown in Table 22.

Table 22: Challenges faced during the implementation of energy efficiency strategies

CHALLENGES	Mean	Standard Deviation	Agreement Level	Rank
High initial costs	4.40	1.31	High	1
Lack of awareness	3.65	1.18	High	2
Lack of governmental support	3.60	1.27	High	3
Lack of market demand	3.40	1.05	High	4
Lack of trained installers	3.30	1.34	Medium	5
Lack of professional advice	3.20	1.32	Medium	6
Lack of competent professionals / consultants on energy efficiency strategies	3.20	1.36	Medium	7

The findings in Table 22 show that participants reported a high level of agreement with 4 of the 7 challenges faced during the implementation of energy efficiency strategies (mean 4.40 – 3.20). The highest ranking response is the high initial costs faced when trying to implement energy efficient strategies (mean = 4.40). Following high initial costs was the lack of awareness around the topic of energy efficiency (mean = 3.65),

lack of governmental support and initiatives (mean = 3.60), as well as the lack of demand from the market (mean = 3.40). The last remaining challenges ranked with medium awareness was the lack of trained professionals (mean = 3.30) to install energy efficient solutions (mean = 3.20) along with the lack of advice (mean = 3.20) as well as lack of competent consultants of energy efficient products and services (mean = 3.20).

It is useful to note that the items that were highly ranked are supported by the reasoning provided by the lower ranked items – for instance, the lack of professionals and installers contribute to the lack of awareness around the implementation of energy efficiency thereby creating a cycle of challenges that are harder to resolve.

The highest barriers faced in the implementation of green and energy efficiency strategies is the higher initial cost, lack of support from governmental states as well as the lack of awareness of the general public in the demand for the implementation of green and energy efficiency strategies. These challenges were found in this study to be true.

5.3.8. Section 6 – Benefits received from the implementation of energy efficient strategies

Participants were presented with 9 possible benefits received from the implementation of energy efficient strategies within their retail centres and were requested to indicate their level of agreement using a 5 point Likert scale of agreement where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree. Their responses were ranked by mean scores shown in Table 23.

Table 23: Benefits received through the implementation of energy efficiency strategies

BENEFITS	Mean	Standard Deviation	Agreement Level	Rank
Lower operation costs	4.40	0.68	High	1
Higher building value / resale value	3.95	1.00	High	2
Branding/Public relations improved	3.60	1.19	High	3
More internal corporate commitment	3.55	1.15	High	4
Locally competitive	3.30	1.17	Medium	5
Globally competitive	2.90	0.91	Medium	6
Increased tenant productivity	2.85	1.27	Medium	7
Higher occupancy rates	2.65	1.46	Medium	8
Higher rental income	2.25	1.21	Medium	9

The findings in Table 23 show participants of the sample reported a high level of awareness for four of the nine benefits received from the implementation of energy efficient strategies. The highest ranked item was the decrease in operation costs of running the retail centre (mean = 4.40). The items ranking 2nd and 3rd indicate the business benefit of the higher resale or building value (mean = 3.95), the branding and public relations of the retail centre being improved (mean = 3.60). Facility Managers indicated being locally (mean = 3.30) and globally competitive (mean = 2.90) was of medium level of awareness as compared to the first ranking item. The item proving to be the least beneficial with medium awareness ranking was higher rental income (mean 2.25). It was indicated by many retail centres that they would not pass on the cost of implementing energy efficiency strategies to their tenants, as tenant demand (mean = 2.45) was not a reason for implementing these strategies as seen in Table 19. This finding is consistent with the awareness of efficiency as tenant demand was

not a reason for implementation due to the low level of awareness of strategies by tenants.

The main benefit found from the implementation of retrofit options is the lowering of operation costs. This can be seen from the ranking and mean values of the study. Globally the lowering of operating costs is rated as the most important reason by 65% of the countries that have implemented green solutions, with 77% of the US stating the reason as important (Smart Market Report, 2018).

5.3.9. Section 7 – International and Local Rating tools

Participants were presented with 12 rating tools and regulations both local and international with regards to energy efficiency. Participants were requested to indicate the level awareness of the listed international and local rating tools and regulations using a 5 point Likert scale of agreement where 1 = very poor, 2 = poor, 3 = fair, 4 = good, 5 = very good. Their responses were ranked by mean scores shown in Table 24.

