DETERMINATION OF THE EFFECT OF GREEN STAR CERTIFICATION ON OFFICE RENTAL IN SANDTON, SOUTH AFRICA

A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Building (Property Development and Management).

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Johannesburg, 2019

DECLARATION

I declare that this research report is my own unaided work. It is being submitted for the Degree of Master of Science in Building, to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

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ABSTRACT

The purpose of the study was to examine the financial benefits of green buildings, particularly the existence of the rental premium in the office market of Sandton, South Africa. The study aimed to investigate whether Green Star SA certified offices in Sandton commanded a higher rental than similar offices in the same environment that are not Green Star SA certified. Green Star SA is the green building rating system adopted by GBCSA in South Africa to certify the buildings that conforms to the global green building standards set by the WGBC.

A perception exists in the built environment that investment in green building is not growing at an acceptable pace to the perceptions by investors that such investments may not render anticipated financial benefits. There is no doubt that investors would not invest in properties provided the particular investment has a feasibility of rendering financial returns particularly, the rent premium.

In order to determine whether obtaining green building certification renders financial benefits in terms of rental premium, the study compared the asking rentals of offices graded P-Grade, AAA-Grade, A-Grade and B-Grade for both Green Star SA certified office space and office space that is not Green Star SA certified. The study further examines if there is a differentiation in premiums within the different levels of 3 Star Green Star SA certification namely, 3 Star Green Star SA; 4 Star Green Star SA; 5 Star Green Star SA and 6 Star Green Star SA.

This empirical research was conducted in two folds by conducting a systematic literature review focusing on relevant past empirical studies on different aspects for the implementation green building practices. Literature reviewed comprised of academic journal papers, Real Estate industry reports, publications like eProp online publication and working papers. The study also analysed the records of relevant stakeholders in the Real Estate industry including websites of different commercial Property Brokers for asking rentals and GBCSA website for Green Star SA certification information.

The results rendered by the research indicated that rental achieved by Green Star SA certified offices were indeed higher than the rental of offices which was not Green Star SA certified, therefore the research hypothesis was supported. The results indicated the overall average premium of 20.73% across all levels of Green Star SA whereas when observed according to different levels there was a significant increase in premium which was evident for 3 Star Green Star SA 3 and 4 Star Green Star SA.

For data analysis, the study used descriptive statistics to analyse the quantitative related variables like asking rentals. The research also used hedonic regression to control other attributes like location, office grading and size in office buildings that may influence the rental price.

Key Words: Green buildings, Rating systems, Green Star SA, Sustainable development, Climate change, Premium rental, Green House Gases, Green Building Councils, Asking rentals

ACKNOWLEDGEMENT

I would like to thank God, the Almighty for being with from the beginning to the completion of this research project.

I acknowledge and appreciate the assistance of my supervisor, Dr. Bekithemba Mpofu, who dedicated his time and efforts by going an extra mile in order to see me through this research project. I am also thankful to Keke Khojane from New Vantage Properties who dedicated her time and made an effort to assist during the research process. My gratitude extends to Dr. Tumellano Sebehello, Mr Abram Phenya, Mr Veli Ndlovu and Ms. Refiloe Matatiele for their assistance in the completion of this research program.

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AQUA: Aqua Qualidade Ambiental

BEAM: Building Environmental Assessment Method

BOMA: Building Owners and Managers Association of Canada

BRE: Building Research Establishment

BREEAM: Building Research Establishment Environmental Assessment Method

CaGBC: Canada Green Building Council

CASBEE: Comprehensive Assessment System for Building Environmental Efficiency

CGBN: China Green Building Network

COP21: 21st Conference of the Parties

DGNB: Deutsche Gesellschaft fur Nachhaltiges Bauen

DK-GBC: Green Building Council of Denmark

EPA: Environmental Protection Agency

ES: Energy Star

F-GBC: France Green Building Council

GBCA: Green Building Council Australia

GBCSA:	Green Building Council of South Africa
GBC:	Green Building Council
GBEL:	Green Building Evaluation Label
GHG:	Green House Gases
GBI:	Green Building Index
GRIHA:	Green Rating for Integrated Habitat Assessments
HK-BEAM:	Hong Kong Building Environmental Assessment Method
HQE:	Haute Qualite´ Environnementale **(**High Environmental Quality)
LEED:	Leadership in Energy and Environmental Design
JLL:	Jones Lang LaSalle
NABERS:	National Australian Built Environment Rating System
PRSE:	Pearl Rating System for Estidama
POPI Act:	Protection of Personal Information Act
RICS:	Royal Institute of Chartered Surveyors
SA:	South Africa
SANS:	South African National Standards
SAPOA:	South African Property Owners Association
SCMD:	Sandton Central Management District
SDGs:	Sustainable Development Goals
UK:	United Kingdom
US:	United States of America

USGBC: United States Green Building Council

UN: United Nations

WGBC: World Green Building Council

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CHAPTER 1 INTRODUCTION AND BACKGROUND

1.1 Introduction

For over decades, scientists have been giving warnings regarding the greenhouse gases that cause climate change as well as its effects that result in global warming which is having severe consequences to both society and the environment. Daily human activities are responsible for almost all of the increase in greenhouse gases in the atmosphere dating back to the last one hundred and fifty years (US Green Building Council 2015). Humans rely on the natural environment for resources (air, water, food, and land) and their consumption patterns put a strain on the natural resources (Green Building Council SA 2012).

The growth and development of our communities due to industrialization and economic development activities has a large impact on the natural environment, that is, they release harmful chemical and physical agents causing global climate change, which causes natural disasters. The manufacturing, design, construction and operation of the buildings in which we live and work are responsible for the consumption of many of our natural resource (Smit and Du Toit 2015).

The effects of the environment affect all nations in different ways and they manifest in the form of natural disasters including global warming, ozone depletion, essential natural resource depletion, energy scarcity, several ecological and human toxicities as well as acid rains. The consequences of these disasters compel the change of behavior of the nations in the way they use the resources (Fuerst and van der Wetering 2015).

Global warming resulting from climate change has been in the agenda of several organizations including the United Nations as one of the major challenges affecting the environment as well as humans negatively worldwide (United Nations 2016).

In order to mitigate the impacts of global warming, the world leaders guided by the UN adopted a concept of sustainable development whose main aim is to balance the economic, environmental and social needs for all nations.

The UN Commission defined sustainable development as 'the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (United Nations 2016). The need for sustainability is becoming a reality and since the environmental degradation affects all countries irrespective of whether they are rich or poor.

The effects are becoming evident in the different parts of the world in a form of the ongoing natural disasters currently manifesting like the ongoing hurricanes in the US, the drought situations in Africa, the earth tremors (Tsunamis) and the volcanoes that recently erupted in the Asian countries.

We also witnessed some effects on our doorstep like the extreme drought situations that has been taking place in different parts of South Africa, which resulted in water inadequacy. Areas like the Northern KwaZulu Natal, Mpumalanga, North West and Northern Cape were severely affected by the droughts, which continued for some few years resulting in the loss of crops and livestock in the agricultural sector. According to Agri-SA such a damage resulted in the loss of jobs in the sector estimated at thirty thousand and that put a strain in the struggling SA economy.

Such effects took a toll in the Western Cape as a result of water restrictions of fifty liters per household per day were to be imposed by the authorities who warned the communities about the risky possibility of day zero. Without a doubt, it has become essential for all human beings to heed the call to sustainable development.

In the drive to implement the concept of sustainable development, the UN adopted seventeen Sustainable Development Goals (SDGs) whose aims is to mobilize efforts of all countries to end all form of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind. It is essential for all countries to be involved in the

drive for sustainable develop especially the developed countries should drive the movement and ensure the proper implementation of the Paris agreement (United Nations 2016).

According to the World Green Building Council (2013) these goals are unique in that they call for action by all countries, poor, rich and middle-income to promote prosperity while protecting the planet. They recognize that ending poverty must go hand-in-hand with strategies that build economic growth and addresses a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection (United Nations 2016).

By assisting the developing countries, the developed countries would benefit by minimizing the problems they are currently facing from the influx of illegal immigrants into their countries. Building structures also directly and indirectly have an impact on the environment during their life cycle that is, construction, and operations during occupancy, renovation, and eventually demolition.

Buildings use energy, water, raw materials; they generate waste, and emit potentially harmful carbon emissions, therefore it is essential that the built environment participate in the fight against global warming (see table 1 below).

According to the World Green Building Council (2013), energy use in buildings and for guiding construction represents more than one third of global final energy and contributes to nearly one quarter of greenhouse gases (GHG) emissions worldwide, therefore, there is a need for nations to take drastic action to minimize the negative impacts of buildings on the environment. The need to emphasize the urgency of sustainable development provokes the adoption of green buildings; therefore, the relevant stakeholders have an obligation to take action in this regard (World Green Building Council 2017).

Table 1: Impacts of the built environment Source, US Green Building Council (2015)

Aspects of Built Environment	Consumption	Environmental Effects	Ultimate Effects
• Siting • Design • Construction • Operation • Maintenance • Renovation • Deconstruction	• Energy • Water • Materials • Natural Resources	• Waste • Air pollution • Water pollution • Indoor pollution • Heat islands • Storm water runoff • Noise	• Harm to Human Health • Environment Degradation • Loss of Resources

Green building is one of the measures taken by the built environment to minimize the negative impact of buildings on the environment (Chegut et al. 2014; Devin & Kok 2015; Yudelson & Meyer 2013 and Zou & Zhao 2014)**.** Building green will be a positive response of the built environment to the call made by the UN to all the leaders of the world to embark on sustainable development. In simple terms, green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life cycle from siting to design, construction, operation, maintenance, renovation and deconstruction (Green Building Council SA 2012).

According to the Green Building Council of South Africa, the objective of green building is to develop buildings, which are energy and resource efficient and environmentally responsible (GBCSA, ASAQS & UP 2016). Such buildings use design, construction and operational practices that reduces the negative impact of construction on people and the environment. For buildings to be considered as green buildings, they must be constructed using the proper materials, insulation, and equipment in an effort to ensure they are energy and water efficient (Green Building Council SA 2012).

Conventional buildings are the opposite of green buildings as they use energy inefficiently, generate large amounts of waste in their construction and operation, and emit large quantities of pollutants and greenhouse gases (US Green Building Council 2015). Conventional buildings are also called brown buildings and such buildings have a high risk of diminishing rentals through brown rent discounts.

Adoption of green buildings is the practical solution that will address the problems of environmental damage as well as ensure the sustainability of essential resources required by humankind for survival (Aliagha et al. 2013).

Not only the environment benefits from green buildings since they are designed for economic and environmental performance over time, with an appreciation for unique local climate and cultural needs, ultimately providing for the health, safety, and productivity of building occupants (O'Mara & Bates 2012). Unhealthy buildings may affect the occupiers negatively and the consequences may be serious for instance a discovery was made which indicated that asbestos roof were the main cause of asthma hence the South African government once passed the legislation for their mitigation of the problem (Carter et al. 2005).

Green building movement is driven globally by the World Green Building Council, which comprises of different councils from all over the world with the aim of transforming the property market globally through green building rating systems. These councils are responsible for creating and managing credible and robust rating tools internationally (World Green Building Council 2013). Such organizations are known as Green Building Councils (GBC's), and they are obliged to be members of the WGBC.

The rating systems used by Green Building Councils to certify qualifying buildings are tools developed in many countries with the purpose of setting standards and benchmarks for what constitutes a 'best practice' in terms of green building initiatives (Green Building Council SA 2012). They enable property owners and property developers to compare one building with another in terms of green building initiatives.

Analysis of the literature on the subject indicated that the most established rating tools include the Australian Green Star system, the American LEED system, the UK BREEAM system, German DNGB and HQE. The South African Green Star SA rating system the only rating system in the African continent (GBCSA; ASAQS;UP, 2016). For the building to be classified as green in South Africa it must have been accredited a green star as such by GBCSA and such accreditation is on a voluntary basis.

The Green Building Council South Africa is the official Green Star SA accreditation body. It is the member of the World Green Building Council and it was formed in 2007 by leaders from all sectors of the commercial property industry to lead the transformation of the South African property industry in the implementation of green buildings (Green Building Council South Africa, 2016).

Research studies have been conducted on different aspects of green buildings worldwide but mainly in the fully developed countries like the US, the UK, Australia, and Canada since the green building market is deemed mature in these countries and data is easily available.

According to Hu et al. (2014), the lack of research studies related to the costs and benefits of green buildings in the developing countries undermines the ability to determine the value of investing in green buildings. Due to the slow take up of green buildings, very few research studies were also conducted in developing countries like China, India and Malaysia and only recently that a study was conducted in South Africa (Vyas and Jha 2018). Most research studies focused on the benefits green building to the environment, costs of creating green buildings as well as the different rating systems.

Several research studies were conducted in the developed countries like the US, UK, Netherlands and Australia on the subject of the effect of certification on the property rent and most of the results rendered by such studies have confirmed the existence of the premium on the certified buildings as compared to the conventional buildings. It appears that the costs of producing the green buildings was the main concern to the stakeholders

and this notion resulted in the number of research studies conducted in the subject worldwide.

In most of the previous research, there is an indication that implementation of green buildings has not been growing as anticipated and several researchers including Chegut, et al. (2014); Smit & Du Toit (2015); Vyas and Jha (2018); and Abraham and Gundimeda (2017) have indicated that the built environment stakeholders were skeptical to adopt green buildings due to a number of identified challenges.

The common challenges identified by these researchers were grouped by as Policy and Market Barriers, Financial and Economic Barriers, Information, Promotion and Education Barriers and Managerial and Organizational Barriers. Several research studies were conducted by researchers who examined the difference in the costs of producing green buildings as compared to conventional buildings and such studies rendered different outcomes.

The studies rendered conflicting results as others indicated that the initial costs were as high as 20% whereas others indicated the cost to be much lower than anticipated and estimated at between 5% and 10%. A similar study on cost was conducted recently in South Africa by GBCSA in collaboration with the ASAQS and University of Pretoria The outcome of the study reported the estimated initial costs of green building to be between 5% and 8% (GBCSA et al. 2016).

This finding is in line with the US study by USGBC which estimated the costs to be between 5% and 10%. One would anticipate the initial cost of green building to become lower with time due to the innovative technologies and new improved products that are gradually coming into the construction field.

Minimum research has been done on the subject of green buildings particularly on the effect of green certification on the rental in the developing countries even though a number of them has adopted the green buildings concept. Literature review revealed a handful of studies that were conducted in the developing countries like China, Malaysia,

India and South Africa. Those studies concentrated on the construction side of green buildings were done with the emphasis put on the costs of producing green buildings.

A number of studies that were conducted mainly in the developed countries including the US; the UK and other European countries; Canada and Australia have indicated that green buildings do render financial benefits. For instance, such studies suggested the certified buildings continued to perform better than the conventional buildings in terms of rental and sales premium even during the economic recession period (Fuerst and van de Wetering 2015).

Green buildings in South Africa is still a new concept and is practiced on a voluntary basis. The adoption of the concept is taking place at a steady pace and few studies conducted which focused on costs of producing green buildings and they include Smit & Du Toit, (2015) and GBCSA et al. (2016).

No study in the South African perspective has been conducted on the effect of green certification to the rental. This study is conducted in order demonstrate the true effect of certification in the context of South Africa

Such research studies have rendered different results and this indicates the important role played by the location variable in property market. The market differs and different countries will react differently to the green building issue therefore it is essential that the similar research is conducted in South Africa to get the true results that reflect the intended market.

The aim of this empirical research is to determine the effects of Green Star SA certification on the market rental of offices in Sandton and surroundings.

Green Star SA is a South African rating tool used by the GBCSA to certify buildings that conform to “Green Buildings” standards and benchmarks that are approved by the World Green Building Council. Green Star SA certified buildings are currently located predominantly in Gauteng, the Western Cape and Kwazulu-Natal as indicated by Green Building Council SA (2018).

The study aims to determine if Green Star SA certified offices command higher rental than conventional offices (offices not Green Star SA certified) in the study area. The purpose of the study is to examine the financial benefits of green buildings particularly by determining the existence of the rental premium deemed to be rendered by green star certified in the offices in Sandton, South Africa.

1.2 Problem statement

Despite the global awareness of the importance of minimizing the effects of buildings on the environment, adoption of green buildings is perceived to be slowing down due to perception of higher construction costs associated with the construction of green buildings as compared to conventional buildings (Falkenbach et al. 2010).

The lack of evidence relating to financial benefits rendered by green buildings is also perceived to contribute to the slowing down on the adoption of green buildings (Chegut et al. 2014; and Smit & Du Toit 2015). This slow or diminishing interest in green buildings jeopardizes the efforts made by both the UN and the WGBC worldwide in their quest of addressing the negative impacts of buildings to both the environment and the world communities (Abraham and Gundimeda 2017).

The purpose of the study is to examine the financial benefits rendered by green certification, particularly the existence of the rental premium in the office market of Sandton South Africa. The results have a potential to provide guidance and motivation to the built environment stakeholders, therefore encouraging the consideration of green star accreditation in the new developments as well as in refurbishing projects.

1.3 Research questions

The purpose of the study was to examine the financial benefits of green building particularly the existence of the rental premium in the office market of Sandton, South Africa. The study aims to answer the following questions:

- How does the market describe Green Buildings and what is their global status?

- How does the market define green buildings global standards and benchmarks and how is implementation of the concept the globe?
- To what extent does the costs and benefits associated with green buildings affect the adoption and how do they influence the supply and demand?
- What is the status of green buildings in the study area?
- To what extent do green buildings in the study area command a premium in market rentals?

1.4 Hypothesis

The researcher is making an assumption that there is a relationship between the independent variable namely, the Green Star SA certification and the dependent variable namely, the market rental of office buildings.

Similar studies conducted in different parts of the world, mainly the developed countries confirmed the impact of different green certification on the office rental. The US studies were dominant and they include Eichholtz et al. (2010); Fuerst and McAllister (2011); Fuerst and van de Wetering (2015); Miller, Spivey, and Florance (2008); Pivo and Fisher (2010); Reichardt, et al. (2012); Robinson and Sanderford (2016); and Wiley et al. (2010) and they found the rental premium ranging between 3% and 19%.

A handful of studies were also conducted in the UK and Australia which indicated the rental premium of between 6% and 26% (Newell, MacFarlane, and Walker 2014; Chegut, Eichholtz, and Kok 2011; Kok and Jennen 2012; and Gabe and Rehm 2014).

With an assumption that the South African green building market has a potential of rendering financial benefits, the researcher aimed to test if those assumptions are applicable to the South African office market.

The researcher suggested that the independent variable (Green Star SA) has an influence on the dependent variable (market rental) and this research attempted to find out if the assumption is true or not (Bell 2014).

H_0: Green star rated office buildings do not command rental that is higher than non-green star rated offices

H_1: Green Star SA rated office buildings command rental, which is higher than non-green star rated offices

1.5 Research aims and objectives

1.5.1 Research aim

This research study aimed to determine if the Green Star SA certified office space commands a premium in market rental as compared to office space that is not Green Star SA certified.

1.5.2 Research Objectives

The research identified five objectives that the researcher aimed to address in order to answer the research questions, which include the following:

- Define Green Buildings in general and determine its current status.
- Analyze the rating certification worldwide and particularly in South Africa.
- Determine the costs and benefits that are associated with the adoption of green buildings and their influence in the office buildings.
- Determine the status of green buildings within the study area and identify the certified buildings.
- Gather and analyze asking market rentals for all offices in the study area in order to determine the extent by which green star certified offices command a rental premium.

The researcher aimed to address such objectives in two folds, that is, by conducting a systematic literature review as well as by analysing secondary data extracted from the records of the Real Estate industry stakeholders.

Literature review focused focus on relevant past empirical studies on different aspects for implementing green building practices will comprise of academic journal papers, Real Estate industry reports, publications and working papers.

Records of Real Estate stakeholders includes asking rentals for office grade A, AAA and P were obtained from the websites of different commercial Property Brokers who are active in the study as well as Green Star SA certification information sourced from the website of the GBCSA.

First, second and third objectives were addressed through literature review whereas the fourth and fifth objectives were addressed through empirical research by the analysis of data from the relevant Real Estate industry stakeholders.

1.6 Importance of the Research

South Africa is also being experiencing the slow pace of implementation of green building as mentioned in the problem statement. One can attest the notion of slow take up of green buildings in South Africa to the number of new construction projects that have taken place during the period 2015 and 2017 without considering GBCSA Green Star SA certification as stated by Smit & Du Toit, (2015).

As mentioned by Falkenbach et al. (2010) and Hu et al. (2014) the diminishing interest in green building is jeopardizing the global efforts of addressing the negative impacts of buildings to the environment.

The negative impacts on the environment have serious consequences to the human beings and, currently some of these consequences are now visible for instance different parts of the world are experiencing repetitive tornado storms and there are also extreme drought situations that results in the loss of livestock therefore affecting the food supply.

Empirical evidence of financial benefits is likely to motivate stakeholders to consider green star certification in the new developments as well as in refurbishing projects

(Eichholtz, Kok, and Quigley, 2013). The study will assist in the achievement of some of the seventeen goals set by the UN in minimizing the negative environmental impacts.

1.7 Scope of research

The purpose of the study was to determine the extent by which the Green Star rating affects the market rental of office buildings in Sandton. The researcher chose Sandton as a study due to the following factors:

- Sandton is a major economic hub in South Africa, labeled “Africa’s richest square mile” (Jones Lang LaSalle 2016). The area has established itself into a premium business area. The built environment comprises of the mixture of commercial properties and prestige residential components. The commercial component comprises of offices, retail and a number of world-class hotel accommodation.
- Major Corporates are operating in Sandton and surroundings (Broll 2016).
- A variety of businesses and institutions also operating in Sandton and surroundings (Jones Lang LaSalle 2016) and (Broll 2016)
- The environment comprises of the majority of property owners including institutions, government, well known organizations and private owners. Private owners include Growthpoint, which is South Africa’s largest property company.
- Sandton is home to about five major banking institutions, and there is a number of institutions including SAPOA.
- Sandton is centrally located with proximity to two major highways namely, the N1 and the M1 therefore it is easily accessible by road. The presence of the Gautrain within walking distance from a number of offices contributes to the success of the node.
- Majority of green office buildings are situated in Sandton (GBCSA et al. 2016). Sandton has the highest number of green building projects mainly offices therefore; the researcher will have access to adequate number of both variables.
- Several major developments are taking place in Sandton contributing to the rejuvenation of the environment (Broll 2016; and SAPOA 2017).

