Challenges to the Adoption of Strategies and Regulations for Energy Efficiency Initiatives in the Retrofitting of Retail Centers

Theo Haupt, pinnacle.haupt@gmail.com
Mangosuthu University of Technology, South Africa

Mariam Akinlolu, akinlolumariam@gmail.com
Mangosuthu University of Technology, South Africa

Narain Upasna, upasna1603@gmail.com
Mangosuthu University of Technology, South Africa

Abstract
This study investigates the challenges experienced in the implementation of energy efficiency retrofit initiatives in retail centres in South Africa. The participants of the study were management of 20 retail centres in and around the KwaZulu-Natal province. A close- ended questionnaire was used to determine to examine the challenges associated with implementation. The stratified random sampling was used to determine the sample of the population to be used. Data was analysed using descriptive statistics comprising of frequency distributions providing the mean, median, standard deviations as well as maximum and minimum values for nominal data. The findings of the study indicated that the issues 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. 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.

Keywords
Energy Efficiency, Retrofit Strategies, Green Buildings, Retail Centres

1 Introduction

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 and Hedden, 2015; Lecca, 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 (Lecca, 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, 2011). 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, 2011). Rolling blackouts are scheduled downtime of electricity for either a scheduled or unscheduled period 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. 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 several initiatives, legislation, and voluntary mechanisms such as green building rating systems for new buildings. Due to these initiatives, several 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%. However, in 2013 the strategy was abandoned due to the targets being no longer achievable (du Can et al, 2014).
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 (Okorafor, 2019). 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 (Zhivov, 2015). The primary value this adds to a building is the reduction of operating costs as well as their adverse environmental impact. 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 (Mason et al., 2019). 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 possible challenges to the implementation of retrofit energy efficient strategies for existing commercial retail buildings in South Africa.

2 Literature Review

2.1 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). 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 and Pero, 2012).

In South Africa, several commercial retail retrofits can be found. Firstly, the Victoria Wharf at Cape Town's V&A Waterfront. The shopping complex is approximately 47 000m2 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).

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).

2.2 Barriers and Challenges to Retrofitting

Barriers faced in the implementation of green building initiatives have been found to range from high initial costs, lack of trained professionals, lack of demand, lack of political support, lack of awareness as well as affordability (Golove and Eto, 1996; Smart Market Report, 2018).

European Retail Forum (2009) highlighted barriers to the adoption of retrofitting as the lack of sufficient incentives or rewards for the implementation of energy efficiency. There also seem to be some conflicts surrounding the payment of the incentive. An excessive amount of administration for constructional changes, making procedures long, tiresome and time consuming was shown to discourage implementation. Nicol (2007) identified a barrier known as the Property Sector Barrier in South Africa. Each sector has its own set of barriers with regards to the implementation of initiatives. The commercial sector is no different. 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, also involves facility managers and property managers which add to the complication. This makes implementation more costly and challenging (Nicol, 2007).

Granade et al. (2010) categorized challenges of implementation into 3 subcategories 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 (Dangana et al.,2012). 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 (Kasai and Jabbour, 2014). 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 (ClimateWorks Australia, 2011; Kasai and Jabbour, 2014). 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.

3 Research Methodology

The quantitative research method was adopted for this study. 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 centres in South Africa with approximately 180 retail centres in KwaZulu-Natal of South Africa Within these 180 retail centres the population size of the sample of 96 retail centres falls within a 100km radius of the CBD of Durban area.

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 and Liu, 1997).

A Five-point Likert scale was used to rank the perceptions of respondents on the challenges that they experienced in the implementation of energy retrofit options in the commercial retail sector. To ensure the reliability of this study, the Cronbach's coefficient alpha was used to test the consistency of the obtained. All constructs had reliability coefficients greater than 0.80 indicating good internal consistency. Descriptive statistics were used to analyse the data obtained. Factor analysis was calculated along with the mean and standard deviation for each construct containing scale data.

4 Findings and Discussion

4.1 Profile of Respondents

The designation of the respondents is shown in Table 1. It is evident that 80% of the participants were Facility Managers. 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.

Table 1. Demographic Statistics

Designation	**No**	**%**
Facility Manager	16	80
Property Manager	3	15
Centre Manager	1	5

From Table 2 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 2. 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	1	60

4.2 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 3.

Table 3. Implementation of energy efficiency strategies

Energy Efficient Strategy	**Mean**	**SD**	**Rank**
Artificial Lighting System	4.00	1.03	1
HVAC System	4.00	1.30	2
The facility management of this mall implements energy efficiently solutions	3.90	1.29	3
Energy efficiency solutions have been purposely implemented throughout maintenance	3.85	1.27	4
Implementation of Natural Lighting through more windows/doors	3.85	1.42	5
Energy efficiency solutions have been purposely implemented through interventions	3.60	1.39	6
Refrigeration System	3.35	1.27	7
Building fabric (thermal insulation)	3.35	1.27	8
Building Envelope	3.30	1.13	9
Glazing/double glazing	3.25	1.29	10
Water heating System	2.55	1.23	11

The findings in Table 4 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 several 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.