Table 24: Awareness of international and local rating tools and regulations

INTERNATIONAL AND LOCAL INITIATIVES	Mean	Standard Deviation	Awareness Level	Rank
GBCSA (Green Building Council of South Africa)	3.37	1.42	High	1
Eskoms' Integrated Demand Management Program also a voluntary program providing incentives for using less energy and reducing your demand on the electricity grid.	3.37	1.54	High	2
LEED (Leadership in Energy and Environmental Design	3.26	1.5	Medium	3
Green Building Council of South Africa voluntary rating tools for offices and retail spaces	3.21	1.55	Medium	4
SANS 10400 XA for energy use in buildings	3.16	1.38	Medium	5
Rating tools for Green Retail buildings	3.05	1.31	Medium	6
National Energy Act 34 of 2008 that explores energy efficiency as the economical and efficient production and utilisation of energy.	3.00	1.45	Medium	7
SANS 50001:2011 that looks at the relationship of input and output energy, as well as the conversion of energy from one form to another.	2.95	1.47	Medium	8
GBCA (Green Building Council Australia Green Star)	2.89	1.24	Medium	9
CASBEE (Comprehensive Assessment System for Built Environment Efficiency)	2.74	1.19	Medium	10
BRREAM (BRE Environmental Assessment Method)	2.63	1.30	Medium	11
HK BEAM (Hong Kong Building Environmental Assessment Method)	2.52	1.12	Medium	12

The findings in Table 24 show the mean responses of participants of their level of awareness of international and local rating tools and regulations. It is encouraging to

see the highest ranked item, the rated tool with highest awareness is The Green Building Council of South Africa (mean = 3.37) and Eskom's Integrated Demand Management Program (mean = 3.37) a local tool and local initiative respectfully towards energy efficiency. The remaining ten strategies, were of medium awareness and initiatives ranked 4th, 5th, 6th, 7th, and 8th are all local initiatives and local regulations (mean 3.37 – 2.95), indicating that participants are well aware of initiatives available locally in terms of energy efficiency. Leadership in Energy and Environmental Design (mean = 3.26), an international tool is the most well-known, while other international initiatives ranked 9th, 10th, 11th and 12th (mean = 2.89 – 2.52). International strategies with medium awareness were not being aware of these strategies. This is expected as international strategies have minimal effect on the local retail centre and are lesser known.

5.4 Chapter Summary

The purpose of the chapter was to present the findings from the data collected. Quantitative research methods were used to collect raw data. SPSS was used to code raw data into data that can be used for statistical analysis. Data was divided into 6 constructs; namely awareness of energy efficiency strategies, the implementation of energy efficiency strategies as well as the benefits received and challenges faced while implementing energy efficiency strategies at retail centres. The last construct investigated the level of awareness of the participant in terms of local and international initiatives and tools available in terms of energy efficiency. Each construct was made up of a number of statements which participants were required to indicate their level of agreement with according to a 5 point Likert scale. Findings for each construct were ranked according to means and analysed respectfully thereof.

Analysis of the data showed a link between the level of awareness and implementation. Strategies that were found to have high levels of awareness were found to have been implemented the most. This association was supported by the evidence found through the analysis of the challenges faced and benefits received in the implementation of energy efficiency strategies. It was further found the challenges faced if overcome would translate to a benefit for the retail centre. The awareness of rating tools locally is greater than the awareness of international rating tools as international rating tools sometimes has little to no effect in the local retail centre.

CHAPTER 6 - CONCLUSION & RECOMMENDATIONS

6.1. Introduction

This chapter provides a summary of key findings regarding the study and draws conclusions from the literature and analysis of data and makes recommendations for future studies. The purpose of the study is to explore the awareness and implementation level of energy efficiency in retail buildings in Kwa-Zulu Natal.

6.2. The Problem Statement

The problem statement that formed the basis of the study was:

South Africa has the 6th highest number of shopping malls in the world, the retrofit of commercial retail buildings plays an important role in the future of energy preservation in the country. The South African retail sector urgently requires strategies to improve its energy efficiency. However, the lack of information and research data in the country about the implementation of strategic energy retrofit options into retail buildings can hinder the sector from achieving this target.

6.3. Research objectives

The research objectives of the study were achieved through a research methodology.

6.3.1. Objective 1

To identify the level of awareness of retail management and level of implementation of energy retrofit options in local retail centres.