- According to Broll (2016), construction in Sandton seems to be one of the top businesses as new developments and refurbishments projects that are currently under construction are likely to add more than 100 000m² of floor space.

In this research study, building attributes that constitute Green buildings globally and South Africa were analyzed and, focus was put on offices situated in the office node known as Sandton and surroundings.

The sample comprise of tenant occupied buildings situated in an area bordered by Grayston, Katherine and Rivonia Roads. Included in the sample is the Wierda Valley precinct, which forms part Sandton Management District as well as offices in the border of Benmore. (See figure 1, Sandton Central: Map of the research area).

The criteria of awarding green building features from GBCSA was used to identify the research sample. The researcher put focus on buildings that were certified with a Green Star SA certification levels 3,4,5, and 6. Asking rentals in the study area, which comprise of **"**rental amount at which the Landlord is offering the property to the market for leasing" were gathered and analyzed for determining the existence of rental premium in Green Star SA certified offices as compared to conventional offices (non-Green Star SA certified).

The study used asking rental data for the vacant office space listed by Commercial Brokers operating in the study area, property owners and property developers. Data collected include office space that was listed between 1 January 2016 and July 2017.

According to Hennigar and Perry (2016), asking rental rates refer to the cost of occupancy for a particular space that is available for lease that is being asked for by the owner of the building, quoted on a per square meter basis. Asking rental rates may slightly differ from the actual (achieved) rates paid by tenants following the negotiation of all terms and conditions in a specific lease. Asking rental rates do not include service charges or building rates. In the office market in South Africa, rentals are determined based on the

office grade of the building and such information is readily available from the brokers who are marketing the buildings.

Property researchers like South African Property Owners Association; Broll, Jones Lang LaSalle and Rode and Associates gather asking rentals from many property owners and compile a database that is usually used as guidance by stakeholders in the property market. The asking rentals uses parameters of the minimum and maximum rental anticipated and the difference between the minimum rental and the maximum rental is normally minimal therefore, the actual rental will definitely fall between the two amounts.

1.8 Limitations

- The study focuses on the office buildings situated in Sandton CBD and surroundings, therefore the pool of information may be limited.
- The study used asking rentals since the actual contract rents was not accessible due to property owner and tenant confidentiality.
- Due to POPI Act, stakeholders may not divulge confidential information about the finances of rented properties
- Some recently constructed buildings may possess green buildings features but may not be Green Star SA certified therefore, such buildings will be regarded as not green even though they perform at the similar level with the Green Star SA certified buildings.
- The study sample comprise of only multi-tenanted office

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The concept of green building is gaining a remarkable traction across the globe resulting into the emergence of several international scholars conducting research in different aspects of the field worldwide.

In order to address the research problem and answer the research questions, the researcher has analyzed different peer reviewed international journals articles that published several articles addressing different aspects of the subject matter.

The built environment in the developed countries like the US, Australia and UK were found to be relatively advanced in the adoption of green buildings. The markets in those countries are growing steadily therefore, a bulk of the research studies on green buildings put more focus on those countries (Dodge Data and Analytics 2016).

Several research studies conducted in the past decade continued to render different results in terms of both costs related to green buildings as well as financial benefits rendered by green buildings (Blumberg 2012). Literature search revealed very few scholarly research studies conducted in the developing countries and, one can attest to the notion by the WGBC that the developing countries have recently joined the green building movement and they are still lagging behind in the adoption of green buildings, hence their green building market is currently at infant stages (World Green Building Council 2013).

Recent developments in literature have witnessed some few scholarly articles in the field of green buildings from developing countries like India; China; Malaysia Nigeria and South Africa. Literature discussed in this study is focusing on the detailed definition of green buildings including their features; overview of global green building certification; overview of different benefits of green buildings; costs associated with green buildings as well as drivers of green buildings.

The purpose of this study is to determine the effects of green star certification on the office rental therefore the study analyzed in detail similar studies that took place in both the developed and developing countries.

Out of the five objectives mentioned earlier in this report, only three were addressed through literature study and the other two will be addressed through the research process where data will be gathered and analyzed accordingly. The three objectives addressed through literature review are the following:

- Define Green Buildings in general and determine its status
- Analyze the rating certification worldwide and particularly in South Africa
- Determine the costs and benefits associated with the adoption of green buildings and their influence the office buildings

Similar studies addressing the different concepts mentioned in the objectives will be analyzed in detail in order to determine the extent by which their findings can be implemented in the South African green building market.

2.2 Definition of green buildings

As mentioned by the GBCSA, the building structures directly and indirectly have an impact on the environment during their life cycle that is, construction, operations during occupancy, renovation, and eventually demolition, therefore the built environment is required to take part in the movement to achieve the goals of sustainable development.

According to the WGBC (2013), the built environment stakeholders are aware that buildings are major contributors to climate change. In order to mitigate the problem, the built environment introduced the concept of green buildings, which is perceived, as one of the most cost-effective solutions to climate change and at the same time is believed to be able to lead to significant environmental, economic and social benefits to all people around the world. Building green does not only benefit the environment but it also renders financial rewards like higher rentals, which this empirical research is aiming to demonstrate (Cheguit et al.2014). According to Czerwinska (2017) green buildings

significantly contributes to nine of the seventeen sustainable development goals that is goal 3, 7, 8, 9, 11, 12, 13, 15 and 17 established by the UN Commission in 2016.

Several terms are used to describe green buildings globally and they include high performance buildings, sustainable buildings, sustainable construction, high performance construction, or green construction and energy efficient buildings but according to (USGBC, 2015), they all refer to the same concept. The researcher analyzed several green building definitions provided in different research studies conducted by EPA, RICS, GBCSA, and WGB. The researcher then summarized the different definitions focusing on the common items that green building aim to address and formulated a collective definition that was adopted for the purpose of this study.

Most of the definitions indicated that, green buildings' main aim is to address issues affecting the environment namely, the consumption of excess energy, GHG emissions reduction, reduced air pollution, reduced water consumption, reduced land consumption and reduced waste. They also address the efficient use of resources as well as the provision of buildings that are healthy and comfortable to the occupants.

According to the World Green Building Council (2013) a building is green when it helps reduce the footprint it leaves on the natural environment and on the health of its inhabitants.

Green building features are becoming a norm in new developments as well as in refurbishment projects considering that they are beneficial to both owners and occupants therefore developers would incorporate them in their developments without acquiring the appropriate certification. The features that can make a building 'green' as highlighted by WGBC and GBCSA include the following:

- 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
- A design that enables adaptation to a changing environment

For the purpose of this study the term “green buildings “which refers to buildings that are being officially certified as such by the relevant Green Building Councils in the particular country where such buildings are situated is used. Green building can be achieved for both newly constructed buildings as well as existing buildings through retrofitting during renovations.

2.3 Global status of Green Buildings

The built environment is responsible for one third of all hazardous carbon emissions resulting in global warming and environmental degradation, therefore it is essential to consider building green for every development and refurbishment taking place worldwide (US Green Building Council 2015).

According to the US Green Building Council (2015), Green building is an emerging trend around the world and it provides the built environment with opportunities to use resources efficiently in order to address climate change. The adoption of green buildings will allow the creation of more productive environments for people to live and work in.

Green buildings in the developed markets like Europe, America and Australia is widely considered to be matured and the trend is already widely adopted globally, with strong growth expected in most countries, but most particularly in the developing world (Kim, Lim, and Kim 2017). This notion was emphasised through a research study conducted and published by Dodge Data and Analytics, which indicated that the green building movement is gaining momentum globally driven by the WGBC.

The WGBC has recorded an expansion to its membership through the establishment of the number of green building councils from the developing markets like India, Brazil,

Saudi Arabia and sub-Saharan Africa. Also highlighted in the study, is that global green building continues to double every three years (US Green Building Council 2015).

The green building market is anticipated to be among the fastest growing industries worldwide and that notion can be attested to the growing number of certified projects as well as the growing number of green building councils coming into the main stream on a yearly basis as recorded by the WGBC.

The growth of this industry is making great contributions to different economies for instance consultation in this field is also creating jobs for professionals who are specialists in the field (Green Building Council of SA 2017). This is evident since the GBCSA and some other stakeholders have recently developed and they also offer some qualifications in the field.

The green building movement is growing and the WGBC continues with the campaign to promote the concept throughout the globe with success. Currently the WGBC has certified more than one billion square meters of green building space through their seventy-three-member Green Building Councils worldwide. The movement is making strides in the developing world with South Africa leading in the African continent (Green Building Council of SA 2017).

According to WGBC (2013) there is a tremendous growth in membership from the developing countries and this notion is based on the number of green building councils that were being established in the past decade. There are also a growing number of green building rating tools that are launched by different countries from time to time.

2.4 Green Buildings Status in South Africa

The green building movement continues to gain momentum in South Africa and it is spreading to other countries across the African continent (GBCSA et al. 2016). The increasing number of new developments and retrofit projects that were certified in the past few years supports this notion. Since its establishment in 2007 to date, the GBCSA has issued more than 300 green building certifications South Africa including other

countries in Africa (GBCSA et al. 2016). GBCSA (2017), continued and mentioned that the 300 certified properties, collectively spanning just under 3.8-million square meters, are expected to save about 450-million kilograms of carbon dioxide, 380-million kilowatt-hours of energy and 350-million liters of drinking water each year.

Green building movement is growing in support throughout the African continent and it is spearheaded by GBCSA, which has been awarding Green Star SA certification to conforming green buildings across the continent outside of South Africa. Green Star SA certification is influenced by the Green Star Australia, which is guided by both LEEDS (US) and BREEAM (UK), which are the most established certification internationally.

Green Star SA is now found in countries like Ghana, Rwanda, Namibia, and Kenya and there are some few upcoming projects to be certified in Nigeria, Tanzania and Mauritius. GBCSA has been instrumental in the establishing of the GBCs in those countries. GBCSA has recently rebranded the Green Star SA rating system and it is referred as Green Star Africa in order to support the uptake of green building projects throughout the continent of Africa (Green Building Council SA 2018).

Green Star SA was adopted from the Australian Green Star and it was designed in a way to adapt for the local African climatic, social and economic context, which make it the rating system of choice for property owners in Africa. The green building milestone reached by South Africa is being reported in several global report like Dodge Analysis and Analytics as one of the fast growing green market in the world.

According to Dodge Data and Analytics (2016), South Africa had the highest level of green building project activity. India and Singapore positioned themselves as the second and third largest green building industries in the world, with Mexico and Germany trailing behind. More developers around the globe are becoming more mindful of the economic benefits brought about by green building projects, among which, decreased operating costs in the long run gained the most credibility (Statista 2017).

In addition to the milestone of success, the GBCSA has also launched a labelling system designed to complement the ratings under the Green Star SA tool, recognizing buildings that completely neutralize or positively redress their carbon emissions, water consumption, solid waste and /or other negative ecological impacts (Green Building Council SA 2017).

Four projects to date have achieved certification to one or more of the criteria. The GBCSA is amongst the fourteen green building councils participating in the WGBC ‘s project of Advancing Net Zero which aims to promote and support the acceleration of net zero carbon to 100% by the year 2020. The net zero carbon buildings ae highly energy efficient buildings, with remaining demand supplied on site and off site renewable sources, or through offsets (World Green Building Council 2013).

2.5 Overview of Different International Certifications

The researcher mentioned previously in this report that buildings have extensive direct and indirect impact on the environment. Such impact occurs at different stages of the life the buildings for instance during construction, occupancy, renovation, repurposing and demolishing. Buildings use energy, water and raw materials; they also generate waste, emit potentially harmful atmospheric emissions (World Green Building Council 2013).

In spite of all the negative factors mentioned about the effect of the buildings on the environment, green building was adopted by the built environment as one of the actions to be taken in order to minimize the negative impact of buildings on the environment (Green Building Council SA 2012; Chegut et al. 2014 and Devine and Kok 2015).

The emergence of green buildings have prompted the creation of green building standards, certifications, and rating systems aimed at mitigating the impact of buildings on the natural environment through sustainable design (Krizmane et al. 2016 and Stein, et al. 2014). The purpose of these schemes rating systems is to measure the environmental sustainability of a built environment in a consistent and comparable manner, with respect to pre-established standards, guidelines, factors, or criteria.

As the Green Building, movement evolves globally, so does the need for rating systems that define green buildings (Krizmane et al. 2016). A rating system is defined as a set of prerequisites and requirements or benchmarks that must be fulfilled for the certification to be issued by relevant authorities, which are Green Building Councils (Stein, et al. 2014).

Green Building certification efforts includes a range of mandatory policies and voluntary programs that are created by both governments and organizations, such as green building councils (WGBC 2013). Green building movement is driven globally by WGBC, which comprises of different councils from all over the world with the aim of transforming the property market globally through green building rating systems. According to the World Green Building Council (2013) there are seventy-four GBC's situated all around the world with members in excess of 32 000 who come from the wide range of sectors linked to the built environment. Different countries have developed their own Green Building rating systems that are suitable to their particular needs.

For a certification to be awarded, the rating systems would normally consider a number of factors including sustainable sites, water efficiency, energy, atmosphere, materials, resources, indoor environmental quality, locations and linkages, awareness and education, innovation in design, and regional priority through a set of prerequisites and credits (Devine, Steiner, and Yönder 2017). Fuerst and van de Wetering (2015) identified some key international rating systems such as LEED and, Energy Star in the United States; Green Star and NABERS in Australia and New Zealand; BREEAM in the UK and some other parts of Europe. According to RICS, LEED is not only used in America but in other parts of the world like Europe and Asia.

As indicated in table 2 below, there is a number of established rating schemes which include South African Green Star SA rating system; the Japanese Comprehensive Assessment System for Built Environment Efficiency (CASBEE); the French (HQE; High Quality Environmental standard); China Green Building Network (CGBN); HK-BEAM in Hong Kong; and the (DGNB; Deutsche Gesellschaft fu¨r Nachhaltiges Bauen) (Stein et al. 2014).

Table 2: Selected Green Building Certification Systems Worldwide Source: Worldwatch Institute

	YEAR	COUNTRIES USING IT	ADMINISTRATIVE ORGANISATION
BREEAM	1990	UK, Persian Gulf	Building Research Establishment Global
LEED	1998	US and more than 150 other countries	USGBC
Green Globes	2000	Canada and US	ECD Energy and Environment Canada
CASBEE	2001	Japan	Japan Sustainable Building Consortium
Green Star	2003	Australia and New Zealand	GBC Australia
Green Mark	2005	Singapore	Building Construction Authority
Sustainable Sites	2006	USA	Green Business Certification, Inc.
Living Building Challenge	2006	Cascadia (Canada and US)	International Living Future Institute
GBEL	2006	China	China Building Research Science Institute
GRIHA	2007	India	The Energy AND Resources Institute (TERI)
AQUA	2008	Brazil	Fundacao Vanzolini
Pearl Rating System for Estidama	2008	United Arab Emirates	Abu Dhabi Urban Planning Council
Green Star SA	2008	South Africa	GBCSA (Adapted from Australian system)
LOTUS	2008	Vietnam	VGBC
BEA	2009	Hong Kong	HK-GBC

2.6 Certification in Europe

According to RICS (2012) there is four major certification tools in Europe namely BREEAM; DGNB; LEED and HQE. France GBC has stated that, LEED is the most widely used rating system in Europe and at a global level whereas, HQE dominates the market by surface area, with around 59 million m² certified at a European level (primarily in

France), ahead of BREEAM and DGNB, although BREEAM is the most common certification in many countries (France GBC 2015).

2.6.1 BREEAM

According to Doan et al. (2017) BREEAM is the world's first environmental assessment method and rating systems to assess the sustainability of buildings that was launched in the UK in 1990. BREEAM encourages all participants in project procurement, including clients and building users, to embrace the principals they espouse. BREEAM's ratings cover categories from energy and CO2 emissions to water, health and wellbeing, management and ecology (BREEAM 2018). Currently the system is available in more than seventy countries and it boasts about 560,500 certificates that have been conferred as well as more than 2.25 million buildings have been registered (BREEAM 2018). It is the most widely used building environmental rating scheme in the U.K. Building Regulation as a benchmark to rate the level of performance improvement.

A BREEAM assessment uses recognized measures of performance, which are set against established benchmarks, to evaluate a building's specification, design, construction and use. They include aspects related to energy and water use, the internal environment (health and well-being), pollution, transport, materials, waste, and management processes (RICS 2012).

Assessments are carried out by trained BREEAM Assessor and are based on the scoring comprising of nine criteria namely, energy, land use and ecology, water, health and wellbeing, pollution, transport, materials, waste and management (Twoney 2017). According to the score percentage, the overall performance of the building can be categorized as Unclassified (<30%) Pass (≥30%), Good (≥45%), Very Good (≥55%), Excellent (≥70%) and Outstanding (≥85%). For each category, there are a minimum number of credits that must be achieved (Twoney 2017).

2.6.2 DGNB

The DGNB System is the green building rating tool used in Germany to certify buildings that conforms to green building standards set by the WGBC. It was developed in close collaboration with the German Federal Ministry of Transport, Building, and Urban Affairs with a view to actively promoting sustainable buildings (Darko, Zhang, and Chan 2017). According to the DK-GBC, the DGNB system it is a certification solution whose purpose is to create a common starting point for measuring and assessing sustainable building. The system is based on a holistic approach and a lifecycle assessment of a building and in that way, it weighs a number of dimensions to assess sustainability (DGNB, 2018).

The DGNB system defines six topics, which must be considered when planning and constructing a sustainable building: ecological quality, economic quality, sociocultural and functional quality, technical quality, process quality and location quality. DGNB is unique and it provides an objective description and assessment of the sustainability of buildings and urban districts. The DGNB Certification System can be applied internationally as it can be easily adapted to the building culture of any country (DGNB, 2018).

According to WBCC, DGNB is one of the leading systems worldwide, mainly due to its comprehensive quality concept, which takes equal account of economics, ecology, and socio-cultural aspects and is based on a holistic view of the building's entire lifecycle. Due to its flexibility as stated by Darko et al. (2017) DGNB System can be tailored precisely to various uses of a building and even to meet country-specific requirements.

Three different grades of certificates are awarded, for three different degrees of conformance with the defined standards: platinum (> 80%), gold (> 65%) and silver (> 50%). A "bronze" certification is also available, for existing structures that achieve conformance > 35%.The outstanding fulfilment of up to 50 sustainability criteria from the quality sections ecology, economy, socio-cultural aspects, technology, process workflows and site are certified. If a performance requirement is met, the DGNB awards the DGNB certificate in bronze, silver, gold and platinum. This international certification route is

currently being implemented in other European countries like Greece, Slovenia, Spain, Turkey and the Ukraine by (Darko et al. 2017).

2.6.3 HQE

Haute Qualite´ Environnementale (HQE) refers to 'High Quality Environmental' design and is a certified label given by the HQE association in France to buildings where the design, construction or restoration as well as the operating and maintenance of the buildings correspond to high environmental quality standards, respecting the environment and engaging in sustainable solutions (HQEGBC 2017). The rating system was developed in 1994 by the non-governmental organization Association HQE based in Paris, France. The Association HQE focuses on research and development as well as on promotional activities. HQE certification covers the entire lifecycle of a building (construction, renovation and operation): non-residential buildings, residential buildings and detached houses as well as planning.

The HQE ratings are mainly pass, Good, Very Good, Excellent and Exceptional. The ratings are represented by four levels of classification associated with specified issues namely energy, environment, health and comfort. The building performance is expressed by a number of the awarded stars that is, HQE Good (1 to 4 stars), HQE Very Good (5 to 8 stars), HQE Excellent (9 to 11 stars) and HQE Exceptional (12 stars and more).The HQE schemes can be adapted to meet the specific context of any country is now energy, environment, health and comfort available for different buildings and different districts worldwide and it is present in 25 countries and situated in five continents. Cerway is a certification body and the operator for HQE out of France - Cerway supports stakeholders across the world for the full duration of their project and ensuring high environmental quality (HQEGBC 2017).

2.7 Certification in America

The main U.S. green building accreditation systems include LEED, Green Globes, and Energy Star. Each of these systems certifies office properties according to different

specifications and methodologies, and there is continued debate as to which one should be the standard-bearer (Blumberg 2012). According to Blumberg (2012) Energy Star solely measures the energy efficiency of the buildings it certifies whereas Green Globes and LEED take into account other building components, such as water usage and construction materials, allowing them to evaluate a broader range of sustainable initiatives.

Both LEED and Green Globes serve to drive green/high-performance-building design, construction, and operation and they rely on an independent third-party verification process (Blumberg 2012). Both systems address factors such as the site characteristics, energy and water consumption, the use of resources/materials, and the indoor environmental quality (IEQ). LEED and Green Globes both offer different tracks for new construction and existing buildings and they both acknowledge the unique requirements of healthcare facilities and offer specific rating systems for them. The two certifications are both recognized and accepted by the General Services Administration (GSA) and other agencies of the Federal government, as well as many state and local jurisdictions (USGBC, 2015).

2.7.1 Green Globes

Green Globes is an online assessment protocol, rating system, and guidance for green building design, operation and management. The system is based on BREEAM, it was created in 1996 and it has been used on projects that range greatly in size, complexity and degree of innovation (Green Globes 2011). The rating system is interactive, flexible and affordable, and provides market recognition of a building's environmental attributes through third party assessment.