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.

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.

4.3 Challenges Faced in 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 4.

Table 4. 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 4 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 public in the demand for the implementation of green and energy efficiency strategies. These challenges were found in this study to be true.

5 Conclusions and Further Research

The study found that implementation of energy efficiency strategies is a growing phenomenon, with many retail centres currently implementing strategies, and many implementing strategies in stages. 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.

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 entire Kwa-Zulu Natal province. 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 daily.

References

Aste N, Pero CD, 2012, Energy retrofit of commercial buildings: Case study and applied methodology*, Energy Efficiency*, 6 (2),407 – 423.

Bullock, D. (2011) Impacts of Increasing Natural Gas Fueled Combined Heat and Power from 20 to 35 Percent of Total Electricity Production in Texas. Houston Advanced Research Center.

Christina, S., Waterson, P., Dainty, A., & Daniels, K. (2015) A socio-technical approach to improving retail energy efficiency behaviours, *Applied Ergonomics*, 47, 324-335.

Dangana Z, Pan W, Goodhew S. 2012. Delivering Sustainable Buildings in Retail Construction In: Smith S.D (Ed) *Procs 28th Annual ARCOM Conference*, 3 – 5 September 2012, Edinburgh, UK, , 1455-1465

Du Can, S. D. L. R., Leventis, G., Phadke, A. and Gopal, A. 2014. Design of incentive programs for accelerating penetration of energy-efficient appliances, *Energy Policy*, 72, 56-66.

Du Plessis, W. 2015. Energy efficiency and the law: A multidisciplinary approach, *South African Journal of Science*, 111(1-2), 01-08.

Fellows, R. F., and Liu, A. M. 2015. Research methods for construction. John Wiley & Sons.

Golove, W. H., and Eto, J. H. 1996. Market barriers to energy efficiency: a critical reappraisal of the rationale for public policies to promote energy efficiency.

Granade HC, Creyte J, Farese P, Ostrowski K, 2010. Energy efficiency: Unlocking the US opportunity, Energy Efficiency: A compelling Global Resource, Mckinsey and Company.

Hedden, S., and Hedden, S. 2015. Gridlocked: A long-term look at South Africa's electricity sector, *Institute for Security Studies Papers*, 15, 24.

Kasai N, Jabbour CJC. 2014. Barriers to green buildings at two Brazilian Schools, *International Journal of Sustainable Built Environment*, 87-93

Langner, R., Deru, M., Hirsch, A., and Williams, S. 2013. High-efficiency retrofit lessons for retail from a SuperTarget (No. NREL/CP-5500-56325). National Renewable Energy Lab. (NREL), Golden, CO (United States).

Lecca, P., McGregor, P. G., Swales, J. K., and Turner, K. 2014. The added value from a general equilibrium analysis of increased efficiency in household energy use, *Ecological economics*, 100, 51-62.

Lux Magazine Europe, 2014. How a massive low-energy retrofit is helping South Africa keep its lights on.

Reynolds, C., Goucher, L., Quested, T., Bromley, S., Gillick, S., Wells, V. K., and Jackson, P. 2019. Consumption-stage food waste reduction interventions–What works and how to design better interventions, *Food policy*, 83, 7-27.

Mason, R. B., Dobbelstein, T., and Corbishley, K. M. 2019. A comparative investigation into the changing use of shopping malls in Germany and South Africa, *Journal of business and retail management research* (Online).

Nicol. D. 2007. Facilitating energy efficiency in the commercial sector, *South African Journal of Green Building*.

Earthworks Magazine. 2012. Retrofitting shopping malls. Available at: http://earthworksmagazine.co.za/features/finding-savings-in-shopping-malls/ accessed 12 September 2021.

Okorafor, C. 2019. Retrofitting to Reduce Carbon Emissions from Existing Buildings in Bloemfontein, South Africa, Unpublished PhD. Thesis, Bloemfontein: Central University of Technology, Free State.

Pérez-Lombard, L., Ortiz, J., González, R., and Maestre, I. R. 2009. A review of benchmarking, rating and labelling concepts within the framework of building energy certification schemes, *Energy and Buildings*, 41(3), 272-278.

Zhivov, A., Lohse, R., Shonder, J. A., Nasseri, C., Staller, H., Moerck, O., and Nokkala, M. 2015. Business and technical concepts for deep energy retrofit of public buildings. ASHRAE.