The level of awareness of energy retrofit options at retail centres is high among the local facility managers at malls in the Durban and surrounding areas of Kwa-Zulu

Natal. It was found by this study that the general level of awareness of two main energy efficiency strategies were the awareness surrounding different lighting systems as well as the awareness of efficient HVAC systems. This was an expected result as many retrofit rating tools state these two strategies as an entry level form of retrofitting option. This finding confirms that the retrofitting of lighting and the retrofitting of HVAC systems to more energy efficient solutions are solutions that facility managers in shopping malls are well aware of at local retail centres. When presented with a similar list of items querying the implementation of energy efficient strategies it was further confirmed that items of high awareness, have high implementation levels. It was further found that implementation occurs at a maintenance level or as a preventative method and not as a purposive method.

The implementation levels of various retrofit options available for each energy intensive system; and as shopping malls move toward energy efficiency, there are currently varying levels of implementation of energy efficiency strategies. This is seen through the wide range of implementation costs across number of stores as well as through the value of implementation at various retail centres. In South Africa, initiatives by ESKOM, Pick ‘n Pay as well as Growthpoint have all made basic implementation changes in their operations to become more energy efficient.

6.3.2. Objective 2

To investigate the critical factors that affect the implementation and adoption of energy retrofit strategies in the Kwa-Zulu Natal commercial retail sector.

Implementation of energy efficiency strategies in a retail centre cannot be made by a single person. Investigation, cost benefit analysis as well as an implementation strategy must be put in place to ensure maximum benefit for maximum people with minimum cost. Through the study, it has been shown that South Africa competes globally in the implementation costs and pay back periods for implementation of energy efficiency strategies.

One of the most critical factors that affect the implementation of energy efficiency strategies in retail centres is the high initial costs of implementation. Global studies as well as this study show that the greatest barrier faced in the implementation of energy efficiency strategies is the high costs. Other factors include the lack of incentives from

government as well as lack of awareness and support from professionals in the industry. These were clearly seen in this study.

6.3.3. Objective 3

To understand the social, environmental and other possible reasons for the benefits that have been associated with the retrofit of retail spaces.

When considering the implementation of new strategies into a retail centre, one of the main factors which contribute to the decision making is the reasoning behind implementation decisions as well as the benefits that will be received through implementation. Reasons were categorised into 3 sections namely: Business, Social and Environmental. This study found participants' driving reasoning for the implementation of energy efficiency strategies to be environmental, while business and social reasons were cited as secondary. One of the main environmental reasons found was for the lowering of greenhouse gas emissions. This was promptly followed by reducing of energy consumption, the promotion of greater health and well-being and lastly to refurbish the building. Similar studies done globally have found similar trends in many other countries, which once again puts South Africa in line with the global community in terms of the retrofit of retail centres.

Through reasoning and implementation of energy efficiency strategies, retail centre ownership and management could experience the benefits of implementing energy efficient strategies. Globally, locally as well as in this study the decrease in operation costs was the main benefit received from the implementation of strategies. Higher building and resale values, branding relations and becoming competitive in the market were secondary benefits experienced from the implementation.

6.3.4. Objective 4

To examine the awareness of Green Building Rating Tools and legislation locally and internationally for the energy retrofit in retail buildings.

A Green Building is a building that in its design, construction and operation reduces or eliminates the negative impact on the climate and natural environment. A Green Building Rating Tool then assesses the design, building and operation of the building. The awareness of retail centre management of local tools is high. The awareness of

international tools locally is not as high compare when compared to the awareness of local tools. Global studies show a high level of awareness for two main rating tools that originated in the United States and United Kingdom respectfully, LEED and BREEAM, but are used worldwide. In the study however these rating tools had medium awareness level.

Legislation in South Africa for Green Buildings is Voluntary. Studies done globally show that more building become green once legislation becomes mandatory, resulting in more savings. The South African government had along with ESKOM attempted the using voluntary policies along with government incentives to promote energy efficiency through the Demand Integrated Management Program. Due to long processes and difficulty in accessing incentives for the public, the program was discontinued.