Currently, the system is primarily in Canada and the USA in Canada and it provides modules for new construction, significant renovations and commercial Interiors. Such modules can be used for a wide range of commercial, institutional and multi-residential building types including offices, school, hospitals, hotels, academic and industrial facilities, warehouses, laboratories, sports facilities and multi-residential buildings (Ashuri

and Durmus-Pedini 2010). Green Globes only has seven different categories from which points are obtained including: site, energy, water, emissions, project management, indoor environment, and materials and resources. Membership of Green Globes is also growing and it was determined that currently there were over 3,000 buildings certified or recertified throughout Canada using this system (Green Globes 2011).

2.7.2 LEED

According to Yudelson and Meyer (2013) the Leadership in Energy and Environmental Design (LEED) system is currently the most widely utilized method for rating a building's environmental performance in the United States. It is the world's best known green building certification system developed in 2000 by the USGBC (US Green Building Council) to provide building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operation and maintenance solutions (Giama and Papadopoulos 2012). The system is most relevant for North America, but is also used in many other regions around the world, such as South America, Europe and Asia. It is based on a set of rating systems where specific topics are assessed, such as transportation, recycling content, etc.

The rating system is recognized as the international mark of excellence for green building in over 160 countries. More than 38,600 commercial projects in over 167 countries and territories are LEED certified. In the United States alone, over 24,000 projects have been certified, with 738 in China and 653 in India (Yudelson and Meyer, 2013). LEED has also expanded beyond new commercial or multi-family construction projects to certify existing buildings, interior fit-outs, neighborhood design and single-family homes (USGBC 2015).

The main purpose of LEED is to promote sustainability in the built environment, improving performance and quality of buildings while minimizing negative environmental impacts. LEED is designed to cover all types of building, from small residential houses to large commercial and public buildings. (Suzer 2015)

LEED is a point-based system where building projects earn LEED points for satisfying specific green building criteria. It awards points for satisfying specific sustainability criteria in seven categories. These categories relate to sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation in design, and regional priority (USGC 2015).

Points are awarded as a LEED Silver certification required 50-59 points, a LEED Gold certification requires 60-79 points, and a LEED Platinum certification requires the project team to obtain over 80 of the 100 points available. According to the USGBC (2015), LEED membership is growing rapidly as a certification in the USA rising from 296 certifications that was recorded in 2006 to over 65 000 in 2017. This figure refers only to projects in the USA and it will be more if LEED certified projects outside the USA were to be included.

2.7.3 Energy Star

The WGBC describes Energy Star as a federal program, which is available for both commercial and residential buildings in the US WGBC (2013). The program was established in 1999 by the U.S. Environmental Protection Agency (EPA). The Energy Star label is awarded if a building's energy efficiency scores in the top quartile based on EPA's National Energy Performance Rating System. The energy efficiency of the building is compared to the values achieved by a group of its peers and is rated on a scale from 1 to 100. Buildings must score at least 75 to earn the Energy Star label (Reichardt et al. 2012). To earn ENERGY STAR certification, a facility must operate among the top 25 percent of similar facilities nationwide, with no sacrifices in comfort or quality.

Since 1999, tens of thousands of buildings and plants across America have already earned EPA's ENERGY STAR for superior energy performance. On average, these buildings use thirty-five percent less energy and cause thirty-five percent fewer greenhouse gas emissions than comparable buildings across the country (Gou, Prasad, and Lau 2014).

Certification is given on an annual basis, so a building must maintain its high performance to be certified year to year. The information which, is submitted in the certification application must be verified by a licensed Professional Engineer (PE) or Registered Architect (RA) to be eligible for approval.

2.8 Certification in Australia and New Zealand

2.8.1 Australian Green Star

According to Mitchell (2010) Green Star is a voluntary sustainability rating system used by the Green Building Council of Australia to certify buildings that conforms to the green building standards set by the World Green Building Council. The system was developed in 2003 and is based on LEED and BREEAM. The purpose of its development was to accommodate the need of buildings in hot climates where cooling systems and solar shading are of major importance and it is leading in Australia and New Zealand.

A Green Star certified rating provides independent verification that a building or community project is sustainable and it benchmarks projects against the nine Green Star categories of Management; Indoor Environment Quality; Energy; Transport; Water; Materials; Land Use & Ecology; Emissions and Innovation (Xia et al. 2014).

According to GBCA (2015c) Green Star uses the credit rating system based on a number of points allocated to the credits in order to determine the total scoring and hence the level of certification. There are up to 142 points that can be achieved. The score is determined for each category based on the percentage of points achieved versus the points available for that category. The credits are organized in the following aspect of the building and process: management, indoor environmental quality, energy, transport, water, materials, land use & ecology, emissions, and innovation (Bond 2010).

The building certification is then expressed as a number of stars: 1-3 Stars (10-44 points; not eligible for formal certification), 4 Stars (45-59 points; Best Practice), 5 Stars (60-74 points; Australian Excellence) and 6 Stars (≥75 points; World Leadership). GBCA has

also grown its number of green certified projects to 1750 since its inception in 2003 to 2017 in Australia and New Zealand (GBCA 2015c).

2.8.2 NABERS

NABERS is defined as a mature rating tool, which is well established in the Australian and New Zealand real estate markets. This scheme compares the actual operational performance of existing buildings and tenancies, relative to similar buildings within a particular area (GBCA 2015c and Bond 2010). NABERS Ratings are available for energy efficiency, water usage, waste management and the indoor environment quality of a building or tenancy and are based on the previous 12 months of measured performance information, and uses parameters such as hours-of-use and the area of the building (Hampton and Clay 2016).

Hampton indicates that the tool was launched in 1998 as the Australian Building Greenhouse Rating (ABGR) scheme and it uses measured and verified performance information, such as utility bills, and converts it into a rating scale from zero to six stars (GBCA 2015c). Different NABERS ratings can be achieved for a number of building types and NABERS is scaled 0 to 6 stars. The higher the star rating, the greater the level of environmental performance that is delivered for instance a 6-star rating demonstrates market leading performance, while a 1-star rating means the building or tenancy has considerable scope for improvement. When the higher rating is achieved year-on-year, this demonstrates the building/tenancy is being well maintained by Facilities (GBCA 2015c).

2.9 Green building certification in Asia

According to Nguyen and Altan (2011) green buildings are increasing in Asia with most countries having at least one domestic green building rating scheme. The numbers of registrations and certifications continue to grow on a yearly basis.There are approximately 13 national green building assessment tools in Asian countries which include BCA-Green Mark (Singapore), Green Building Index (Malaysia), CASBEE (Japan), Three Star System

(China), BEAM (Hong Kong), IGBC (India), Greenship (Indonesia), LOTUS (Vietnam), Berde (Philippines), G-SEED (South Korea), EEWH (Taiwan) and TREES (Thailand). In addition, the LEED and Green Star Australia rating systems have been adopted across the regions of Asia. (Nguyen and Altan 2011)

Nguyen and Altan (2011) continued to state that companies in Asia are adopting green goals to help boost social responsibility, branding and to attract talent and, as the real estate sector in Asia undergoes changes due to rapid urbanisation, sustainability has become big business. Green practices are adopted mostly in Singapore, Tokyo, Australia and China According to JLL's Real Estate Environmental Sustainability Transparency Index, Japan has become a leader in sustainable real estate transparency this year joining France, Australia and the UK in the 'highly transparent' group for the first time (Hwang et al. 2017).

The majority of certified green buildings in Asia have been benchmarked with systems that assess design and construction standards but do not verify actual performance. For example, official data for China shows that green buildings assessing only design accounted for 93.7% of green buildings in 2013 (WGBC 2013).

According to Hwang, et al. (2017) Singapore has set itself the goal to get 80% of its building stock certified with its Green Mark tool by 2030. This is backed up by a framework of legislation that requires newly developed properties to be certified, and re-certified after three years with the existing buildings version of Green Mark. In addition, any existing property that now undergoes a heating, ventilation and air conditioning upgrade must get Green Mark certified (Hwang et al. 2017).

According to WGBC (2013), China launched its Green Building Action Plan in 2013, requiring all public buildings, public residential buildings and commercial buildings with a gross floor area (GFA) greater than 20,000m² to achieve at least one star in the China Green Building Evaluation Standard.

In India, where the national green building footprint exceeds 356m², there are more than 850 buildings certified with the national IGBC rating tool. The government is leading by example by getting their own buildings certified. Policy focus is around decarbonizing the economy, with a push to renewables (WGBC 2013).

2.9.1 CASBEE

The CASBEE is the Japanese tool for assessing and rating the environmental performance of buildings. It was developed by a research committee established in 2001 through the collaboration of academia, industry and national and local governments, which established the Japan Sustainable Building Consortium (JSBC) under the auspice of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) (Michael 2013). The system measures the ratio between the Building Environmental Quality & Performance (e.g., thermal comfort) and the Building Environmental Loads (e.g. energy efficiency, global warming) and it covers four categories namely energy efficiency, resource efficiency, local environment and Indoor environment. Under CASBEE, there are two theoretical «spaces», the internal and the external (Shamseldin 2016).

Corresponding to the building lifecycle, CASBEE is composed of four assessment tools for building scale: CASBEE for Pre-design, CASBEE for New Construction, CASBEE for Existing Buildings and CASBEE for Renovation, and to serve at each stage of the design process (Hui, Chan, and Balaban 2015; and de Oliveira 2017)

2.9.2 China Green Building Design Label

Buildings in China are certified mainly by two rating systems: China Green Building Design Label normally referred to as “Three Star” and LEED. Three Star is more or less similar to LEED (Zhou 2014). In 2006, China launched a green building labeling system to identify the “greenness” of a building with the award of one to three stars, with three stars being the highest score. Under these national standards, a building can receive two separate labels namely, the Green Design Label and the Green Operations Label (Geng et al. 2012).

2.9.3 HK-BEAM

HK-BEAM is the comprehensive environmental assessment scheme used in Hong Kong to assess and certify the buildings that conforms to the green building standards as set by the WGBC (DeLisle, Grissom and Högberg 2013). The Hong Kong Green Building Council launched the scheme in 2010 and it is being widely adopted throughout Hong Kong. By adopting an affordable range of best practices, BEAM seeks to reduce the environmental impacts of a new building while also improving environmental quality and user satisfaction (WGBC 2013). It covers the demolition, planning, design, construction and commissioning of a new building project. It can also be applied to major renovations, alterations and additions.

Since its launch in 2010, more than 400 sustainable building projects have been registered under the BEAM Plus for New Buildings and Beam Plus for Existing Buildings schemes - making up approximately 22 million square feet of registered building space - making it one of the most successful systems in the world to date (DeLisle et al. 2013).

2.9.4 GBI

GBI is Malaysia's industry recognized rating tool for buildings to promote sustainability in the Built Environment and raise awareness among developers, architects, engineers, planners, designers, contractors and the public about environmental issues as well as the nation's responsibility to the future generations (Saadatian et al. 2012). The GBI rating tool provides an opportunity for developers and building owners to design and construct green, sustainable buildings that can provide energy saving, water savings, a healthier indoor environment, better connectivity to public transport and the adoption of recycling and greenery for their projects and reduce our impact on the environment (Sood, Chua and Peng 2011).

GBI four classifications are given for the green building certifications to show the gradient of compliance with the requirements. Green building index Classification Points Ratings

are awarded as 86 Platinum Global excellence, 76-85 Gold National excellence, 66-75 Silver Excellent practice and 50-75 Certified Good practice.

2.9.5 BCA Green Mark Scheme

The BCA Green Mark Scheme was launched in January 2005 as an initiative to drive Singapore's construction industry towards more environment-friendly buildings. It is intended to promote sustainability in the built environment and raise environmental awareness among developers, designers and builders when they start project conceptualization and design, as well as during construction (Kim et al. 2017). The system provides a comprehensive framework for assessing the overall environmental performance of new and existing buildings to promote sustainable design, construction and operations practices in buildings (Wu et al. 2016).

Under the assessment framework for new buildings, developers and design teams are encouraged to design and construct green, sustainable buildings, which can promote energy savings, water savings, healthier indoor environments as well as the adoption of more extensive greenery for their projects. The assessment criteria cover the five key areas namely, energy efficiency, water efficiency, environmental protection, Indoor environmental quality and other Green features and innovation

The assessment identifies the specific energy efficient and environment-friendly features and practices incorporated in the projects. Points are awarded for incorporating depending on the overall assessment and point scoring, the building will be certified to have met the BCA Green Mark Platinum, GoldPlus, Gold or Certified rating. Certified Green Mark buildings are required to be re-assessed every three years to maintain the Green Mark status (Wu et al 2016).

2.10 Certification in South Africa

Green and efficient building has been an area of growing focus in South Africa particularly in the commercial property and construction industry following the severe electricity shortages and large increases in electricity prices over the past decade (GBCSA 2012).

According to Dodge Data and Analytics (2016), Green building is already widely adopted globally, with strong growth expected in most countries, but most particularly in the developing world. The results of the survey conducted by Dodge Data and Analytic were published in World Green Building Trends 2016 report and they indicated that South Africa has the highest green building share, in the world, with impressive growth also expected, trumping countries such as the UK and the US, China, Singapore, Germany, and the historical green building market leader Australia.

Green Star SA is an official certification system in South Africa and it is in the custody of Green Building Council of South Africa, which is the official member of the World Green Building Council. The Green Star SA certification system is used to recognize and reward environmental leadership in the built environment and it is based on the Australian system and customized for the South African context. The green rating systems can be applied to new buildings as well as existing buildings and can apply to both the design and construction of the building as well as the operational practices.

The levels of Green Star SA certification are classified includes 4 Green Star SA certified rating which recognizes best practice; 5 Green Star SA certified rating which recognizes South African excellence and 6 Green Star SA certified rating which recognizes world leadership (GBCSA 2012). According to GBCSA (2012), Green Star SA covers a number of categories that assess the environment impact of the building and they include management, indoor environment quality (IEQ), energy, transport, water, materials, land use and ecology, carbon emission, innovation and socio- economic factor.

Each Green Star SA rating tool reflects a different market sector including Existing Building Performance, Office, Retail, Multi-Unit Residential, Public and Education Buildings, and Interiors. GBCSA is making strides in the promotion of green buildings in South Africa and this notion can be confirmed by the huge milestones witnessed in the field which include a growing number of green buildings. Green buildings that are coming into the mainstream in South Africa currently accounts for almost half (41%) of building project activity, compared to the global average of 24% GBCSA (2018). (GBCSA 2018)

has confidently estimated that about 61% of building projects in SA are expected to be green by 2018, almost double the projected global average of 37% for the same year.

The Green Star SA Rating Tools aim to fulfill several objectives including the establishment a common language and standard of measurement for green buildings; promote integrated, whole-building design; raise awareness of green building benefits; recognize environmental leadership; reduce the environmental impacts of development (GBCSA, 2012). It consists of nine separate environmental impact categories under which specific key criteria are grouped and assessed. These nine categories include Management, Indoor Environmental Quality (which target the wellbeing of the occupants), Energy, Transport, Water, Materials (which target the consumption of resources through selection, use, reuse and efficient management practices), Land Use and Ecology, Emissions and Innovation.

The categories are divided into credits, each of which addresses an initiative that improves or has the potential to improve a design, project or building's environmental performance. Points are awarded in each credit for actions that demonstrate that the project has met the overall objectives of Green Star SA and the specific aims of the Green Star SA rating tool. Green Star is being customized for other countries across Africa. History of success in education, awareness, and certification for green buildings in South Africa.

2.10.1 Green Star SA certified ratings

The following Green Star SA certified ratings are available for buildings:

• 4 Star Green Star SA Certified Rating recognizes "Best Practice" (Weighted score of 45-59)

• 5 Star Green Star SA Certified Rating recognizes "South African Excellence" (Weighted score of 60-74)

• 6 Star Green Star SA Certified Rating recognizes "World Leadership" (Weighted score of 75-100)

There are two types of ratings that can be applied for namely, “Design” or “As built”. The Design rating is a certification of the project’s sustainable design, prior to construction. The reason for this certification is so that the building can be marketed as Green Star SA certified to attract tenants, investors and/or buyers (GBCSA 2012). According to GBCSA (2018) there are about three hundred and fifty buildings that been accredited different levels of Green Star certification and the high penetration is found particularly in the office sub-sector. Projects are spread throughout the country though Johannesburg metro area leads in number of projects.

2.11 Conclusion on Certification

From the literature review one deduce that the field of building environmental assessment has been maturing remarkably and steadily over the past decade. There is a number rating systems in existence in different countries but only four of them namely (BREEAM (UK), LEED (US), DGNB (DE) and HQE (FR)) are adopted internationally outside the countries of their origin. According to Bernardi et al. (2017); Poveda and Lipsett (2011; and Kim et al. (2017) the different certification schemes have the common purpose which is to measure the environmental sustainability of a built environment in a consistent and comparable manner, with respect to pre-established standards, guidelines, factors, or criteria.

The tools that measure environmental issues focuses on efforts to reduce the impact of the buildings on the natural ecological system like the reduction of greenhouse gases and the minimized consumption of natural resources (Doan et al. 2017). All of the major certification systems contain criteria on the efficient use of energy and water. Most systems also consider appropriate site selection, proximity to public transportation, and the indoor environment (strategic day lighting, air temperature, etc.).

(BREEAM) was the first scheme to be established aimed at assessing the environmental impact of a building and it was followed by LEED. In the establishment of the rating systems, most of the countries will normally adopt either BREEAM or LEED practices and adjust their rating systems to suit the conditions of their countries (Yudelson and Meyer

2013). Due to the need to address issues in local contexts of individual countries or regions, different rating systems have a different emphasis influenced by local geographical, cultural, economic and social parameters (Suzer 2015). For instance, energy and water is emphasised in South Africa due to constraints of these resources whereas the Middle East countries put less emphasis on energy due to its abundance.

Our Green Building Council in South Africa places an emphasis on socio-economic issues such as employment or skills within its green building certification, while in the UK, addressing health and wellbeing in green buildings is of particular importance to the UK Green Building Council (Green Building Council South Africa, 2016). The Green Star SA system is well received by stakeholders in the built environment as it encourages developers and architects to minimise the environmental impacts of their developments. The system also rewards projects for reducing waste sent to landfill, and for building designs that yield reduced energy and water consumption and lower operating costs (Green Building Council South Africa, 2016).

Analysis of different rating systems revealed that the following characteristics are common to most schemes (Bernardi et al. 2017 and Poveda and Lipsett 2011):

- The schemes are voluntary and they are all administered by the GBC's
- Their main aim is to establish a common language and standard of measurement for green buildings in the industry, and encourage and reward environmental leadership in the property industry.
- They all measure the performance of a building in a consistent and harmonized manner with respect to pre-established standards, guidelines, factors, or criteria.
- They all use scoring methods for assessing the environmental sustainability of buildings which are based on four major components namely, categories (which form a specific set of items relating to the environmental performance considered during the assessment); scoring systems (which is a performance measurement system that cumulates the number of possible points or credits that can be earned by achieving a given level of performance in several analysed aspects); weighting

system (representing the relevance assigned to each specific category within the overall scoring system; and output item (which show the results of the environmental performance obtained during the scoring phase in a direct and comprehensive manor).

- They are all designed for use to certify Rating schemes and can be used to certify the environmental performances of different types of buildings, such as residential, office, commercial, industrial, and educational buildings, and all other special buildings
- Energy performance, solid waste management, material, and water were found to be the most considered categories from a quantitative perspective;

2.12 Benefits of green buildings

Based on different definitions found in literature study, the term green building usually refers to a building that considers and minimizes its impact on the natural environment and human health, utilizes considerably less water and energy than a conventional building (refer to figure 1 below).

According to Neyestani (2017) green buildings generally has higher levels of indoor air quality, and accounts for some measure of the lifecycle impact of choices amongst different kinds of building materials, furnishings, and furniture.

The goals of green building include optimizing the way the building uses water, energy and internal materials while reducing the building's impact on the local environment and human health (WGBC 2013). The built environment will normally plan such goals over the long-term in order to provide individuals with a better building usage experience over the life of the structure.

Several studies conducted by different researchers like Neyestani 2017; Allen et al. (2015); and Gou et al. (2014) have suggested that the adoption of green building concept in building projects may render numerous benefits that can be classified as environmental economic and social benefits.

- **Environmental benefits:** Refer to the benefits that aim to reduce or eliminate negative impacts of building on the environment. Several studies have repeatedly indicated that buildings contribute to the negative environmental effects through energy consumption, carbon emission as well as extensive use of natural resources and waste production (Ashuri and Durmus-Pedini, 2010). Building green will enhance and protect biodiversity and ecosystems; improve air and water quality; reduce waste streams, reduce water wastage and; conserve and restore natural resources, reduce between 30 - 40% energy and carbon emissions.
- **Economic benefits:** Refer to the benefits received by the investor for investing in the green property asset and they include capital appreciation, higher rental income and improved cost saving factors (Issa et al. 2013). Empirical evidence has indicated that green buildings provide financial rewards for building owners, operators, and occupants. Green buildings typically have lower annual costs for energy, water, maintenance/repair, churn which, refers to reconfiguring space because of changing needs (Dwaikat and Ali (2016) and Issa et al. 2013) and other operating expenses.

  WGBC and USGBC have demonstrated in their studies that, green buildings cost less to run and save energy on an average of 30%, reduce water consumption by almost 60%); improve occupant productivity by 25%, and, enhance asset values by 10%, and resulted in 5%-10% higher rental.
- **Social benefits:** Refer to the benefits around the health and wellbeing of people who work and live in green buildings, that is, offices and residential. Beside the economics and the environment benefits, studies have demonstrated that green building are capable of bringing positive social impacts. Green buildings will enhance occupant health and comfort, improve indoor air quality, minimize strain on local utility infrastructure, and improve overall quality of life. A study by the USGBC and WGBC has demonstrated that green building can annually reduce the sick building syndrome of its occupants by 41.5%. and result in 27% higher occupants' satisfaction therefore reducing absenteeism (Gou et al. 2014).

Figure 1: The benchmark of green building based on reducing negative impacts

There is consensus among previous researchers in both the developed and developing countries that green buildings deliver a number of benefits to both space users (tenants) and space providers (owners ad investors). Studies suggested that green buildings do not only benefit the environment, they also provide healthier places to live and more productive places to work.