6.4 Conclusion

The main findings of the study showed:

- Management of Retail Centres in the Kwa-Zulu Natal, Durban Region have high levels of awareness of energy retrofit strategies;
- The gap between awareness and implementation has a large number of barriers or challenges. Once these challenges are overcome, there are significant benefits that are achieved.
- Implementation of energy efficiency strategies is a growing phenomenon, with many retail centres currently implementing strategies, and many implementing strategies in stages.
- Retail centres reasons for the implementation of energy efficiency strategies are widely environmental and business oriented. Social reasoning is a secondary driver for the implementation of energy efficiency strategies.
- Finally, awareness around local strategies and local legislation is high, and few retailers have minimal knowledge around international legislation and rating tools. Larger retailers along with their property developers and higher management further employ consultants to advise on implementation of strategies, thereby eliminating the input from the facility manager and forces the facility manager to follow implementation plans for the retail centre as opposed to creating them.

6.5 Recommendations for future study

It is evident from this study there is a gap between awareness and implementation of energy efficiency strategies in the local retail centres of Kwa-Zulu Natal. The study was set out to determine the awareness and implementation levels of energy efficiency in the local retail community of Kwa-Zulu Natal. The aim of the study was further to promote the implementation of energy efficiency and create awareness of rating tools and legislation locally.

This study is limited to one aspect of green buildings, namely energy efficiency. Implementation of the many green strategies available to local retail centres is a topic that can be further explored in many aspects. The findings of this study do not represent the whole of Kwa-Zulu Natal. However they do represent the wide range of strategies that are being implemented at many levels in different retail centres at different costs and by different levels of management. This variance creates many avenues to be discussed and explored as electricity in South Africa becomes expensive and unreliable as demand grows on a daily basis.

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ANNEXURE A – INFORMED CONSENT FORM

Dear Sir /Madam

My name is Upasna Narain, an MSc Cons Man (by research) student from the Property Development Department at the School of Engineering of the University of Kwa-Zulu Natal. I am developing a study for my MSc entitled “A study into the awareness and implementation of Green Building Initiatives in the refurbishment of commercial buildings in South Africa”.

You are being invited to consider participating in this study that involves research into energy efficiency initiatives being implemented in the existing commercial retail sector. The aim and purpose of this research is to determine whether people are aware and are implementing these initiatives. The study is expected to enroll approximately 80 malls around Kwa-Zulu Natal. It will involve the filling of a questionnaire either telephonically or physically – whichever you prefer. The duration of your participation if you choose to enroll and remain in the study is expected to be 15-20 minutes.

The study does not involve any risks or discomforts. We hope that the study will provide us with a framework of solutions that a retailer manager such as yourself would be able to implement effectively to enjoy energy savings.

There are no risks associated with this study. This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number HSS/1334/015M).

Participation in this research is voluntary and that participants may withdraw participation at any point, and that in the event of refusal/withdrawal of participation the participants will not incur penalty or loss of treatment or other benefit to which they are normally entitled. There are no consequences to the participant for withdrawal from the study and no procedures required from the participants for orderly withdrawal. The researcher will terminate the participant from the study should he present any unethical behavior or provide any information obtained through unethical means.

There are no costs incurred by participants as a result of participation in the study. There are also no incentives or reimbursements for participation in the study.

All documentation is expected to be stored electronically and confidentially in password protected files on an external hard drive for a period of 5 years and will be permanently deleted afterwards. Any paper documentation is to be scanned and kept electronically and the paper recycled.

There are no risks associated with this study. This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number HSS/1334/015M).

In the event of any problems or concerns/questions you may contact the researcher, the supervisor or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

Mrs Upasna Narain

071 212 5960

upasna1603@gmail.com or

Supervisor

Prof Theodore Haupt

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CONSENT FORM

I_____(full name of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

I hereby provide consent to:

Audio-record my interview / focus group discussions	YES	NO
Use of photographs for research purposes	YES	NO

_____

Signature of Participant **Date**

_____ _____

Signature of Witness **Date** (Where applicable)

_____ _____

Signature of Translator **Date**

(Where applicable)

ANNEXURE B – QUESTIONNAIRE

Section 1: General information

Name of Mall (optional):_____Contact Details: _____

1. How many stores are in the retail centre:_____
2. What is the age of the retail centre:_____Years/Months
3. Designation of participant:
   a. Facility Manager
   b. Sustainability Manager
   c. Building engineer
   d. Contractor
   e. Owner
   f. Building Consultants(architect, environmental scientist, specialist trades)
   g. Other_____

Section 2 - Awareness

4. On a scale of 1 – 5 where 1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree; indicate the extent of agreement with the following statements about the **level of awareness** of energy efficient solutions in this retail centre.