According to Darko at al. (2017), green buildings render a number of benefits through reduced lifecycle costs of the building to reduced environmental impact. The five most reported benefits of green buildings include aspects of reduced lifecycle costs, energy saving, enhanced occupant's health and comfort, improved overall productivity, and environmental protection (Darko at al. 2017; Gou et al. 2014; Issa et al. 2010, and Li et al. 2014).

For occupiers, the benefits include reduced utility costs, improved productivity (lower staff turnover, absenteeism, and higher outputs) and reputational benefits. Whereas investors and owners may benefit through higher occupancy rates, lower utility costs (especially in gross leases), higher rental income, increased property values resulting in higher sale prices, decreased rates of depreciation, reduced carbon/greenhouse gas emissions and reduced regulatory obsolescence (Eichholtz, Kok, and Quigley, 2013; Fuerst and McAllister 2011a).

If stakeholders such as tenants who are occupying these buildings could be properly informed, they would be increasingly demanding them to minimize both their occupancy costs and environmental impact.

With all these benefits taken into consideration, stakeholders like owners and tenants are willing to invest in such buildings. The empirical evidence of all the benefits that is, environmental, financial and social has a potential of motivating stakeholders in South Africa to consider green star certification in the new developments as well as in refurbishing projects (Eichholtz, Kok, and Quigley, 2013). That will see the increase in the number of green buildings as well as the rise in higher green certification levels.

2.13 Costs associated with green buildings

The international green building industry has expanded and matured significantly during the past few decades, however a number of factors with the potential to hamper the growth of the industry have also been identified during this period. Previous research conducted by Khoshbakht, Gou, and Dupre (2017); Neyestani (2017) and Wiencke (2014) suggested that though there is a demand for green buildings, it is not clear if owners of commercial properties are willing to pay a premium price for green buildings compared to conventional buildings as cost premiums are often perceived to be far higher and that perception becomes one of the barrier in the adoption of green buildings.

Despite the real estate sector's awareness of the environmental effects of the built environment and the positive developments made in recent years there are still some obstacles on the way. Implementation was slowed down as built environment stakeholders became skeptical and as they anticipated the implementation to be costly (Worldwatch Institute 2016).

(Dwaikat and Ali 2016) suggested stated that green building costs such as higher initial design and construction, extra costs of searching for green alternatives and certification processes as well as a long payback time of 20 years and more are some of the barriers to green building market readiness.

The perceived higher upfront cost by building owners and investors is frequently cited as a hurdle to a widespread adoption of green buildings. Several market surveys concluded that green building practitioners believe that the construction cost of the green building is significantly higher than that of its conventional counterpart (GBCSA et al. 2016).

Results rendered by studies conducted by USBGC and other researchers suggested that there is no significant variation between the cost of green buildings and conventional buildings. These researchers argued that green buildings cost is not greater than conventional buildings therefore even green buildings can be achieved with little or no added cost.

The recent study done in South Africa by the University of Pretoria, GBCSA and ASAQS have indicated that sustainable buildings generally incur a small green premium above the costs of standard construction (GBCSA et al. 2016).

The GBCSA study indicated that the South African property industry should expect the cost premium of building a new commercial green building to be between approximately 1% and 10% and this result is in line with the majority of research results, which perceived the initial cost to be between 5% and 10%. The study conducted in Singapore also confirmed that the green cost premiums range from 5% to 10% and that project type and size are significant factors affecting the cost premiums (Hwang et al. 2017).

2.14 Drivers of green buildings

As mentioned previously in this report that buildings have extensive direct and indirect impacts on the environment therefore over the past decades the built environment vigorously has taken part in the sustainability movement through the green building movement (WGBC 2013).

Besides responding to the call by the UN to save the environment, the built environment stakeholders will require some incentives that will drive them to adopt the green building concept taking into consideration that its implementation entail huge initial costs. The term ‘drivers’ in the context of this report refers to the factors that encourage adoption of green building practices.

Empirical studies conducted by Ahn et al. (2013); Qi et al. (2010) and Serpell et al. (2013) show that a number of identifiable drivers and mutual benefits with different priorities, according to country or region, for diverse stakeholders exist.

According to Darko et al. (2017), green building drivers can be grouped into five main categories: external drivers, corporate-level drivers, property-level drivers, project-level drivers, and individual-level drivers.

External drivers: Refer to the drivers are that are mainly set by external parties, such as government, United Nations (UN), European Union (EU), trade unions, and clients/customers, to companies or organizations that develops green building (Darko et al. 2017).

For instance, the EU requires all of its member states to meet higher efficiency standards and acquire energy performance certificates for all new construction and renovations, through the EU Energy Performance of Buildings Directive of 2002 (Darko et al. 2017 and Allouhi et al. 2015). The US also has several legislations, executive orders, and national policies that require or encourage GB actions in different states (Mulligan et al. 2014). In Asia countries such as China, Singapore, Hong Kong, and India are rapidly embracing the green building concept through their respective government national policies (Gou & Lau, 2014 and Ye et al. 2013). Incentives received from government like subsidies and tax benefits also drives the adoption of green buildings.

In South Africa the government introduced strict minimum standards for energy efficiency in new buildings and retrofits through NBRs, SANS 10400XA & SANS 0204 (Green Business Guide 2012). In a quest to adopt sustainability the SA government introduced legislation on the carbon tax aimed at businesses and companies that emit a high level of carbon, polluting the atmosphere. The carbon tax legislation is being implemented in order to facilitate the transition to a low carbon economy and reduce carbon emissions in the country by 34% by 2020 and by 42% by 2025 (Carbon Tax Policy Paper, 2013).

The government of South Africa is the largest owner of buildings and is also a tenant in most of the office buildings in South Africa. The Department of Public Works (DPW) is the custodian of all immovable assets vested in the national government, which are not otherwise vested in the custodianship of other departments through legislation; it has a responsibility to drive the green building practice in government (Department of Public Works 2011).

In attempt to drive the adoption of green buildings, the DPW has formulated the Green Building Policy that will guide the practice with regard to green buildings in both the public

and private sectors and through that policy a decision for government to lease green certified buildings has been adopted by a number of government departments.

Corporate-level drivers: These are the internal drivers that enhance business in terms of sustainability and image was identified as a corporate-level driver (Falkenbach et al. 2010). Companies would like to keep their image and reputation at high level for opportunities of enhanced marketability that could help them to increase their market shares as an integral part of the business strategy encourages green building adoption (Windapo 2014 and Zhang et al. 2011).

In South Africa it has become a norm for real estate companies to incorporate green building strategies in their day to day business, for instance Growthpoint which is the largest real estate company indicate their commitment to sustainable development by demonstrating in the marketing of space adverts the level of certification in all their buildings. They even published the Growthpoint sustainable brochure which showcases all their green certified buildings and that is made available to their potential clients (Growthpoint). Their green building strategies give them a competitive advantage over their competitors in the real estate market.

Property-level drivers: These drivers are related to the benefits received by the investor for investing in the green property asset and they include capital appreciation, higher rental income and improved cost saving factors (Issa et al. 2013).

In the absence of compelling legislation, most of the green buildings decisions and actions in the construction industry are based on financial returns therefore, stakeholders only use green options if they are financially viable (Udawatta et al., 2015; Windapo, 2014).

Decision makers in the real estate market will invest in property assets to benefit from maximization of the capital value of the building, and that can be achieved through decreasing costs, capitalization rates, and increasing income. In fact, the recognition that high operation and maintenance costs of buildings particularly, utility costs could be reduced through green design has been confirmed by several studies (Dwaikat and Ali

(2016) and Issa et al. 2013). This echoes with several other investigations, including Windapo (2014) who discovered in South Africa that rising energy costs has become a key driver for stakeholders to incorporate green building principles into their projects, and this driver has not changed significantly over time.

Project-level drivers: Project-level drivers Decisions at the project level have significant impact on the overall or final cost of the building. Making the right design decisions is therefore required to keep cost within an acceptable range (Darko et al. 2017)

Individual-level drivers: Individual-level drivers are relatively intrinsic and describe what internally drives people to want to move towards sustainability goals or adopt green building practices on their own projects. Four main individual-level drivers were identified as moral imperative or social conscience, personal commitment, attitudes and traditions, and self-identity (Darko et al. 2017).

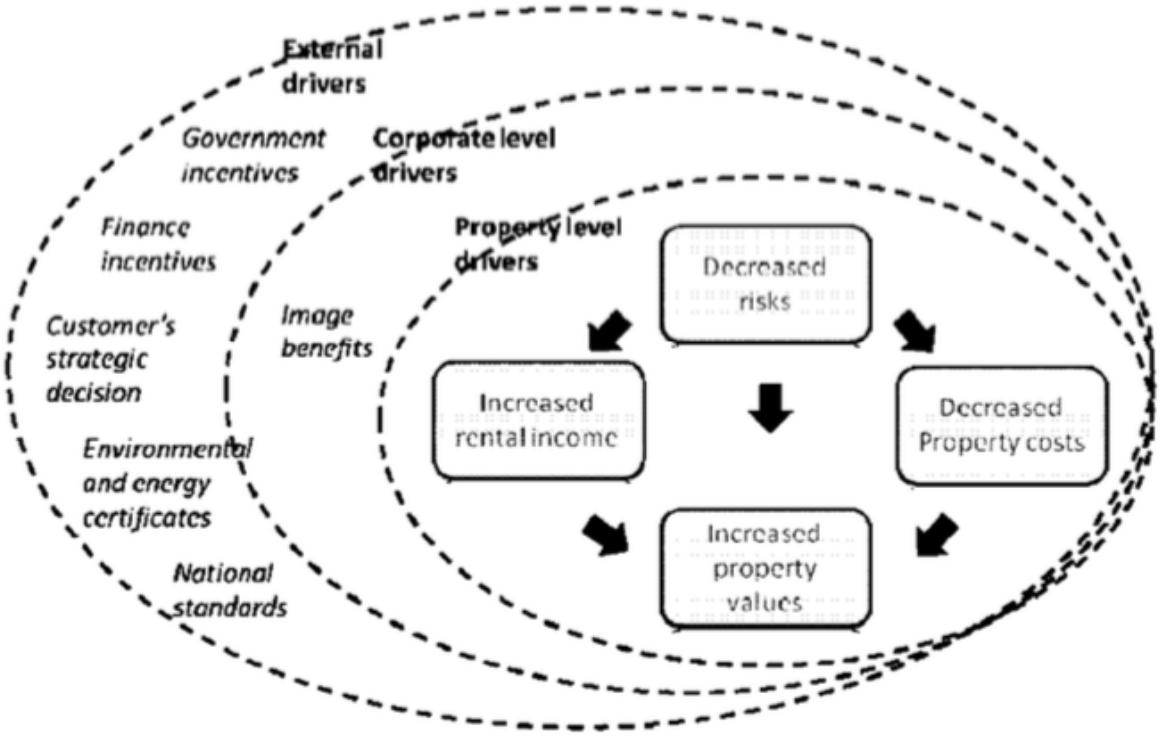

Figure 2: Drivers of green buildings and potential benefits for developers and investors

2.15 Similar studies investigating effects of certification on office rental

Even though the belief exists that obtaining a green building certification on offices have a potential of rendering financial benefits, literature review revealed that very limited empirical studies have been able to investigate the impact of various environmental certificates on the economic performance of real estate during the last few years (Falkenbach et al. 2010).

Kim et al. (2017)) also attested to the suggestion by Falkenbach et al. (2010) previous studies have shown that green buildings are not just environmentally friendly and energy efficient. In fact, they are also strong performers of the real estate market. Using regression analyses in conjunction with other techniques, literature found that green office buildings do command rental price premium over the comparable non-green office buildings. Several similar empirical studies were conducted in the developed countries like the US, UK, Netherlands, Canada and Australia on office buildings confirmed the existence of the financial benefits identified as the premium on both the rental price and sale price (refer to Table 3 below).

Eichholtz et al. (2010); Fuerst and McAllister, (2011); Kim et al. (2017); Miller, Spivey, and Florance (2008); Pivo and Fisher (2010); Reichardt et al. (2012); Robinson and Sanderford 2016; and Wiley et al. (2010) conducted similar studies in the US office market and such studies were published in the peer-reviewed international journal.

Most of these studies in the American market focused on the effect LEED and Energy Star has on office rental in America and they include researchers like (Eichholtz et al 2010; Fuerst and McAllister 2011; and Pivo and Fischer 2010) who used data from CoStar which is the data base for US office market asking rents. All these studies used a sample of multi-tenant office building in different cities of America comprising of two sets. One set comprised of offices certified as green by either LEED or Energy Star ratings or the other set comprised of conventional buildings. They used hedonic regression to analyse their

results and the outcome of their studies indicated that green certified offices commanded a rental premium that ranges between 3% and 10.9%.

The results of all these similar studies also confirmed the existence of the premium on the sale price that ranged between 16% and 26% (Eichholtz et al. 2010; Fuerst and McAllister 2011; Kim et al. 2017; Miller, Spivey, and Florance (2008); Pivo and Fisher, 2010; Reichardt et al. 2012; Robinson and Sanderford 2016; and Wiley et al. 2010).

In an effort to determine the financial benefits, these studies also confirmed that green certificated office buildings not only render a premium on the rental and sale price, but there were some other benefits that were identified as lower operating costs, higher occupancy rate, as well as positive image of buildings.

There is one recent similar study that was conducted in the developing country and that study also confirmed the premium rendered by green certified in Shanghai, China. It was conducted by Hui, Chan, and Yu (2015) and its aim was to examine whether Leadership in Energy and Environmental Design (LEED) certification yields additional premiums for Shanghai's office rental sector. The results rendered by the study confirmed the premium of 12.8% for LEED certified office as compared to non-LEED certified buildings. This result confirms that the market in China has confidence in LEED as an international rating system even the Chinese has their local rating system.

Closer to home similar studies in Australia were conducted by Newell, MacFarlane, and Walker (2014) and the Australian Property Institute (2011) to determine if there was a premium on the rental of green star certified office building as compared to non-green office buildings. The results of both these studies confirmed a rental premium between 3.6% and 9%. In conducting the South African research, the researcher will be referring to this research particular Australian research since the two country's the rating system are almost similar, that is, Green Star with the same characteristics.

Similar to the studies in the US and China, the Australian study also used hedonic regression model to isolate other property attributes that might have an influence on the

rental. The results of the study revealed that green certified offices commanded a rental premium of 6.6% and the sale premium of 11.5% as compared to the conventional counterparts. The South African research study will be referring more to the Australian study since the two countries are using similar rating systems and both countries are situated in Southern hemisphere.

Similar research studies were also conducted to capture the financial benefits rendered by the green certification in the European market. Researchers used green certified measures for BREEAM obtained from BRE (Chegut, Eichholtz, and Kok 2011; Kok and Jennen 2012; and Gabe and Rehm 2014).

The peer-reviewed studies in Europe also confirmed that green office buildings provide financial and non-financial benefits for tenants and/or owners through several mechanisms, such as premiums on property values and rents, lower operating costs, higher occupancy rates, and the positive image of buildings. The rental premium for Netherlands was found to be between 5.5% -10.2% and the UK market rendered excellent rental premium Rental 19.7% Sale 14.7%.

The overall objective of these studies was to investigate if green certification has an impact on economic profits like rent and sale price and they all confirmed the existence of the premium for both the rental rates and the sale prices averaged between 3% and 19% for rental market and between 5% and 28%.

All these research studies made use of the Hedonic regression model and through it, characteristics, neighborhood controls and contract features were identified in the international research as variables that affect rental and sales rates most significantly Building height, building size, location, green certification and renovations are noted as premium generating building variables (Chegut et al. 2014).

Green building movement in South Africa is gaining momentum since the establishment of the GBCSA in 2007 and the number of green building projects are growing at a rapid rate. Even though the movement is growing, very few research studies have been

conducted and such research focus on costs, policy and environmental benefits. According to GBCSA, the growth in green building is taking place in the office market but still there is currently very little research done in those markets.

The purpose of this study was to determine the effects of green star certification on the office rental. The study analyzed in detail similar studies that took place in both the developed and developing countries with the aim of determining the gaps in literature that require to be addressed especially in the South African context. To conduct the South African study, similar methods used by the international market will be used that is,

- The research will use the rental data obtained from the market comprising of Real estate brokers operating in the research area. Similar research studies also used rental and sale data obtained from brokers and property databanks in their area of operation (for the US and BRE CoStar for the UK).
- The green certification data will be obtained from the GBCSA and will be verified with the relevant brokers operating in the study area. Similar studies also used green certification sourced from their respective Green Building Councils (GBC's) like Costar in the UK and in the US.

Table 3: Studies on the effect of green certification on rental (from Kim, Lim, and Kim, 2017)

RESEARCHER	YEAR	ARTICLE	CONTEXT	ANALYTICAL METHOD	RENTAL PREMIUM
Robinson, S.J. and Sander ford, A.R.	2016	Green buildings: similar to other premium buildings?	US	Logistic regression, OLSDV regression, Propensity Score Matching technique	Rental 8% Sale 16%
Hui, E.C.M., Chan, E.W.F. and Yu, K.H	2015	The effect of LEED certification on Shanghai prime office rental value	China	Hedonic regression	Rental 12.8%
Fuerst, F. and van de Wetering, J.	2015	How does environmental efficiency impact on the rents of commercial offices in the UK?	UK	Hedonic pricing model	Rental 23%–26%
Newell, G., MacFarlane, J., and Walker, R.	2014	"Assessing energy rating premiums in the performance of green office buildings in Australia",	Australia	Hedonic regression method, Log value analysis, Correlation analysis	Rental 6.6% Sale 11.8%
Chegut, A., Eichholtz, P. and Kok, N.	2013	Supply, demand and the value of green buildings	UK	Regression analysis, OLS analysis, PSM, Semi log equation, Non parametric comparison	Rental 19.7%. Sale 14.7%
Eichholtz, P., Kok, N. and Quigley, J.M.	2013	The economics of green building	US	Regression analysis, OLS analysis, PSM, Semi log equation	Rental 3.5% - 7.9%
Kok, N. and Jennen, M	2013	The impact of energy labels and accessibility on office rents.	Netherlands	Regression analysis, Walk score algorithm, log equation	Rental 5.5%-0.2%
Reichardt, A., Fuerst, F., Rottke, N. and Zietz, J.	2012	Sustainable building certification and the rent premium: a panel data approach	US	Panel data regression (difference in difference (DID) and fixed models), cross sectional regression, Pooled OLS, Log-linear hedonic model	Rental 2.5% - 2.9%

Das, P., Tidwell, A. and Ziobrowski, A.	2011	Dynamics of green rentals over market cycles: Evidence from commercial office properties in San Francisco and Washington DC.	US	Regression analysis	Rental 2.4%
Fuerst, F. and McAllister, P.	2011 (c)	Green noise or green value? Measuring the effects of environmental certification on office values.	US	Robust regression analysis, OLS regression analysis, Fractional logit models, Log equation	Rental 3.0% –9.4%. Sale 19.7% - 28.4%
Fuerst, F. and McAllister, P.	2011 (b)	Eco-labelling in commercial office markets: Do LEED and Energy Star offices obtain multiple premiums?	US	Hedonic regression analysis, log equation, Least square dummy variable (LSDV) approach	Rental 4.1%
Fuerst, F. and McAllister, P.	2011	The impact of energy performance certificates on the rental and capital values of commercial property assets.	UK	Hedonic regression analysis, log equation,	Sale 32.3% – 3.6%
Pivo, G. and Fisher, J	2010	Income, value, and returns in socially responsible office properties	US	Panel regression	Rental 4.8%-5.2%
Wiley, J.A., Benefield, J.D. and Johnson, K.H	2010	Green design and the market for commercial office space.	US	OLS & 2SLS analysis, T-statistics, Hedonic regression analysis	Rental 7.6%–18.9% Sale 5.1% - 22%
Eichholtz, P., Kok, N. and Quigley, J.M	2009	Doing well by doing good? Green office buildings.	US	Hedonic regression analysis, Semi-log equation, PSM	Rental 6.% Sale 16%
Eichholtz, P., Kok, N. and Quigley, J.M	2010	Sustainability and the Dynamics of green Building.	US	Regression analysis, Log equation, PSM	Rental 3.4% –0.5%. Sale 9.9% - 21%
Robinson, S.J. and Sander ford, A.R.	2016	Green buildings: similar to other premium buildings?	US	Logistic regression, OLSDV regression, Propensity Score Matching technique	Rental 8% Sale16%
Hui, E.C.M., Chan, E.W.F. and Yu, K.H	2015	The effect of LEED certification on Shanghai prime office rental value	China	Hedonic regression	Rental 12.8%

Fuerst, F. and van de Wetering, J.	2015	How does environmental efficiency impact on the rents of commercial offices in the UK?	UK	Hedonic pricing model	Rental 23%–26%
Newell, G., MacFarlane, J., and Walker, R.	2014	"Assessing energy rating premiums in the performance of green office buildings in Australia",	Australia	Hedonic regression method, Log value analysis, Correlation analysis	Rental 6.6% Sale 11.8%
Chegut, A., Eichholtz, P. and Kok, N.	2013	Supply, demand and the value of green buildings	UK	Regression analysis, OLS analysis, PSM, Semi log equation, Non parametric comparison	Rental 19.7% Sale 14.7%
Eichholtz, P., Kok, N. and Quigley, J.M.	2013	The economics of green building	US	Regression analysis, OLS analysis, PSM, Semi log equation	Rental 3.5% - 7.9%
Kok, N. and Jennen, M	2013	The impact of energy labels and accessibility on office rents.	Netherlands	Regression analysis, Walk score algorithm, log equation	Rental 5.5%-0.2%
Reichardt, A., Fuerst, F., Rottke, N. and Zietz, J.	2012	Sustainable building certification and the rent premium: a panel data approach	US	Panel data regression (difference in difference (DID) and fixed models), cross sectional regression, Pooled OLS, Log-linear hedonic model	Rental 2.5%-2.9%
Das, P., Tidwell, A. and Ziobrowski, A.	2011	Dynamics of green rentals over market cycles: Evidence from commercial office properties in San Francisco and Washington DC.	US	Regression analysis	Rental 2.4%
Fuerst, F. and McAllister, P.	2011 (c)	Green noise or green value? Measuring the effects of environmental certification on office values.	US	Robust regression analysis, OLS regression analysis, Fractional logit models, Log equation	Rental3.0%–9.4% Sale 19.7%- 28.4%
Fuerst, F. and McAllister, P.	2011 (b)	Eco-labelling in commercial office markets: Do LEED and Energy Star offices obtain multiple premiums?	US	Hedonic regression analysis, log equation, Least square dummy variable (LSDV) approach	Rental 4.1%-5.1%

Fuerst, F. and McAllister, P.	2011	The impact of energy performance certificates on the rental and capital values of commercial property assets.	UK	Hedonic regression analysis, log equation,	Sale 32.3%–33.6%
Pivo, G. and Fisher, J	2010	Income, value, and returns in socially responsible office properties	US	Panel regression	Rental 4.8%-5.2%
Wiley, J.A., Benefield, J.D. and Johnson, K.H	2010	Green design and the market for commercial office space.	US	OLS & 2SLS analysis, T-statistics, Hedonic regression analysis	Rental 7.6%–18.9% Sale 5.1%-22.0%
Eichholtz, P., Kok, N. and Quigley, J.M	2009	Doing well by doing good? Green office buildings.	US	Hedonic regression analysis, Semi-log equation, PSM	Rental 6. % Sale 16%
Eichholtz, P., Kok, N. and Quigley, J.M	2010	Sustainability and the Dynamics of green Building.	US	Regression analysis, Log equation, PSM	Rental 3.4%–10.5% Sale 9.9% -21.0%

2.16 Literature overview

Findings from the peer reviewed literature indicate that green building is a global burning issue which is the major topic of discussion among governments, business and private communities. There is no doubt that global climate change and its consequences are real since its impact is identified in the form of rising temperatures, changing rainfall patterns and extreme weather conditions that occurring more often in all parts of the world.