	Energy efficient strategies	1	2	3	4	5
4.1	The Facility Management of this mall is aware of energy efficiency.					
4.2	Energy efficiency is a key driver to running an efficient mall.					
4.3	The mall has energy efficiency strategies in place.					
4.4	This mall is actually energy efficient.					

5. On a scale of 1 – 5 where 1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree; indicate the extent of agreement with the following statements about the **level of awareness** of energy efficient strategies to be implemented in retail centres.

	Energy efficiency strategies	1	2	3	4	5
5.1	Energy Efficient HVAC systems, water heating systems, lighting systems.					
5.2	Lighting changed to LED (artificial)					
5.3	Natural lighting and Ventilation					
5.4	Change in glazing					
5.5	Upgrading appliances to green star rated appliances					
5.6	HVAC Preventative Maintenance					

5.7	Sequencing of energy usage through Energy Management Systems					
5.8	Thermal insulation of building					
5.9	Solar water heating					

Section 3 - Implementation

6. On a scale of 1 – 5 where 1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree; indicate the extent of your agreement with the following statements about the **level of implementation** of energy efficient solutions in this retail centre.

	Energy efficiency strategies	1	2	3	4	5
6.1	The Facility Management of this mall implements energy efficiency solutions					
6.2	Energy efficiency solutions have been implemented through regular maintenance					
6.3	Energy efficiency solutions have been purposely implemented through interventions					
6.4	Energy efficiency solutions have never been implemented					

7. When were energy efficiency strategies implemented in this building?

_____ number of years ago

8. On a scale of 1 – 5 where 1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree; indicate the extent of your agreement with the following statements about the following energy efficiency **strategies implemented** at this retail centre.

	Energy efficiency strategies	1	2	3	4	5
8.1	HVAC System					
8.2	Water heating System					
8.3	Building Envelope					
8.4	Artificial Lighting Systems					
8.5	Implementation of Natural Lighting through more windows/doors					
8.6	Refrigeration Systems					
8.7	Glazing / double glazing					
8.8	Building fabric (thermal insulation)					
8.9	Any renewable options installed (e.g. solar power, wind power, solar water heating)					

9. On a scale of 1 – 5 where 1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree; indicate the extent of your agreement with the following statements about the **reasons for the implementation** of energy efficiency strategies.

	Business reasons	1	2	3	4	5
9.1	Refurbishment of building					

9.2	Increasing running costs					
9.3	Tenant demand					
9.4	Owner/management demand					
9.5	Limitations in South African supply of electricity					
9.6	Ethical and environmental responsibilities					
9.7	New regulations					
9.8	Client demand					
9.9	Market demand					
9.10	Lower operating costs					
9.11	Branding and public relations					

9.12	Social responsibility					
9.13	Internal corporate commitment					
9.14	Environmental regulations					
9.15	Market transformation					
9.16	Higher building values					
9.17	Global competiveness					
9.18	Local competition					
	Social Reasons	1	2	3	4	5
9.19	Promotes greater health, environmental quality and well being					
9.20	Encourages Sustainable building practices					
9.21	Increases worker productivity					
9.22	Supports local manufacturers of energy efficient products					
9.23	Promotes the aesthetics of the building					
9.24	No social reasons encouraged for the implementation of energy efficiency					
	Environmental Reasons	1	2	3	4	5
9.25	Reduction in energy consumption					
9.26	Lower greenhouse gas emissions					
9.27	Protecting natural resources					
9.28	Reducing wastage of natural resources					
9.29	Improving indoor environmental quality					

Section 4 – Benefits and Challenges

10. On a scale of 1 – 5 where 1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree; indicate the extent of your agreement with the following statements about the challenges you have faced when implementing energy efficiency strategies.

	Challenges	1	2	3	4	5
10.1	High initial costs					
10.2	Lack of governmental support (e.g. Incentives)					
10.3	Lack of market demand					
10.4	Lack of awareness					
10.5	Lack of trained installers					
10.6	Lack of professional advice on energy efficiency					
10.7	Lack of competent professionals/consultants on energy efficiency					

11. On a scale of 1 – 5 where 1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree; indicate the extent of your agreement with the following statements about the business benefits received through the implementation of energy efficiency strategies.