Researchers agree that the humans in their daily activities contribute to the problem and experts are calling for immediate and far-reaching action to fight global warming and remedy its consequences. Literature has indicated one of the most important tasks to remedy the situation is to reduce greenhouse gas emissions. An increasing concentration level in the atmosphere is said to be the main reason for rising temperatures.

It also came out strongly that buildings over their life cycle account for a large share of global greenhouse gas emissions. The need to emphasize the urgency of sustainable development provokes the adoption of green buildings; therefore, the relevant stakeholders have an obligation to take action in this regard (World Green Building Council 2017).

The built environment had different names for green building as they are also known as sustainable buildings, ‘high performance’ buildings and energy efficient buildings. Literature review revealed that all these names refer to the buildings, which were created by adopting the practice of creating structures, and using processes that are environmentally responsible and resource-efficient throughout a building’s life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction.

Different countries and regions have a variety of characteristics such as distinctive climatic conditions, unique cultures and traditions, diverse building types and ages, or wide-ranging environmental, economic and social priorities – all of which shape their approach to green building.

At the same time, other studies demonstrate that green buildings need not cost much more to construct than less efficient buildings, particularly once government incentives are reflected. There is consensus among stakeholders regarding the cost of producing green buildings estimated at a range between 5% and 10%. There is an anticipation that the costs will eventually drop much less due to new technologies that are coming in the mainstream and knowledge among the stakeholders is also growing.

Several research studies have demonstrated that green buildings bring multiple benefits. They provide some of the most effective means to achieving a range of global goals, such as addressing climate change, creating sustainable and thriving communities, and driving economic growth. Green buildings generate benefits, not only from environmental efficiency, but also improved health and productivity, have a competitive advantage over conventional buildings and are more marketable.

In summary, these benefits of green buildings can be grouped within three categories: environmental, economic and social. The wealth of research and studies show that green buildings have characteristics and benefits that could influence value. Results showed that reduced lifecycle costs, energy saving, enhanced occupants' health and comfort, improved overall productivity, and environmental protection are the most reported benefits in the literature.

The business case for green buildings by now is widely accepted by academics and researchers and this backed by prominent studies which compared green certified buildings to conventional buildings and concluded that there was a rental premium ranging between 3% and the high of 28%.

Literature also indicated that the number of certification systems has surged in the last decade, although their usage remains limited outside the UK and the US. There is consensus among researchers that they are valuable since they help facilitate the move to greener buildings by enhancing the transparency of building operating costs and other sustainability metrics. Researchers agree that certification of green buildings do play a major role in the transition to a more efficient real estate sector.

New projects typically must, among other things, comply with more rigorous building codes and meet higher resource-efficiency standards in order to be certified. When executed well, investment decisions made on the basis of life cycle costing reduce performance risks and enhance the returns on the investment.

The challenge with the certification is that currently there are no globally agreed-upon standards and measurements for green buildings and certification systems due to climatic as well as historical differences.

South Africa has the highest green building share in the world, trumping countries such as the UK and the US, china, Singapore, Germany, and the historical green building market leader Australia. Electricity shortages and most recently the drought that's been with us the past two to three years have increased the level of awareness across the board and the property sector is one such sector that is beginning to show leadership in sustainability thinking.

There has been an increase in pressure to reduce the environmental impacts of the built environment, both internationally and in South Africa. This has led to more stringent building regulations by the government in the form of SANS 10400-XA:2011, which is enforceable by the National Building Regulations and Building Standards Act, the voluntary SANS 204 standard and possible implementation of energy performance certificates in the future. The SA governance is taking part in the sustainability movement as a result in 2015, it introduced legislation on the carbon tax aimed at businesses and companies that emit a high level of carbon, polluting the atmosphere.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction

The purpose of the study was to examine the financial benefits of green buildings by determining the existence of the rental premium deemed to be rendered by the Green Star SA certification in the offices in Sandton, South Africa. Literature review has confirmed that indeed green certified offices have rendered a rental premium as compared to their conventional counterparts in the international market.

Using the research onion model made popular by Saunders, Lewis, and Thornhill (2016) the researcher will clearly structure and design the framework that will guide the process of gathering evidence and data required to address the research problem (see figure 3 below).

The chapter aims to explain in detail the research methods and the methodology implemented for this study which will include the research philosophy, research approaches, methodological choices, research strategies, time horizon, data collection techniques and procedures. It will also discuss in details the ethical considerations that are applicable to the study and also deal with any limitations that may be posed by the study.

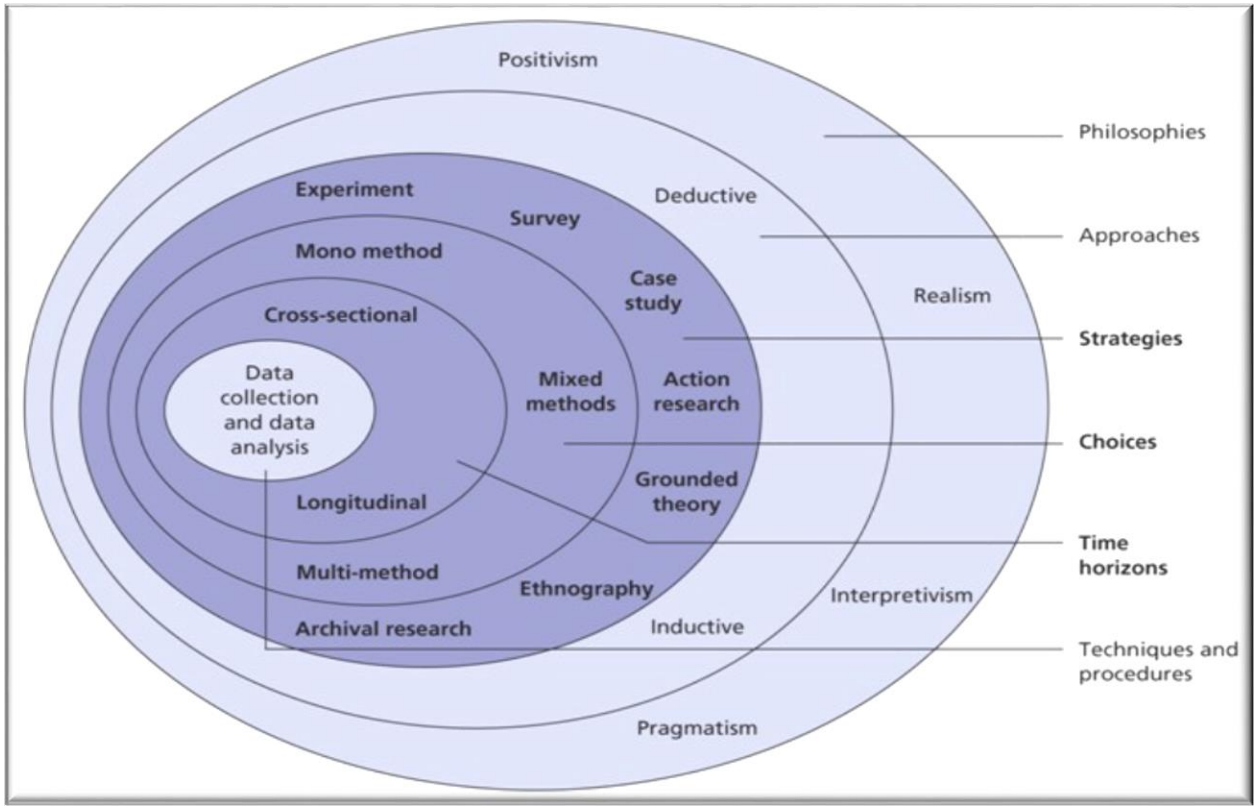

Figure 3: The research onion (Saunders et al. 2016)

3.2 Research philosophy

This is an empirical research study beginning with the assumption that “Green Star SA certified office space command rental, which is higher than conventional (non-green star certified) office space.” The formulated hypothesis simply states that Green Star SA certification (independent variable) have an influence on the market rental (dependent variable) of the office buildings, therefore this research study was conducted to test the relationship between these variables.

The researcher followed positivism as a research philosophy since the study allows the researcher to maintain the distance from the research subject. The role of the researcher is limited to data collection and interpretation in an objective way therefore minimal or no interaction with the owners of the properties will be maintained when conducting the research. To further justify the choice of a positivism philosophy, the study conducted a

deductive theory testing with the aim of finding evidence to either support or contradict the hypothesis that have been formulated (Saunders, Lewis, and Thornhill 2016).

The findings can easily be generalized to the green office markets of South Africa to explain rental difference amongst green certified and conventional office buildings and that will assist the space users in their choice of office premises.

Testing of the hypothesis is conducted using relevant research designs and techniques that include structured data collection, data analysis and presentation of research results. Based on the results of the data analysis, the hypothesis was to be either confirmed or rejected (see illustration below under quantitative method discussion).

3.3 Research approach

This study followed the deductive approach and it began with the development of the hypothesis that needed to be scientifically tested thereafter be confirmed, rejected or modified depending on the findings. According to Dudovskiy (2016), a deductive approach is concerned with "developing a hypothesis (or hypotheses) based on existing theory, and then designing a research strategy to test the hypothesis.

The study moved from general to specific in an attempt to test the theory of the rental premium rendered by green certification in office buildings that was theorized by previous studies. The study will attempt to explain the relationship between the two variables, measure the concepts quantitavely and generalize the findings to the office rental market in Sandton.

3.4 Methodological choice

The study comprises of both numerical and categorical data therefore the researcher chose a quantitative research method, which utilises organised procedures and

techniques to gather information and transforms what is collected or observed into numerical data (Saunders et al.2016).

The study gathered two sets of data namely, the asking rental which is numeric in nature and quantified in rands per square metre and, the green rating information and such which is categorical in nature, therefore a quantitative approach was found to be the most suitable. Once collected, the data would be analysed using inferential statistics and hedonic regression in order to be in line with other international researchers who conducted similar studies.

The use of quantitative method was found to be of advantage since it will allow possibilities for the research to be replicated as and when required and it also allow easy identification of relationships between variables (Kothari 2004 and Dudovskiy 2016). Its use is also in line with the research studies conducted worldwide on the similar subject for instance most of the similar studies used asking rentals obtained from either CoStar, BRE or IPD. They also used green certification data obtained from the relevant GBC's like USGBC for LEED information and EPA for Energy Star information in the US as well as BRE for BREEAM in the UK.

Summary of Quantitative Research illustrated

3.5 Research strategy

The purpose of this research was to test a research hypothesis by conducting a systematic literature review as well as by analysing secondary data extracted from the records of the Real Estate industry stakeholders. The data collection in this research was

done with the use of the existing information or archive documents and therefore it is referred to as archival research.

Even though the research tested the cause-effect relationship, it cannot be referred to as experimental since there is no manipulation of the independent variable; instead the researcher anticipates whether a relationship will exist between the variables (Saunders et al.2016 and Bell 2014). Both experimental and no-experimental strategies are normally associated with the deductive approach and they normally answer the “who, what where, how much and how many questions”.

3.6 Time horizon

The researcher aimed to execute the research within a short period and the data would be collected on a once off basis therefore the study made use of a cross sectional design. Data for the dependent variable (asking rents) was collected on a once off and include office space that was listed between 1 January 2016 and July 2017 whereas the data for the independent variable (Green Star SA certification was also collected on a once off and includes all office premises in Sandton that were certified from the 2009 to 2017.

Cross-sectional design, which enable the researcher to collect and analyse data over a short period of time for instance data for both the dependent and independent variables were downloaded from the websites of the relevant sources for a period of a month. The researcher opted for cross sectional design because was found to be the most popular in business and management research and it was also less expensive and convenient to conduct.

The cross sectional design was found also to be suitable found to be in line with the similar studies conducted previously by researchers including (Eichholtz et al. 2010; Fuerst and McAllister 2011; Kim et al. 2016; Miller, Spivey, and Florance (2008); Pivo and Fisher, 2010; Reichardt, et al. 2012; Robinson & Sander ford 2016; and Wiley et al. 2010).

3.7 Research techniques and procedures

3.7.1 Data collection

The aim of this study was to determine the effects of Green Star SA on the rental of office buildings in Sandton. The study used two sets of secondary data, that is, data collected by someone else for a different purpose (Johnston 2017).

One set of data comprising of Green Star SA certified office space was sourced from GBCSA. The second set of data comprising of asking rental data sourced from the websites of the commercial brokers operating in Sandton was used in the study.

This technique is in line with the research studies conducted internationally since most previous studies used sets of data of certification like LEED and Energy Star in the US for the green building measure obtained from USGBC and EPA accordingly. Such research practices were confirmed by the US studies conducted by (Eichholtz et al. 2010; Fuerst and McAllister 2011; Kim et al. 2016; Miller, Spivey, and Florance (2008); Pivo and Fisher 2010; Reichardt et al. 2012; Robinson & Sanderford 2016; and Wiley et al. 2010).

The European studies used green certified measures for BREEAM obtained from BRE and studies conducted in the UK and EU building market within this field by researchers like (Chegut, Eichholtz, and Kok 2011; Kok and Jennen 2012; and Gabe & Rehm 2014) also used the same principles.

Once data for both the dependent and independent variable were identified the researcher validated them by testing them against the following validating:

(a) For what purpose was the data collected? (b) Who collected the information?

(c) What type of information was actually collected? (d) When was the information collected? (e) How was the information obtained? And (f) How consistent is the information obtained from one source with information available from other sources?

The following answers confirmed the validity of the secondary data for both variables of the study:

(a) Data for the dependent variable (rental) was collected for the purpose of selling the available vacant office premises to the potential tenants whereas the data for the independent variable was collected for the purpose of certifying different office buildings

(b) The rental was collected by the commercial property brokers whereas the certification information was collected by the GBCSA

(c) The asking rental was collected for the dependent variable whereas the Green Star SA category was collected for the independent variable

(d) The rental information was collected between 2016 and 2017 for rental and from 2009 for the independent variable.

(e) Rental information were obtained from the listing owners and managing agents whereas the certification information was obtained from the GBCSA who certified the buildings in question.

(f) The rental information was found to be consistent since some office premises were found to be listed in several different commercial broker websites, that is, they were multi-listed.

3.7.2 Data collection technique

The research study used secondary data, which have already been collected by someone else for a different purpose other than this particular study (Johnston 2017). This data is referred to as secondary because the researcher did not source it raw from different property owners, but it was sourced from the property brokers who initially sourced it from the different owners.

The study downloaded secondary quantitative data, which was intended for the use of the public as marketing information and industry knowledge. The criteria that was

identified by (Johnston 2017) which included availability, relevance, appropriateness, reliability and replicability were utilised in the identification of the relevant data. The research required two sets of basic data to be collected namely:

1. Monthly asking rental of office buildings in the study area and
2. Green Star SA certification information for office building in the study area

Asking rentals:

- Refer to “rental amount at which the Landlord is offering the property for leasing.” Asking rental is a dependent variable which is a numerical value measured in rand per square meters obtained from commercial property brokers who are active in the research area,
- The rental data used in the research comprise of vacant office space listed between January 2016 and July 2017. The asking rental data for the listed vacant office space was downloaded from the websites of Commercial Brokers operating in the study area, property owners and property developers.
- Leasing brochures and any other source used by brokers for marketing the vacant space were also utilized to collect data.

Green Star SA certification information

- Information about the status of Green Star certification on office buildings in the study area.
- Other set of data comprise of Green Star SA certification awarded by the GBCSA to those buildings which conform to the required green building standards as set out by the WGBC.

Such buildings are certified by GBCSA as green buildings with a Green Star A certification rating of 4; 5; and 6 (4 Green Star SA certified rating recognizes best practice; 5 Green Star SA certified rating recognizes South African excellence; and 6 Green Star SA certified rating recognizes world leadership). Data of the Green Star SA offices was

obtained from the website of the GBCSA by downloading the latest updated record of all buildings certified dating from the establishment of the GBCSA to December 2017.

The researcher used additional sources like online records of publishing institutions like SAPOA, Broll, CBRE, JLL reports, and IPD Property index to gain more insight on the market information like office grading levels, rental escalation rates as well as asking rental going rates.

In order to obtain the sample data, the researcher analyzed different the websites of the commercial brokers and downloaded 105 multi tenanted office buildings, which possessed some pockets of vacant office space in the study area. Out of the 105 office buildings, 511 vacant office space with different office grading varying from P-Grade, A-Grade, AAA-Grade, and B-Grade were identified and formed part of the sample. The asking rental data for the 511 listed vacant office space was recorded and it comprise of the rental of office space that was listed between 1 January 2016 and July 2017.

The sample data was downloaded from the websites of different commercial brokers including 3Cube, Abland, Anvil, Ashbrook, Black Pepper Properties, Broll International, Colliers International, Eris Property Group, JHI, JLL, Knight Frank, New Vantage Properties, Officebook, Redefine, Renprop Commercial, Space Online Group Rent Spice and Zenprop. One set of data comprising of Green Star SA certified office space was sourced from the website of GBCSA.

3.7.3 Data analysis technique

This quantitative research utilised two techniques to analyse data namely, descriptive statistics and hedonic regression which is in line with the previous similar studies conducted by Eichholtz et al. (2010); Fuerst and McAllister (2011); Kim et al. (2016); Miller, Spivey, and Florance (2008); Pivo and Fisher, (2010); Reichardt, et al. (2012); Robinson & Sanderford (2016); and Wiley et al. (2010).

3.7.4 Descriptive Statistics

The study used descriptive statistics to analyse the variables of the sample with quantitative value, which is asking rent per square meters and listed vacant space size in square meters' terms of this research study. The statistical analysis focused on determining the mean, median and standard deviation of all variable for both the Green Star SA certified office space and conventional office space and it would be presented in tables and histograms.

3.7.5 Hedonic Regression Analysis

According to Dunse and Jones, (1998) an office property is a heterogeneous good whose rental value is normally dependent upon a number of property related attributes and they include physical attributes and location attributes. This notion is informed by the rental theory that was introduced by Alonso in 1964. The theory indicated that the rent is determined by land and its location. This theory is applied to the modern times where the land and buildings, location and a number of attributes that makes the space available for rent to be attractive to the potential tenants' influence rent.

Physical attributes include condition of the building, building age, building height, adequate parking, size of the building in square metres and proximity to essential amenities. Location attributes include distance from the CBD or access to transit or public transport. The physical attributes in this study with the exception of size are grouped together and referred as office grades or office class (P- Grade, A- Grade, AAA- Grade, and B- Grade).

In order to control these attributes, the research study used hedonic regression model, which is in line with the previous research conducted by several researchers in the UK, US and Australia. The use of hedonic regression (see below) is of utmost importance in the determination of the office rent since it allows the researcher to account for these attributes (Dunse and Jones 1998; and Newell, MacFarlane, and Walker 2014).

3.7.6 Description of variables

The study comprises of one dependent variable namely asking rent (Y) and four independent variables (X) namely Green Star SA certification, size of the listed premises, grade of the building and location of the building. Asking rent (Y) and size are numeric and they are measured in rands per square meter whereas all the other variables are categorical and they bare assigned a dummy measurement of 0 and 1 (see table 4 below).

Table 4: Description of variables

VARIABLES	VARIABLES CODE	MEASURE	DESRIPTION
Rent per m² (Y)	RENT/M²	Number	Asking rent of listed vacant office space in m²
Office area/m² (X)	SIZE/M²	Number	Area of listed vacant office space measured in m²
Green Star SA (X)			
3 Star Green Star SA (X)	Star 3	Dummy	Green Star SA certification level 3
4 Star Green Star SA (X)	Star 4	Dummy	Green Star SA certification level 4
5 Star Green Star SA (X)	Star 5	Dummy	Green Star SA certification level 5
6 Star Green Star SA (X)	Star 6	Dummy	Green Star SA certification level 6
Office Grade/Class (X)			
A-Grade (X)	A-GR	Dummy	SAPOA - Office grade A
AAA-Grade (X)	AAA-GR	Dummy	SAPOA - Office grade AAA
P-Grade (X)	P-GR	Dummy	SAPOA - Office grade P (Premium top of range)
B-Grade (X)	B-GR	Dummy	SAPOA - Office grade B (Older than 15 years)
Location (X)			
Central Core (X)	AREA 1	Dummy	Location in CBD, near amenities
Illovo (X)	AREA 2	Dummy	Location in Illovo
Periphery (X)	AREA 3	Dummy	Location out of the CBD, away from amenities
Wierda Valley (X)	AREA 4	Dummy	Location in the Wierda Valley area

3.7.7 Hedonic regression model

$$\ln R_i = \beta 0 + \beta 1 \ln AGR_i + \beta 2 \ln AAAGR_i + \beta 3 \ln PGR_i + \beta 4 \ln BGR_i + \beta 5 \ln AREA1_i + \beta 6 \ln AREA2_i + \beta 7 \ln AREA31_i + \beta 8 \ln AREA41_i + \beta 9 \ln STAR3_i + \beta 10 \ln STAR4_i + \beta 11 \ln STAR5_i + \beta 12 \ln STAR6_i + \beta 13 \ln SIZE_i + \varepsilon_i$$

The different symbols used in the model are defined as follows:

3.7.8 Main variables in the study

Main variables comprise of dependent variable (asking rent R*i*) and independent variable (Green Star SA categorized as Green Star SA 3 (STAR3*i)***,** Green Star SA 4 (STAR4*i*), Green Star SA 5 (STAR5*i*), and Green Star SA 6 STAR6*i*)

- R*i* – represents the natural log of average rental amount, which is a numerical value, measured in South African R/m² (Dependent variable).
- STAR3*i*, STAR4*i*, STAR5*i* and STAR6*i* - represent the different levels of different Green Star SA certification. It is also variable which is assigned a value of either 0 or 1 (Independent variable).

3.7.9 Other independent variables (attributes)

- **Office grade -** AGR*i*, AAAGR*i*, PGR*i* and BGR*i* - represent the different levels of office grade which is a categorical variable commonly known as a binary or a dummy variable. The variable is assigned a value of either 0 or 1.
- **Location -** AREA1*i*, AREA2*i*, AREA31*i* and AREA4*i* - represent the different levels of different location determined as a distance away from the Central Business District. It is also variable which is assigned a value of either 0 or 1.
- **Size -** SIZE*i* – this is a numerical variable representing the size of the listed office space measured in square meters

3.7.10 Symbols used in the regression analysis

- The εi *is* the statistical error term, which is assumed independent across all observations and normally distributed with constant variance and a mean of zero.
- β – represents the statistical parameter that the model aims to estimate

The hedonic price model is estimated using regression analysis in which the dependent variable is asking rent. The independent variables comprise of the main variable of this study (Green Star SA) as well as the previously mentioned physical, location attributes, and they are expressed as dummy variables in a binary code (Dunse and Jones 1998).

3.8 Description of the sample

The study sample comprise of listed vacant office space from several office buildings situated in the famous office node of Sandton picked from the population of all office buildings in Sandton (see Appendix A).

The study focused on office buildings that falls in a specific location bordered by Grayston, Katherine and Rivonia Roads. Office buildings situated in Wierda Road was also included in the study (refer to figure 1). The office buildings included in the sample are in a fairly good condition as the majority of them falls within the top office grades namely, A, AAA, and P. A handful of office buildings were found to be B-grade and this is an indication that a number of buildings have undergone major renovations.

The area of study, which is the location bordered by Grayston, Katherine; and Rivonia Roads comprise of different types of properties namely offices, residential units, retail and hospitality properties. Amongst all the variety types of properties, the study opted for office buildings because according to GBCSA, Sandton has the majority of Green Star SA certified office buildings in South Africa. The researcher believes that by choosing offices, Sandton as a study would allow availability of adequate data and information required by the study.

According to Green Building Council of South Africa there are 280 buildings certified, as green buildings in South Africa and the bulk of them comprise of offices situated mainly in Gauteng and the Western Cape provinces (GBCSA et al. 2016). GBCSA further indicated that the Gauteng green building offices are concentrated mainly in Sandton and surroundings. Based on that information, the study used a convenient sample of multi tenanted office buildings situated in Sandton Central Business District considering the adequate data anticipated (see Appendix B).

Only offices certified using Green Star SA Office v1 rating tool and classified as “as built projects or design projects according to GBCSA standards. The researcher made use of the locality plan showing all commercial buildings in Sandton and surroundings obtained from the Central Management District (SCMD) to identify office buildings in the study area (see figure 4 below).

Not all office buildings are the same, as a result the real estate industry globally established a general classification system that is used to categorize them depending on what sector of the market they are in, the size and age of the unit, their usage type, the condition of the building, features they have as well as where their location. Commercial real estate brokers use these classes to prepare market data and justify the prices of spaces within office buildings (refer to grade description below by SAPOA (2017).

P-grade (Prime grade): Top quality, modern space, a pacesetter in establishing top-range rentals. Essential features include high security (manned and electronic), backup generator and water tank. They also feature the latest or recent generation of building services, ample on-site parking, prestigious lobby finish and a good environment (SAPOA 2017).

A-grade: Buildings not older than 15 years and have generally undergone major refurbishments. They feature high quality modern finishes, air conditioning, and adequate on-site parking, with market rentals near the top of the range in the metropolitan areas where they are located. Backup generator is also essential in such buildings.

B-grade: Generally, older buildings, but accommodation and finishes are close to modern standards as a result of refurbishments and renovation from time to time, air conditioned, on-site parking, unless special circumstances pertain.

C-grade: Buildings with old style finishes, services and building systems. May or may not be air-conditioned or have on-site parking. No C-grade office buildings were found in Sandton; hence they are not included in the research sample.

In conclusion the research sample comprise of 511-listed office space (situated in 105 buildings). The size of the listed space ranges between 50m ² and 15 000m ².The 511-listed vacant space comprise of both Green Star SA certified space and conventional office space and they are classified into relevant office grades namely P-grade; A-grade; AAA- grade as well as B-grade.

Hedonic regression analysis was used in order to account for the abovementioned property attributes that influenced the rental value of the office building and determine the extent by which each attribute affected the rental price of the listed office space in the study area.Out of the four identified independent variables (X), only one variable namely the office area in square metres was numerical in value and the other three variables were all categorical therefore were assigned a dummy value of either 0 or 1 in the regression model. The research used the rental model displayed below to perform the hedonic regression in order to determine the effect of each of the independent variables mentioned in this report. Fuerst.and McAllister (2011) applied the same model to measure the effect of both LEEDS and Energy certification on the office rental in the US market.

3.9 Description of the study area

The research was conducted in Sandton, which is the most popular decentralized office area in the City of Johannesburg, South Africa. Sandton is regarded as a major economic

hub in South Africa and it is being labeled as the ‘Africa’s richest square mile” (Jones Lang LaSalle 2017).

Sandton is home to major corporates, which includes South Africa’s top investment banks, financial consultants and legal firms, such as the Johannesburg Stock Exchange, EY, Webber Wentzel, Norton Rose etc. (Broll 2016). This popular node is a mixed-use node, offering premier office space, retail amenities as well as affluent medium rise townhouses and high rise residential apartments.

The Sandton node continues to be South Africa’s premier office location and is expected to grow cautiously. Currently about 250 000m ^{2} new office developments are coming to the main stream during 2017 and 2018. According to GBCSA, Sandton has the highest number of green buildings in Gauteng therefore, it was found to be suitable for the study.

Figure 4: Sandton Central Map of the Research Area (SCMD 2015)

3.10 Ethical considerations

The research used two sets of basic data to be collected namely, monthly asking rental of office buildings in the study area and Green Star SA certification information for office building in the study area.

Both these data sets were gathered from the public platforms that is, websites and brochures of different commercial brokers for asking rentals and the website of GBCSA for Green star SA information, therefore no special consent was necessary in order to access them. Ethical clearance was obtained from the Wits Ethical Committee even though data used was secondary because the researcher at some stage had unstructured telephone contact with some of the commercial brokers.

CHAPTER 4 DATA ANLYSIS AND RESULTS

4.1 Introduction

The aim of this study was to determine the effects of Green Star SA on the rental of office buildings in Sandton. In order to execute the study, two sets of secondary data were collected from two electronic sources namely, websites of Commercial brokers for asking rentals and GBCSA for Green Star SA information.

This method of data collection is in line with the practices followed by other researchers worldwide. The method was popular among the similar studies conducted by researchers like Eichholtz et al. (2010); Fuerst and McAllister (2011); Kim et al. (2016); Miller, Spivey, and Florance (2008); Pivo and Fisher, (2010); Reichardt, et al. (2012); Robinson & Sanderford (2016); and Wiley et al. (2010) in the US, who used secondary data from the popular brokerage company named Costar.

Studies conducted in the European Countries also confirmed that the use of this method popular among researchers as they also used rental information obtained from local brokerage companies, information from BRE as well as Costar. In the collection of the second set of data the study also followed the same techniques used by researchers in similar studies who used their relevant GBC's to collect the green building measuring information and they include USGBC for LEED, EPA for Energy Star and BRE for BREEAM.

4.2 Analysis of listed vacant office space

The researcher collected data comprising of a total of 511-listed vacant office space from 105 office buildings comprising of both Green Star SA certified and conventional space from the websites of the Commercial Property Brokers who are active in the study area.

Since the purpose of the study was to compare the rental between green buildings and conventional buildings, the researcher determined the Green Star SA certified office space by analyzing the second set of data comprising of Green Star SA information

obtained from GBCSA. Out of the available data of 511 listed vacant offices only 203 listed office space which amounted to 39.7% of the sample were Green Star SA certified and the rest of the space amounting to 308 which made 60.3% of the sample were conventional (refer to Table 5 and figure 5 below).

Table 5: Total number of all listed vacant office space in the research area

	Frequency	Percentage
Green Star SA certified	203	39.7
Non Green Star SA certified	308	60.3
Total	511	100

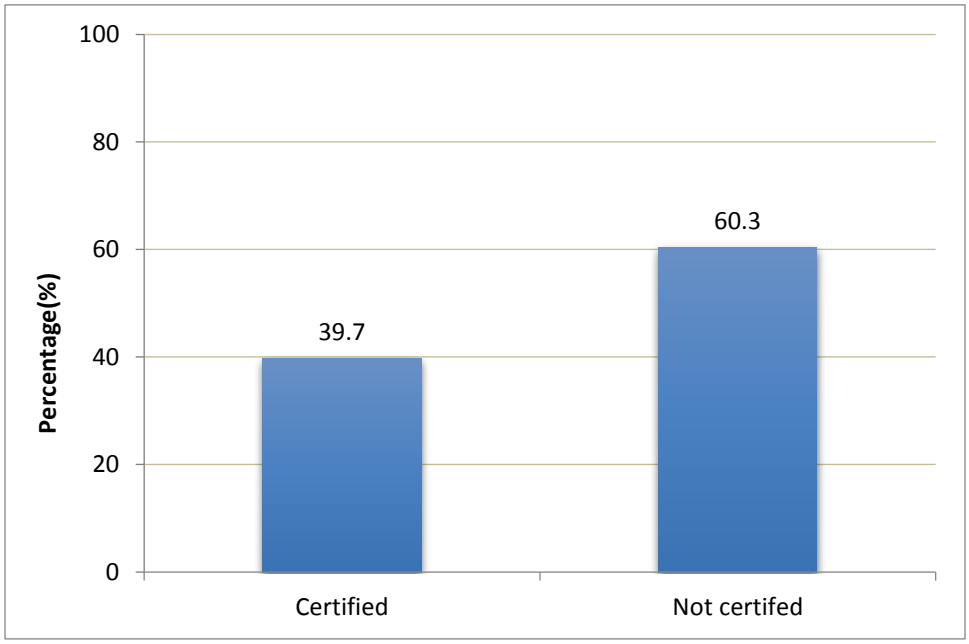

Figure 5: Percentage of listed office certified and not certified space in the research area

Both the table 5 and the figure 5 displays the distribution of both Green Star SA certified and conventional listed vacant office space in the study area. It is evident from both table 5 and figure 5 that a bulk of the space listed as vacant in the study area were not Green

Star SA certified. This revelation is familiar in the green building markets since previous studies worldwide have attested to the notion.

The study by (Fuerst, Kontokosta, and McAllister 2014.) have indicated that even though the rates of adoption of certification was showing growth, LEED-certified stock accounted for a relatively small proportion estimated at less than 1% the total commercial stock in the US market.

4.3 Analysis of office grading status

Table 6: Descriptive statistics showing different office grades

A-Grade		AAA-Grade		P-Grade		B-Grade	
Mean	0,001957	Mean	0,23092	Mean	0,191781	Mean	0,04501
Standard Error	0,001957	Standard Error	0,018661	Standard Error	0,017433	Standard Error	0,009181
Median	0	Median	0	Median	0	Median	0
Mode	0	Mode	0	Mode	0	Mode	0
Standard Deviation	0,044237	Standard Deviation	0,421834	Standard Deviation	0,394087	Standard Deviation	0,207529
Sample Variance	0,001957	Sample Variance	0,177944	Sample Variance	0,155305	Sample Variance	0,043068
Kurtosis	511	Kurtosis	-0,36104	Kurtosis	0,467858	Kurtosis	17,44648
Skewness	22,60531	Skewness	1,280776	Skewness	1,570364	Skewness	4,402069
Range	1	Range	1	Range	1	Range	1
Minimum	0	Minimum	0	Minimum	0	Minimum	0
Maximum	1	Maximum	1	Maximum	1	Maximum	1
Sum	1	Sum	118	Sum	98	Sum	23
Count	511	Count	511	Count	511	Count	511

Results of the analysed sample in table 6 is skewed to the right because the office market of Sandton is dominated by the A-grade offices and there is a sizeable number of AAA – grade. There is a small percentage of P – grade offices with a much higher rental and they automatically skew the distribution to the right. The B - grade office space is just a

handful and such buildings are at a high risk and will soon suffer from economic obsolescence in terms of design and purpose over a period of time.

With further analysis the researcher grouped the data of both Green Star SA certified and conventional 511-listed vacant office space according to different office grade varying from P-Grade, A-Grade, AAA-Grade, and B-Grade.

The listed vacant office space for both Green Star SA certified and conventional referred to include all office grades namely P-grade; A-grade; AAA- grade as well as B-grade (see table 7 and figure 6, below).

- 273 listed vacant office space amounting to (53.4%) were classified as A-grade;
- 117 listed vacant office space amounting to (22.9%) were classified as AAA-grade;
- 98 listed vacant office space amounting to (19.2%) were classified as P-grade and
- 23 listed office space amounting to (4.5%) were classified as B-grade

Results of the analysed sample in table 6 indicate that the office market of Sandton is dominated by the A-grade offices and there is a sizeable number of AAA - grade, and there is a small percentage of P – grade offices. The B - grade office space is just a handful and such buildings are at a high risk and will soon suffer from economic obsolescence in terms of design and purpose over a period of time (Issa, et al. 2013).

Study area having office space, which is in good condition based on the number of offices falling on top office grade. This mean that a bulk of these buildings were built within the period of ten years or else they were renovated as stated by Broll in the explanation of the different office grades.

Table 7: Office grading for certified and uncertified listed offices in the research area

	Frequency	Percentage
A	273	53.4
AAA	117	22.9
B	23	4.5
P	98	19.2
Total	511	100

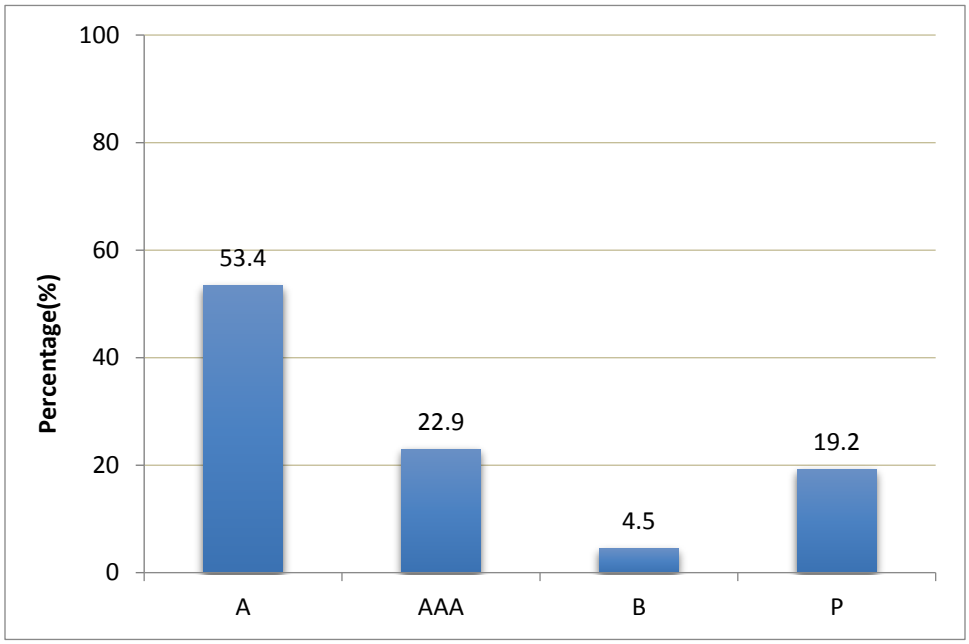

Figure 6: **Office grading for certified and not certified listed offices in the research area**

Analysis of the status of different Green Star SA levels

As mentioned earlier in this report that only 203 listed office space out of the 511-listed vacant office space, which amounted to 39.7% of the sample, were Green Star SA certified in Sandton.

This 39% was certified as either 3 Star Green Star SA (Good Practice); 4 Star Green Star SA (Best Practice); 5 Star Green Star SA (South African Excellence) and 6 Star Green Star SA (World Leadership)

The listed vacant office space for both Green Star SA certified and conventional referred to include all office grades namely P-grade; A-grade; AAA- grade as well as B-grade. Analysis of the records of GBCSA indicated that out of the 203 Green Star SA certified listed office space the following numbers prevailed (refer to Table 8 and Table 9 below):

- 26 listed office space that were certified as 3 Star Green Star SA that amounted to (12.8%).
- 165 listed office space which amounted to (81.3%) were certified as 4 Star Green Star SA;
- 9 listed office space which amounted to ((4.4%) were certified as 5 Star Green Star SA and
- 3 listed office space that amounted to (1.5%) were certified as 6 Star Green Star SA.

Table 8: **Green Star SA Certified listed office space in the research area.**

	Frequency	Percentage
3 Star Green Star SA	26	12.8
4 Star Green Star SA	165	81.3
5 Star Green Star SA	9	4.4
6 Star Green Star SA	3	1.5
Total	203	100

The figures tabulated in both table 8 and table 9 suggests that 4 Star Green Star SA certified offices are dominant in the study area.

Table 9: Descriptive Statistics results showing Green Star SA certification levels

3 STAR		4 STAR		5 STAR		6 STAR	
Mean	0,050881	Mean	0,322896	Mean	0,019569	Mean	0,005871
Standard Error	0,009731	Standard Error	0,020705	Standard Error	0,006134	Standard Error	0,003383
Median	0	Median	0	Median	0	Median	0
Mode	0	Mode	0	Mode	0	Mode	0
Standard Deviation	0,219969	Standard Deviation	0,468042	Standard Deviation	0,138651	Standard Deviation	0,076471
Sample Variance	0,048386	Sample Variance	0,219063	Sample Variance	0,019224	Sample Variance	0,005848
Kurtosis	14,86422	Kurtosis	-1,42837	Kurtosis	46,58627	Kurtosis	166,9803
Skewness	4,099519	Skewness	0,75976	Skewness	6,957294	Skewness	12,97408
Range	1	Range	1	Range	1	Range	1
Minimum	0	Minimum	0	Minimum	0	Minimum	0
Maximum	1	Maximum	1	Maximum	1	Maximum	1
Sum	26	Sum	165	Sum	10	Sum	3
Count	511	Count	511	Count	511	Count	511

4.4 Summary of office grades and Green Star SA status

Overall, the research sample of both Green Star SA certified and conventional 511 listed vacant office space represented all office grade namely P-Grade, A-Grade, AAA-Grade, and B-Grade.

The two groups of Green Star SA comprising of 203 listed office space and conventional comprising of 308 vacant listed offices were further analyzed to the percentage of the different grades allocated per group and the result are as follows (refer to Table 10 below):

- Out of the 273 listed vacant office space classified as A-grade; 53 were Green Star SA certified
- Out of the 117 listed vacant office space classified as AAA-grade; 56 were Green Star SA certified

- Out of the 98 listed vacant office space classified as P-grade; 94 were Green Star SA certified
- None of the 23 listed office space classified as B-grade were Green Star SA certified

Results of the analysed sample indicate that the office market of Sandton is dominated by the A-grade offices and there is a sizeable number of AAA - grade, and there is also a small percentage of P – grade offices. The P-grade listed office space had more Green Star SA certified office and that support the notion by (Fuerst, Kontokosta, and McAllister, 2014.) who suggested that certified buildings are mostly new buildings and they being seen as luxury goods that are more likely to be acquired by those stakeholders who are more affluent.

The dominance of the A – grade and AAA- grade in study indicate that Sandton is indeed a prime office node, having office space, which is in good condition based on the number of offices falling on top office grade. This mean that the age of a bulk of these buildings is less than fifteen years or else they were renovated as stated by Broll in the explanation of the different office grades. The B - grade office space is just a handful and such buildings are at a high risk and will soon suffer from economic obsolescence in terms of design and purpose over a period of time (Issa et al, 2013).