	Business benefits	1	2	3	4	5
11.1	Lower operation costs					
11.2	Branding/Public relations improved					
11.3	More internal corporate commitment					
11.4	Higher building value / resale value					
11.5	Globally competitive					
11.6	Locally competitive					
11.7	Higher rental income					

11.8	Increased tenant productivity					
11.9	Higher occupancy rates					

12. When did your company retrofit this building?
    _____Number of yearsago

13. What was the approximate initial cost to implement retrofitted options?

    R_____

14. What was the expected payback period for the retrofit intervention?

    _____Number of years

15. What was the expected increase in asset value after the retrofit intervention?

    _____%

16. What was the actual increase in asset value after the retrofit intervention?

    _____%

Section 5 – Rating tools and Regulations

17. Using the scale below, indicate the extent of your knowledge/awareness to the following initiatives.

	International Initiatives	Very poor	Poor	Fair	Good	Very good
17.1	Rating tools for Green Retail buildings					
17.2	LEED (Leadership in Energy and Environmental Design					
17.3	BRREAM (BRE Environmental Assessment Method)					
17.4	GBCA (Green Building Council Australia Green Star)					
17.5	CASBEE (Comprehensive Assessment System for Built Environment Efficiency)					
17.6	HK BEAM (Hong Kong Building Environmental Assessment Method)					
17.7	GBCSA (Green Building Council of South Africa)					
	Local Initiatives	Very poor	Poor	Fair	Good	Very good

	SANS 10400 XA for energy use in buildings					
	National Energy Act 34 of 2008 that explores energy efficiency as the economical and efficient production and utilisation of energy.					
	SANS 50001:2011 that looks at the relationship of input and output energy, as well as the conversion of energy from one form to another.					
	Green Building Council of South Africa voluntary rating tools for offices and retail spaces					
	Eskoms' Integrated Demand Management Program also a voluntary program providing incentives for using less energy and reducing your demand on the electricity grid.					

Question 6 - Optional Questions

18. Have any of your tenants requested that the mall become more aware of energy efficiency?_____
    _____
    _____
    _____
19. Are you aware if any of your tenants have any energy efficiency initiatives in place, if so please describe or name a few
    _____
    _____
    _____
20. Who in the organisation decides about the implementation of any energy efficient initiatives?-
    _____
    _____
    _____
    _____
21. In light of the current energy crisis in South Africa, How does your retail center cope with the loss electricity during the work day?
    _____
    _____
    _____
    _____

Thank you for completing the survey. Your assistance is greatly appreciated!

ANNEXURE C - PROVISIONAL ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

8 February 2016

Mrs Upasna Narain 215081690
School of Agriculture, Earth and Environmental Sciences
Howard College Campus

Dear Mrs Narain

Protocol reference number: HSS/1334/015M
Project title: A study into the awareness and implementation of Green Building initiatives in the refurbishment of retail buildings in South Africa

Provisional Approval – Expedited Application

This letter serves to notify you that your application received 16 September 2015 in connection with the above, has been provisionally approved, subject to the following:

1. Gatekeeper permission letter(s) is required

This approval is granted provisionally and the final approval for this project will be given once the above condition has been met. In case you have further queries/correspondence, please quote the above reference number.

Please note that the research study cannot start until Full Approval has been granted.

Kindly submit your response to the Chair: Dr Shenuka Singh, Research Office as soon as possible

Yours faithfully

.....
Dr Shenuka Singh (Chair)
Humanities & Social Sciences Research Ethics Committee

/pm

Cc Supervisor: Dr V Tramontein
Cc Academic Leader Research: Professor Onisimo Mutanga
Cc School Administrator: Ms Marsha Manjoo

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
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ANNEXURE D – FINAL ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

12 August 2019

Mrs Upasna Narain (215081690)
School of Agriculture, Earth and Environmental Sciences
Howard College Campus

Dear Mrs Narain,

Protocol reference number: HSS/1334/015M
Project title: A study into the awareness and implementation of Green Building initiatives in the refurbishment of retail buildings in South Africa

Full Approval – Expedited / Amendment Application

With regards to your response received on 27 May 2019 to our letter of 08 February 2016 and request for an amendment on 27 May 2019, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Amendment:

- Research Methodology

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

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

The ethical clearance certificate is only valid for a period of 1 year from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Rosemary Sibanda (Chair)

/ms

Cc Supervisor: Dr V Tramontin
Cc Academic Leader Research: Professor Trevor Hill
Cc School Administrator: Ms Marsha Manjoo

Humanities & Social Sciences Research Ethics Committee
Dr Rosemary Sibanda (Chair)
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