Table 10: Summary of all listed vacant space showing office grades and Green Star SA status

Office grades	3 Star Green Star SA	4 Star Green Star SA	5 Star Green Star SA	6 Star Green Star SA	Not certified	Total listed office space per grade
A-Grade	20	30	0	3	220	273
AAA-Grade	0	48	8	0	61	117
B-Grade	0	0	0	0	23	23
P-Grade	6	87	1	0	4	98
Total certified					Total not certified	Total listed office space for all grades and all Green Star SA certification
203					308	511

4.5 Analysis of the sample in terms of rental

Table 11: Descriptive analysis of rental

RENT/M²		AREA/M²	
Mean	174,2367906	Mean	1777,563464
Standard Error	1,75245649	Standard Error	197,9705265
Median	165	Median	534
Mode	160	Mode	5000
Standard Deviation	39,61482067	Standard Deviation	4475,184945
Sample Variance	1569,334016	Sample Variance	20027280,29
Kurtosis	-0,592349278	Kurtosis	52,23952283
Skewness	0,360061344	Skewness	6,359444229
Range	200	Range	49987
Minimum	75	Minimum	13
Maximum	275	Maximum	50000
Sum	89035	Sum	908334,93
Count	511	Count	511

Both table 12 and figure 7 below outlined the average rent for the different office grades on both Green Star SA certified and conventional listed office space in the study area.

The results of this study indicated that Green Star SA certified offices do command higher rental than conventional offices therefore the research hypothesis is supported. They also highlighted different premiums for different Green Star SA levels for instance R8.95 for A-grade, which amounts to 5.6%, R26.32 for AAA-grade, which amounts to 15%, and R3.33 for P- grade amounting to 1.6%.

The results also indicated that there was no significant premium between Green Star SA certified and conventional office space among the P-grade offices. This result indicates that even though tenants are prepared to pay a premium for the green certified offices, they are only prepared to pay for the green features that are not referred to as luxury, hence the majority were willing to pay for Green Star SA 4 Green Star SA 5 in a small scale. This takes us back to the suggestion made by (Fuerst et al. 2013) that certified buildings are most or the time being labelled as luxury goods that are more likely to be acquired by those stakeholders who are more affluent.

Table 12: Average rent for different office grades both Certified and conventional listed office space in the study area

Green Star SA certified		Conventional office space		Rent Premium	% Premium
Class	Mean	Class	Mean		
A	R169,30	A	R160,35	R8,95	5.6
AAA	R199,30	AAA	R172,98	R26,32	15
B	R0,00	B	R128,39	0	0
P	R205,83	P	R202,50	R3,33	1.6

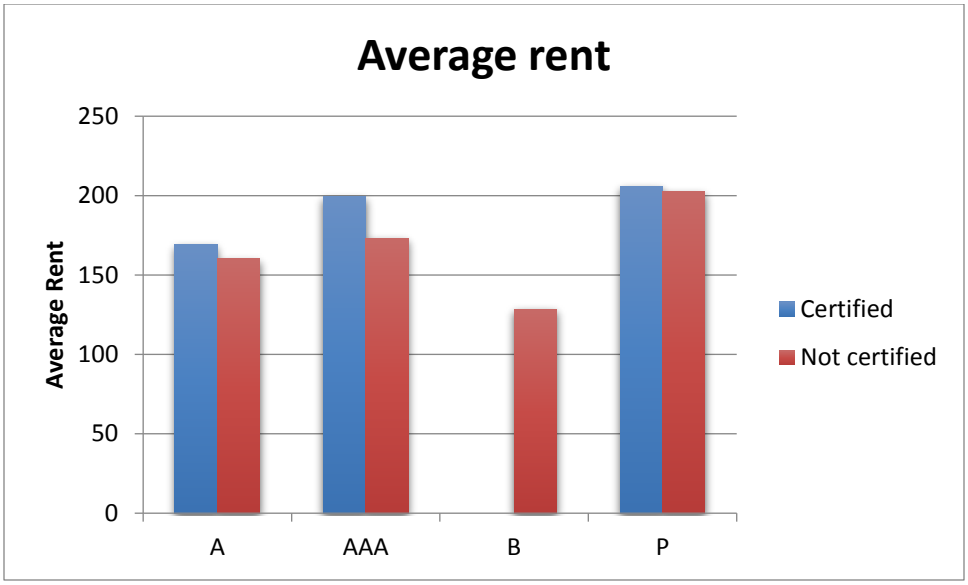

Figure 7: **Average rent for different office grades for certified and conventional offices**

4.6 Rental analysis according to different levels of Green Star SA certification

The sample was further analyzed to compare the rental differentiation among the different levels of Green Star SA certification and the analysis rendered the following results (refer to Table 13 and figure 8 below).

- Star Green Star SA, comprised of 20 A-grade office space at a rental of R169.25/m² and 6 P-grade office space at a rental of R197.50/m²
- 4 Star Green Star SA, comprised of 30 A-grade office space at a rental of R206.36/m², 48 AAA-grade office space at a rental of R203.77/m² and 87 P-grade office space at a rental of R206.36/m²
- 5 Star Green Star SA, comprised of 8 AAA-grade office space at a rental of R172.50/m² and 1 P-grade office space at a rental of R210.00/m²
- 6 Star Green Star SA, comprised of 3 A-grade office space at a rental of R145.00/m²

Table 13: Green Star SA 3 - 6 Certified office space in the research area

Grade	3Star Green Star SA		4Star Green Star SA		5Star Green Star SA		6Star Green Star SA	
	Frequency	Rent/ m²	Frequency	Rent/ m²	Frequency	Rent/ m²	Frequency	Rent/ m²
A-Grade	20	R169.25	30	R171.45	0		3	R145.00
AAA-Grade	0	0	48	R203.77	8	R172.50	0	
P-Grade	6	R197.50	87	R206.36	1	R210.00	0	
TOTAL	26		165		9		3	

Figure 8: Average-asking rent for different Green Star SA certifications with office grading considered

The results indicated a statistically significant difference in the average rental for Green Star SA certified office space and conventional office space in the study area. The average rent for certified office space was R194.40/m² for all levels of Green Star SA combined and the average rent for conventional office space was 161.01/m², which

constitutes a rental premium of R33.39 that is, 20.73%. The study clearly indicated that indeed Green Star SA certified office buildings command higher rental than conventional office buildings.

Based on the results the researcher conclude that the study supported the previous studies on the similar subject by (Eichholtz et al. 2010; Fuerst and McAllister 2011; Kim et al. 2016; Miller, Spivey, and Florance (2008); Pivo and Fisher, 2010; Reichardt, et al. 2012; Robinson & Sander ford 2016; and Wiley et al. 2010) who suggested that investing in green buildings render financial benefits. These studies conducted by these researchers suggested a rental premium between 5% and 33%.

Table 14: Average rent for different Green Star SA Certification of offices in Sandton

TYPE	AVERAGE RENT/M²
3 Star Green Star SA	R175.77
4 Star Green Star SA	R199.26
5 Star Green Star SA	R176.67
6 Star Green Star SA	R145.00

4.7 Analysis using hedonic regression

The purpose of this research is to establish the relationship between the asking rental (dependent variable and Green Star SA certification (independent variable). As mentioned earlier in this report, other than the Green Star SA certification, property rental is normally influenced by a number of attributes like location, size, lease contract that require stringent control for the result to be reliable (Dunse and Jones, 1998). In the case of this research Sandton rental is also influenced by a number of attributes which incorporates the age and the condition of the building, location of the building in terms of accessibility to important amenities like shopping facilities, restaurants and the Gautrain station in particular which form part of the independent variable. The area available for renting was also considered as an independent variable.

Asking rentals data comprising of a total of 511-listed vacant office space from 105 office buildings comprising of both Green Star SA certified (203) and conventional space (308) were downloaded from the websites of commercial property brokers in Sandton (refer to Table 3.)

Out of the Green Star certified 81.3% (n=165) were 4 Star Green Star SA certified, 12.8% (n=26) were 3 Star Green Star SA certified, 4.4% (n=9) were 5 Star Green Star SA certified and 1.5% (n=3) were 6 Star Green Star SA certified.

4.7.1 Hedonic regression model

The hedonic model was used to calculate the significance of the independent variable and the results were attached in the Appendix section as hedonic regression analysis model 1 and 2

$\ln R_i = \beta 0 + \beta 1 \ln AGR_i + \beta 2 \ln AAAGR_i + \beta 3 \ln PGR_i + \beta 4 \ln BGR_i + \beta 6 \ln AREA2_i + \beta 7 \ln AREA31_i + \beta 8 \ln AREA41_i + \beta 9 \ln STAR3_i + \beta 10 \ln STAR4_i + \beta 11 \ln STAR5_i + \beta 12 \ln STAR6_i + \beta 13 \ln SIZE_i + \varepsilon i$

4.7.2 Regression Analysis Model 1

All variables namely dependent variable (asking rental) and independent variables comprising of different Green Star SA certification levels, size of the vacant space, location of the building and the office grade of the building are considered and analysed in the regression model. The results are analysed to determine the significance of each variable which is measures as p-value. The p-value above 0.005 are deemed as being insignificant therefore those variables are taken off from the calculation in model 2.

$\ln R_i = \beta 0(120{,}45) + \beta 1(19{,}95) + \beta 2\ (38{,}20) + \beta 3(48{,}16936) + (0) + \beta 5\ (18{,}95) + (18{,}35) + (0) + (0) + \beta 9\ (9{,}62) + \beta 10\ (18{,}83) + \beta 11\ (-2{,}84) + \beta 12\ (-14{,}55) + \beta 13\ (0{,}000664) + \varepsilon i$

4.7.3 Regression Analysis Model 2

In executing further calculation, the researcher eliminated the independent variables that were not significant to the dependent variable including area 3, area 4, office grade B, Green Star Sa 5 and 6.

4.8 Overall analysis summary

The study data comprised of a total of 511-listed vacant office space from 105 office buildings comprising of both Green Star SA certified and conventional space extracted from the websites of the Commercial Property Brokers who are active in the study area. The aim of the study was to compare Green Star SA certified offices with conventional offices to establish the existence of the premium among the certified office space.

The researcher arranged the data into two groups of Green Star SA certified office space (as verified by the records of GBCSA) and conventional office space. An analysis of the two groups revealed that 60.3% of office space were conventional office space and 39.75% was certified office space in the area. This revelation supported the suggestion by several researchers who conducted similar studies in the same field.

Further analysis indicated a bulk of premises are in a fairly good condition as the bulk of the buildings were constructed in less than fifteen years or they renovated to upgrade their standards and finishes. This notion is supported by dominance of the A-grade (53.4%) and AAA-grade (22.9%) building and also the huge presence of the P-grade (19.2%). The green building adoption is showing a steady growth with a number of investors and property owners opting for the lower level of Green Star SA certification as indicated by the dominance of the 4 Star Green Star SA which accounted for 81.3% of the certified office space.

There was also a small 12.8% of space whose owners opted for 3 Star Green Star SA 3 which in actual fact is not even referred to as green building certification, instead those buildings have complied to the minimum energy standards prescribed in terms of SANSX10400 part XA which is a minimum requirement for submission to GBCSA for

certification. Amongst that space there are some P-grade which are newer and such buildings will eventually be subjected to the risk of economic obsolescence.

Analysis of the rental indicated that there is indeed a premium in rental commanded by the Green Star SA certified office space as compared to conventional office space. The overall premium averaged 20.73% across all levels of Green Star SA whereas when observed per individual level there was a significant increase in premium which is evident for 3 Star Green Star SA 3 and 4 Star Green Star SA. Surprisingly the average rental for 6 Star Green Star SA indicated an average rental of R145/m² which was even lower than the average rental for 3 Star Green Star SA and 4 Star Green Star SA certification levels. Detailed analysis indicated that the office rental was highly influenced by property attributes like the office grade and the location.

The sample had only three 6 Star Green Star SA office space situated in one building named Upper Grayston. A closer look at that particular office building revealed that those office premises were located further away from the CBD on the lower side of Grayston not very far from the public open space Innesfree far from popular amenities enjoyed by the premises located in the CBD. A number of high-rise residential properties formed a buffer that separated those office premises from the Sandton CBD. Those offices were in the northern part of Sandton an environment situated not within the walking distance to the favorable amenities like the Gautrain station, the shopping malls and restaurants. Its location was not favorable as compared to the rest of the properties which are situated within the Sandton CBD precinct which is popularly known as the ‘Africa’s richest square mile” (Jones Lang LaSalle 2017).

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The purpose of the study was to examine the financial benefits of green buildings particularly by determining the existence of the rental premium deemed to be rendered by the Green Star SA certification in the offices in Sandton, South Africa.

The main aim of the research study was to gather rental information on both Green Star SA certified office space and conventional office space and compare the two in order to determine the premium suggested by researchers in previous similar studies.

Previous studies suggested in consensus that investors, owners and occupiers of green certified buildings obtain a bundle of benefits related to lower operating costs, reputation benefits and higher productivity (Fuerst and McAllister 2011).

In order to execute the research project, the author identified five objectives that the study aimed to address and they include the following:

- Define Green Buildings in general and determine its current status
- Analyze the rating certification worldwide and particularly in South Africa
- Determine the costs and benefits that are associated with the adoption of green buildings and their influence in the office buildings
- Determine the status of green buildings within the study area and identify the certified buildings
- Gather and analyze asking market rentals for all offices in the study area in order to determine the extent by which green star certified offices command a rental premium

The research addressed these objectives in two folds firstly, by conducting a systematic literature review, and secondly by analyzing secondary quantitative data from the records of the relevant Real Estate industry stakeholders, namely, the websites of commercial property brokers operating in the study area for asking rentals as well as the GBCSA's

website for information pertaining to the green Star SA certified buildings focusing in the study area.

The analysed literature comprised of past empirical studies on different aspects in the green building field, which included academic journal papers, Real Estate industry reports, publications and working papers, and it addressed objectives one, two and three tabulated below. Literature was of utmost importance in the study as it guided the researcher regarding the issues in the green building field that still required to be addressed. The research unpacked the concept of green through focusing on the detailed definition of the concept green building in order to gain better understanding of the concept worldwide and within the South African context.

The costs and benefits of building green were somehow to be a boiling issue that still need vigorous research throughout the globes since literature available was produced more than ten years ago. The field of green building is evolving and some innovative products and technological systems have been coming onto the mainstream therefore making it much easier and cost effective to construct green buildings.

Literature analysis made it clear that sustainable development is no longer a responsibility for the few but it equally affects everyone in the globe therefore everyone need to play a part accordingly.Through thorough literature analysis, the concept of green buildings was unpacked and the commonly described as refers buildings that are being officially certified as such by the relevant Green Building Councils in the particular country where such buildings are situated is used.

As for the status of green building worldwide most authors suggested that the green building movement was growing at a steady pace and the participation of the developing countries was recorded as growing in a higher pace with more GBC' emerging in those countries (WGBC 2013).

There was number of publications which analyzed green building certification worldwide and the results of those analysis indicated the UK and US certification systems are

continuing to influence certification worldwide for instance such certifications are adopted globally. Australia is one of the country whose rating tool is influenced by both the UK-BREEAM and the US-LEEDS. South Africa has established its certification system by adopting the Australian Green Star certification system and modified to suit the conditions of the local environment. Green building concept have been a subject of discussion for many decades with different perceptions with regard to cost of building as well as the benefits rendered by them.

The issue of benefits has been addressed by authors (Eichholtz et al. 2010; Fuerst and McAllister 2011; Kim et al. 2016; Miller, Spivey, and Florance (2008); Pivo and Fisher, 2010; Reichardt et al. 2012; Robinson & Sander ford 2016; and Wiley et al. 2010) who suggested rental premium between 5% and 33% therefore further advocating that it really pays to invest in green buildings.

There were very few studies conducted that addressed the costs including that of USGBC, Kats and David Langsdon which suggested that actually initial cost of green buildings is not as high as anticipated and they suggested the costs to range between 5% and 10%. The only South African study on costs conducted by GBCSA et al. produced the results which are in line with the international studies and it also concluded that the costs are anticipated to become lower as the new technologies are coming into the mainstream. Using literature, the study unpacked the complex issue of different certification systems worldwide and established that through the growing number of GBCs worldwide, the WGBC managed to spread the awareness in a much broader scale.

The literature analyzed succeeded in addressing objectives one, two and three and in the context of South Africa gaps were identified which include the lack of research in the legislation that affects green building. Detailed study on the effects of legislation and regulations may assist the government to enforce the adoption of green buildings. Other countries have mandatory green instruments that investigate the energy performance of buildings and they also have mandatory tools that govern the sustainability of buildings. South Africa has no mandatory sustainability measure instead; it has a voluntary body that certify buildings that conforms to sustainability practices.

The study succeeded in addressing all the objectives that were formulated therefore giving direction towards addressing the research problem that was stated earlier in the report. In order to address the problem, the hypothesis was formulated which suggested that Green Star SA certified office buildings command rental which is higher than non-green star certified office buildings.

This study focused only on the determination of the rental premium and also its results supported the previous studies by demonstrating that Green Star certified office buildings commanded a higher rental than their conventional counterparts did. The results indicated a statistically significant difference in the average rent for Green Star SA certified office space and conventional office space. The average rent for certified office space was R194.40/m² and the average rent for conventional office space was 161.01/m², which constitutes a premium of R33.39 that is, 20.73%. The results clearly indicated that tenants recognize the benefits rendered by the Green Star SA certified office buildings therefore they are willing to pay the higher rental as compared to conventional space.

5.2 Recommendations

There is very little motivation emanating from the government in South Africa hence the adoption of green building practices is growing at a steady pace considering that stakeholders obtain certification solely on a voluntary basis. Further research studies need to focus on the strategies the government may use to enforce the adoption of green buildings through legislation as well as through incentives.

The local government may play an important role in the implementation of incentives by granting rebates to property owners and developers who adopt the green building practices in their property portfolios. For the municipalities to implement the incentives systems, vigorous training is required for the stakeholders like property valuers regarding the incorporation of green features in the valuation of properties for the compilation of the municipal valuation rolls.

The researcher would like to share the findings of this empirical research studies with the Real Industry stakeholders through SAPOA and the GBCSA as part of information aimed to inform the built environment stakeholders about the importance of incorporating green features in their building projects.

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APENDICES

Appendix A: Tabulated Raw Data on Asking Rent

PROPERTY	CLASS	AREA/M²	RENT/M²	GREEN STAR RATING	AGENT
Alice Lane - Building 1	A	470	R 189,00	4 star SA	JLL
Alice Lane - Building 3	P	195	R 223,00	4 star SA	Office Place
Alice Lane - Building 3	P	510	R 225,00	4 star SA	Anvil
Alice Lane - Building 3	P	295	R 225,00	4 star SA	Anvil
Alice Lane - Building 3	P	316	R 225,00	4 star SA	Anvil
Alice Lane - Building 3	P	886	R 225,00	4 star SA	Anvil
Alice Lane - Building 3	P	195	R 225,00	4 star SA	Anvil
Alice Lane - Building 3	P	1000	R 225,00	4 star SA	Anvil
Alice Lane - Building 3	P	477	R 225,00	4 star SA	Anvil
Alice Lane - Building 3	P	895	R 225,00	4 star SA	Anvil
Alice Lane - Building 3	P	460	R 225,00	4 star SA	Anvil
Alice Lane - Building 3	P	547	R 225,00	4 star SA	Anvil
Alice Lane - Building 3	P	2077	R 225,00	4 star SA	Anvil
Alice Lane 11, Unit 5	P	510	R 225,00	4 star SA	Knight Frank

Alice Lane 11, Unit 6	P	316	R 225,00	4 star SA	Knight Frank
Alice Lane 11, Unit 7	P	477	R 225,00	4 star SA	Knight Frank
Alice Lane 11, Unit 8	P	547	R 225,00	4 star SA	Knight Frank
Alice Lane 11, Unit 9	P	460	R 225,00	4 star SA	Knight Frank
Alice Lane 11, Unit 10	P	336	R 225,00	4 star SA	Knight Frank
Alice Lane 11, Unit 11	P	966	R 225,00	4 star SA	Knight Frank
Alice Lane , Building 3, 3rd Floor, 11 Alice Lane, Sandton	P	886	R 225,00	4 star SA	New Vantage Properties
Alice Lane 11, Building 3,	P	886	R 225,00	4 Star SA	New Vantage Properties
Alice Lane 11 , Building 1, 3rd Floor,	P	2250	R 223,00	4 Star SA	New Vantage Properties
Alice Lane 15, Alice Towers	AAA	24000	R 212,00	4 Star SA	Zenprop
Alice Lane 15, ABSA Capital	AAA	11500	R 212,00	4 Star SA	Zenprop
Alice Lane 15, Norton Rose Fulbright Towers	AAA	1200	R 212,00	4 Star SA	Anvil
Alice Lane 15, Norton Rose Fulbright Towers	AAA	1350	R 212,00	4 Star SA	Anvil
Alice Lane 15, Norton Rose Fulbright Towers	AAA	1750	R 212,00	4 Star SA	Anvil
Alice Lane 15, Norton Rose Fulbright Towers	AAA	450	R 212,00	4 Star SA	Anvil

Alice Lane 15, Norton Rose Fulbright Towers	AAA	600	R 212,00	4 Star SA	Anvil
Alice Lane 15, Norton Rose Fulbright Towers	AAA	850	R 212,00	4 Star SA	Anvil
Alice Lane 15, Norton Rose Fulbright Towers	AAA	750	R 212,00	4 Star SA	Anvil
Alice Lane 15, Norton Rose Fulbright Towers	AAA	350	R 212,00	4 Star SA	Anvil
Atholl Towers	AAA	276	R 140,00	5 Star SA	Officebook
Atholl Towers	AAA	115	R 150,00	5 Star SA	Office Place
Atholl Towers	AAA	139	R 200,00	5 Star SA	Office Place
Atholl Towers	AAA	219	R 165,00	5 Star SA	Office Place
Atholl Towers	AAA	228	R 160,00	5 Star SA	Office Place
Atholl Towers	AAA	7000	R 190,00	5 Star SA	Anvil
Atholl Towers	AAA	1765	R 185,00	5 Star SA	Anvil
Atholl Towers	AAA	704	R 190,00	5 Star SA	Anvil
Athol towers, 1st Floor, 1.3,	AAA	237	R 190,00	4 Star SA	New Vantage Properties
Atrium on 5th,	P	1,213	R 160,00	4 Star SA	Knight Frank
Atrium on 5th,	P	612	R 160,00	4 Star SA	Knight Frank

Atrium on 5th,	P	101	R 160,00	4 Star SA	Knight Frank
Atrium on 5th,	P	1,196	R 170,00	4 Star SA	Knight Frank
Atrium on 5th,	P	232	R 170,00	4 Star SA	Knight Frank
Atrium on 5th,	P	1,187	R 180,00	4 Star SA	Knight Frank
Atrium on 5th,	P	624	R 160,00	4 Star SA	Knight Frank
Atrium on 5th,	P	1,225	R 180,00	4 Star SA	Knight Frank
Atrium on 5th, 3rd Floor East, 5th Street, Sandton	P	1213	R 180,00	4 Star SA	New Vantage Properties
Atrium on 5th, 3rd Floor East,	P	4256	R 180,00	4 Star SA	Anvil
Benmore Road 10	A	340	R 218,00	Not certified	Knight Frank
Boundary Place, 1st Floor,	A	394	R 155,00	Not certified	New Vantage Properties
Bute Lane 85 , Sandton	A	9082	R 155,00	Not certified	JHI Properties
Capital Hill,	AAA	1254	R 195,00	4 star SA	New Vantage Properties
Capital Hill,	AAA	9493	R 195,00	4 star SA	Black Pepper Properties
Capital Hill,	AAA	1253	R 220,00	4 star SA	Anvil
Capital Hill,	AAA	924	R 240,00	4 star SA	Anvil

Central Offices 24,	A	4110	R 150,00	Not certified	JHI Properties
Central Offices 24,	A	613	R 180,00	Not certified	Anvil
Central Offices 24,	A	2490	R 190,00	Not certified	Rennie Property
Central Square, Option 1	AAA	500	R 200,00	4 star SA	Anvil
Central Square, Option 6	AAA	3500	R 200,00	4 star SA	Anvil
Central Square, Unit 1	AAA	2047	R 240,00	4 star SA	Anvil
Central Square, Unit 2	AAA	451	R 240,00	4 star SA	Anvil
Central Square, Unit 3	AAA	342	R 240,00	4 star SA	Anvil
Central Square, Unit 4	AAA	103	R 240,00	4 star SA	Anvil
Central Square, Unit 5	AAA	773	R 240,00	4 star SA	Anvil
Central Square, Unit 6	AAA	766	R 240,00	4 star SA	Anvil
Central Square, Unit 7	AAA	741	R 240,00	4 star SA	Anvil
Central Square, Unit 8	AAA	1125	R 240,00	4 star SA	Anvil
Commerce Square, Building 4, Ground Floor,	AAA	430	R 190,00	Not certified	New Vantage Properties
Commerce Square, Building 2, Ground Floor,	AAA	250	R 190,00	Not certified	New Vantage Properties

Commerce Square, Building 5, Ground Floor,	AAA	293	R 190,00	Not certified	Redefine
Commerce Square, Building 3, Ground Floor,	AAA	142	R 190,00	Not certified	Redefine
Corporate Place,	A	1,018	R 135,00	Not certified	Knight Frank
Corporate Place, G floor	A	862	R 135,00	Not certified	Anvil
Corporate Place, 1st floor	A	473	R 135,00	Not certified	Anvil
Corporate Place, G floor	A	1614	R 135,00	Not certified	Anvil
Corporate Place, Unit SCFL00	A	1017	R 136,00	Not certified	Anvil
Corporate Place, 2nd floor	A	386	R 135,00	Not certified	Anvil
Corporate Place, 4th floor	A	435	R 135,00	Not certified	Anvil
Daisy Street 135, Suite 01, Ground Floor,	A	545	R 160,00	Not certified	New Vantage Properties
Daisy Street Office Park	A	43	R 250,00	Not certified	Office Place
Daisy Street Office Park	A	55	R 250,00	Not certified	Office Place

Daisy Street Office Park	A	92	R 239,00	Not certified	Office Place
Daisy Street Office Park	A	900	R 170,00	Not certified	Anvil
Daisy Street Office Park	A	4683	R 125,00	Not certified	Black Pepper Properties
Dennis Road 114, Atholl Gardens	B	5736	R 110,00	Not certified	New Vantage Properties
Elizabeth Avenue 108, 1st Floor	B	255	R 103,93	Not certified	JHI Properties
Exchange Square 2, HSBC,	P	1365	R 180,00	Not certified	JHI Properties
Exchange Square	P	176	R 195,00	Not certified	Black Pepper Properties
Exchange Square	P	849	R 195,00	Not certified	Black Pepper Properties
Fredman Towers	A	285	R 170,00	3 Star SA	Eris Property Group
Fredman Towers	A	330	R 170,00	3 Star SA	Eris Property Group
Fredman Towers	A	352	R 170,00	3 Star SA	Eris Property Group
Fredman Towers	A	387	R 170,00	3 Star SA	Eris Property Group
Fredman Towers	A	93	R 170,00	3 Star SA	Office Place
Fredman Towers	A	167	R 170,00	3 Star SA	Office Place

Fredman Towers	A	194	R 170,00	3 Star SA	Office Place
Fredman Towers	A	212	R 170,00	3 Star SA	Office Place
Fredman Towers	A	208	R 170,00	3 Star SA	Rent Spice
Fredman Towers, 6th Floor	A	257	R 170,00	3 Star SA	Anvil
Fredman Towers, 4th Floor	A	268	R 170,00	3 Star SA	Anvil
Fredman Towers 8th Floor	A	109	R 170,00	3 Star SA	Anvil
Fredman Towers 3rd Floor	A	216	R 170,00	3 Star SA	Anvil
Fredman Towers G Floor	A	234	R 170,00	3 Star SA	Anvil
Fredman Towers G Floor	A	103	R 170,00	3 Star SA	Anvil
Fredman Drive 13 , Sandton	A	924	R 155,00	3 Star SA	JHI Properties
Fredman Towers	A	235	R 170,00	3 Star SA	Knight Frank
Fredman Towers	A	217	R 170,00	3 Star SA	Knight Frank
Fredman Towers	A	268	R 170,00	3 Star SA	Knight Frank
Fredman Towers	A	258	R 170,00	3 Star SA	Knight Frank
Fredman Towers, 3rd floor 13	A	234	R 170,00	Not certified	New Vantage Properties
Fredman Drive 12, 1st floor, Sala House	A	529	R 135,00	Not certified	Anvil

Fredman Drive 12, 2nd floor, Sala House	A	413	R 135,00	Not certified	Anvil
Fredman Drive 13, Unit 1, Sandton	A	216	R 155,00	Not certified	JHI Properties
Fredman Drive 13 Unit 4, Sandton	A	149	R 160,00	Not certified	JHI Properties
Fredman Drive 13 , Unit 2, Sandton	A	206	R 155,00	Not certified	JHI Properties
Fredman Drive 13 unit 3, Sandton	A	353	R 155,00	Not certified	JHI Properties
Fredman Drive 15, Sandton	A	18000	R 155,00	Not certified	JHI Properties
Fredman Drive 16, Sandton Option 1	A	1000	R 205,00	Not certified	Anvil
Fredman Drive 16, Sandton Option 2	A	2000	R 205,00	Not certified	Anvil
Fredman Drive 16, Sandton Option 3	A	3000	R 205,00	Not certified	Anvil
Fredman Drive 16, Sandton Option 4	A	4000	R 205,00	Not certified	Anvil
Fredman Drive 16, Sandton Option 5	A	5000	R 205,00	Not certified	Anvil
Fredman Drive 16, Sandton Option 6	A	5000	R 205,00	Not certified	Anvil

Fredman Drive 16, Sandton Option 7	A	5000	R 205,00	Not certified	Anvil
Fredman Drive 16, Sandton Option 8	A	5000	R 205,00	Not certified	Anvil
Fredman Drive 16, Sandton Option 9	A	5000	R 205,00	Not certified	Anvil
Fredman Drive 16, Sandton Option 10	A	5000	R 205,00	Not certified	Anvil
Fredman Drive 16, Sandton Option 11	A	5000	R 205,00	Not certified	Anvil
Fredman Drive 16, Sandton Option 12	A	5000	R 205,00	Not certified	Anvil
Fredman Drive 22, Sandton	AAA	10,974	R 175,00	Not certified	Knight Frank
Fredman Drive 22, Sandton	AAA	10974	R 185,00	Not certified	New Vantage Properties
Fredman Drive 23, 2nd Floor,	AAA	386	R 135,00	Not certified	New Vantage Properties
Fredman Drive 23, Sandton	AAA	51	R 135,00	Not certified	Office Place
Fredman Drive 27, Discovery Building	A	2512	R 161,00	4 star SA	JHI Properties
Fredman Drive 27, Discovery Building	A	1291	157.55	4 star SA	New Vantage Properties
Freestone Office Park,	A	902	R 135,00	Not certified	New Vantage Properties

Fricker Road 4, Illovo	A	1498	R 135,00	4 Star SA	Black Pepper Properties
Fricker Road 10, Illovo	A	6026	R 146,00	Not certified	Rennie Properties
Fricker Road 11, Illovo	A	10,594	R 149,00	Not certified	Knight Frank
Fricker Road 11, Illovo	A	551	R 149,00	Not certified	Knight Frank
Fricker Road 11, Illovo	A	438	R 149,00	Not certified	Knight Frank
Fricker Road 11, Illovo	A	714	R 149,00	Not certified	Knight Frank
Fricker Road 16, Illovo	A	3248	R 185,00	Not certified	Black Pepper Properties
Fricker Road 21, Illovo. Turner and Townsend House	A	375	R 160,00	Not certified	Knight Frank
Fricker Road 23, Illovo	A	122	R 155,00	Not certified	Rennie Properties
Fricker Road 27, Genesis House, Illovo	A	4000	R 185,00	Not certified	Black Pepper Properties
Fricker Road 28, Illovo	A	968	R 165,00	Not certified	Rennie Properties
Fricker Road 28, Illovo	A	473	R 165,00	Not certified	Rennie Properties

Fricker Road 28, Illovo	A	392	R 165,00	Not certified	Rennie Properties
Fricker Road 34-36, Illovo	A	340	R 165,00	4 Star SA	Rennie Properties
Fricker Road 36, Illovo	A	340	R 165,00	Not certified	Black Pepper Properties
Grayston Drive 70 , Sandton	A	635	R 145,00	Not certified	Knight Frank
Grayston Drive 70 , Sandton	A	683	R 145,00	Not certified	Knight Frank
Grayston Drive 70 , Sandton	A	683	R 145,00	Not certified	Knight Frank
Grayston Drive 82 , Sandton	AAA	397	R 145,00	4 Star SA	JHI Properties
Grayston Drive 82 , Sandton	AAA	380	R 145,00	4 Star SA	Knight Frank
Grayston Drive 82 , Sandton	AAA	325	R 145,00	4 Star SA	Rent Spice
Grayston Drive 82 , Sandton	AAA	244	R 145,00	4 Star SA	Officebook
Grayston Drive 82 , Sandton	AAA	1 405	R 208,00	4 Star SA	Ashbrook
Grayston Drive 82 , Sandton	AAA	379	R 145,00	4 Star SA	Anvil
Grayston Drive 85,Sandton	AAA	1279	R 199,00	Not certified	3Cube
Grayston Drive 85,Sandton	AAA	1,215	R 199,00	Not certified	Knight Frank

Grayston Drive 85,Sandton	AAA	1,215	R 199,00	Not certified	Knight Frank
Grayston Drive 85,Sandton	AAA	1279	R 199,00	Not certified	New Vantage Properties
Grayston Drive 85,Sandton	AAA	2745	R 200,00	Not certified	JHI Properties
Grayston Drive 88,Sandton	P	7500	R 150,00	4 Star SA	Anvil
Grayston Drive 90 , Sandton	P	590	R 120,00	4 Star SA	Knight Frank
Grayston Drive 90 , Sandton	P	590	R 160,00	4 Star SA	JHI Properties
Grayston Drive 90 , Sandton	P	590	R 120,00	4 Star SA	Anvil
Grayston Drive 95, 3rd FLOOR, China Construction Bank	A	1038	R 167,00	Not certified	New Vantage Properties
Grayston 168,Sandton	A	312	R 238,00	Not certified	Anvil
Grayston Office Park, 1st Floor, Building 5,	A	969	R 125,00	4 Star SA	New Vantage Properties
Grayston Office Park	A	969	R 125,00	4 Star SA	Knight Frank
Grayston Office Park	A	5,611	R 126,00	4 Star SA	Knight Frank
Grayston Office Park, 1st Floor, Building 4,	A	1626	R 125,00	4 Star SA	Anvil

Grayston Office Park, 1st Floor, Building 4,	A	2330	R 125,00	4 Star SA	Anvil
Grayston Ridge Office Park, Block B, Lower Ground,	A	485	R 95,00	Not certified	New Vantage Properties
Grayston Ridge Office Park	A	485	R 95,00	Not certified	Anvil
GreenPark Corner	A	80	R 200,00	Not certified	Office Place
GreenPark Corner	A	81	R 200,00	Not certified	Office Place
GreenPark Corner	A	88	R 136,00	Not certified	Office Place
GreenPark Corner	A	13	R 200,00	Not certified	Office Place
GreenPark Corner	A	225	R 200,00	Not certified	Office Place
GreenPark Corner	A	228	R 204,00	Not certified	Office Place
Greenpark Corner ,	A	232	R 200,00	Not certified	Knight Frank
Greenpark Corner ,	A	288	R 200,00	Not certified	Knight Frank
Greenpark Corner ,	A	274	R 200,00	Not certified	Knight Frank

Greenpark Corner ,	A	701	R 200,00	Not certified	Knight Frank
Greenpark Corner ,	A	232	R 200,00	Not certified	Knight Frank
Greenpark Corner ,	A	427	R 220,00	Not certified	Knight Frank
Greenpark Corner ,	A	224	R 238,00	Not certified	Knight Frank
Greenpark Corner ,	A	438	R 200,00	Not certified	Knight Frank
Greenpark Corner ,	A	675	R 220,00	Not certified	Knight Frank
Greenpark Corner ,	A	650	R 220,00	Not certified	Knight Frank
Greenpark Corner ,	A	438	R 220,00	Not certified	Anvil
Greenpark Corner ,	A	287	R 200,00	Not certified	Anvil
Grindrod Towers,	A	6000	R 190,00	Not certified	Knight Frank
Grindrod Bank, Grindrod Towers	A	1040	R 185,00	Not certified	Anvil
Gwen Lane, Sandton	A	111	R 139,00	Not certified	Ashbrook

Gwen Lane 3, Sandton	A	396	R 147,00	Not certified	Knight Frank
Hunts End 42	B	3814	R 124,00	Not certified	Anvil
Hunts End 38, Whole building	B	996	R 124,00	Not certified	Anvil
Hunts End 36, Paddock View	B	124	R 124,00	Not certified	Anvil
Hunts End 36, Paddock View	B	240	R 124,00	Not certified	Anvil
Hunts End 36, Paddock View, Ex Sa Gambling	B	256	R 124,00	Not certified	Anvil
Hunts End 36, Paddock View,	B	1396	R 124,00	Not certified	Anvil
Hunts End 36, Paddock View	B	1078	R 124,00	Not certified	Anvil
Illovo Edge, Phase 3,G Floor Section 1	P	385	R 210,00	5 Star SA	Anvil
Illovo Mews	A	4000	R 180,00	Not certified	Black Pepper Properties
Impala Rd 19, Chiselhurston	B	501	R 137,00	Not certified	Rent Spice
Impala Rd 19, Chiselhurston	B	501	R 137,00	Not certified	Knight Frank

Impala Rd 19, The Bridle, Chiselhurston	B	690	R 137,00	Not certified	Colliers International
Impala Road 23, Chislehurston	B	270	135	Not certified	Knight Frank
Inanda Greens	P	201	R 154,00	4 Star SA	Office Place
Inanda Greens	P	219	R 153,00	4 Star SA	Office Place
Inanda Greens 1st Floor, Building 6	P	219	R 156,00	4 Star SA	Anvil
Inanda Greens G-Floor, Building 5	P	201	R 156,00	4 Star SA	Anvil
Inanda Greens 1st Floor, Building 8	P	320	R 156,00	4 Star SA	Anvil
Innesfree View,	A	1036	115.99	Not certified	New Vantage Properties
JHI House,	A	1,633	R 130,00	Not certified	Knight Frank
JHI House,	A	207	R 135,00	Not certified	Knight Frank
JHI House,	A	267	R 135,00	Not certified	Knight Frank
JHI House,	A	1,641	R 130,00	Not certified	Knight Frank
JHI House,	A	1,68	R 130,00	Not certified	Knight Frank

JHI House,	A	742	R 130,00	Not certified	Knight Frank
JHI House,	A	1,64	R 130,00	Not certified	Knight Frank
JHI House,	A	1,606	R 130,00	Not certified	Knight Frank
JHI House,	A	267	R 135,00	Not certified	Knight Frank
JHI House,	A	1,097	R 130,00	Not certified	Knight Frank
Johan Avenue 106 , Sandton	AAA	879	R 179,00	Not certified	JHI Properties
Johan Avenue 106 , Sandton	AAA	75	R 155,00	Not certified	Office Place
Johan Avenue 106 , Sandton	AAA	76	R 155,00	Not certified	Office Place
Johan Avenue 106 , Sandton	AAA	80	R 155,00	Not certified	Office Place
Johan Avenue 106 , Sandton	AAA	115	R 155,00	Not certified	Office Place
Johan Avenue 106 , Sandton	AAA	125	R 155,00	Not certified	Office Place
Johan Avenue 106 , Sandton	AAA	142	R 154,00	Not certified	Office Place

Johan Avenue 106 , Sandton	AAA	142	R 154,00	Not certified	Office Place
Johan Avenue 106 , Sandton	AAA	153	R 155,00	Not certified	Office Place
Johan Avenue 106 , Sandton	AAA	54	R 164,00	Not certified	Office Place
Johan Avenue 106 , Sandton	AAA	277	R 155,00	Not certified	Knight Frank
Johan Avenue 106 , Sandton	AAA	249	R 156,00	Not certified	Knight Frank
Katherine Corner,	A	26000	R 250,00	Not certified	JHI Properties
Johan Avenue 108 , SMG House	A	3501	R 141,00	Not certified	Anvil
Katherine Street 61, Sandton	A	214	R 205,00	Not certified	Office Place
Katherine Street 61, Sandton	A	550	R 205,00	4 Star SA	Anvil
Katherine Street 152 , Sandton	A	107	R 136,00	Not certified	Office Place
Katherine & West, Sandton	AAA	425	R 199,00	Not certified	Knight Frank
Katherine & West, Sandton	AAA	493	R 181,00	Not certified	Knight Frank

Katherine & West, Sandton	AAA	620	R 180,00	Not certified	Knight Frank
Katherine & West, Sandton	AAA	634	R 189,00	Not certified	Knight Frank
Katherine Street 171, Sandton	A	1,306	R 120,00	Not certified	Knight Frank
Katherine Street 171, Sandton	A	460	R 125,00	Not certified	Knight Frank
Katherine Street 171, Sandton	A	314	R 120,00	Not certified	Knight Frank
Katherine Street 171, Sandton	A	261	R 120,00	Not certified	Knight Frank
Katherine Street 171. Block 1, Ground floor	A	460	120.53	Not certified	New Vantage Properties
Katherine and West Suite 18, 2nd floor suite 18,	A	281	R 190,00	Not certified	New Vantage Properties
Katherine Street Towers	P	2000	R 250,00	4 Star SA	Anvil
Katherine Street Towers, Option 1	P	293	R 250,00	4 Star SA	Anvil
Katherine Street Towers, Option 2	P	492	R 250,00	4 Star SA	Anvil
Katherine Street Towers, Option 3	P	580	R 250,00	4 Star SA	Anvil
Katherine Street Towers, Option 4	P	984	R 250,00	4 Star SA	Anvil

Katherine Street Towers, Option 5	P	1046	R 250,00	4 Star SA	Anvil
Katherine Street Towers, Option 6	P	1160	R 250,00	4 Star SA	Anvil
Katherine Street Towers, Option 7	P	1476	R 250,00	4 Star SA	Anvil
Katherine Street Towers, Option 8	P	2093	R 250,00	4 Star SA	Anvil
Katherine Street Towers, Option 9	P	2380	R 250,00	4 Star SA	Anvil
Katherine Street Towers, Option 10	P	3572	R 250,00	4 Star SA	Anvil
Katherine Street Towers, Option 11	P	4765	R 250,00	4 Star SA	Anvil
Kgoro Gateway, Sandton	A	194500	R 275,00	4 Star SA	Anvil
Kingsley Office Park,	A	218	R 140,00	Not certified	Knight Frank
Kingsley Office Park,	A	318	R 140,00	Not certified	Knight Frank
Kingsley Office Park, Office 1 A	A	317	R 140,00	Not certified	Anvil
Kingsley Office Park, Block B, Ground Floor	A	179	R 145,00	Not certified	Anvil
Kingsley Office Park, Block A, 1st Floor	A	271	R 140,00	Not certified	Anvil
Kingsley Office Park, Block A, 1st Floor	A	218	R 140,00	Not certified	Anvil

Maude Street 82, Sandton	A	1271	R 135,00	Not certified	Officebook
Maude Street 82, Sandton	A	564	R 133,00	Not certified	Officebook
Maude Street 82, Sandton	A	1068	R 110,00	Not certified	New Vantage Properties
Maude Street 82, Sandton	A	2904	R 110,00	Not certified	JHI Properties
Medical Mews,	A	512	R 155,00	Not certified	JHI Properties
Melrose Arch 2	A	875	R 230,00	Not certified	Black Pepper Properties
Nelson Mandela Square Office Towers,	P	298	R 179,00	4 Star SA	New Vantage Properties
Nelson Mandela Square Office Towers,	p	227	R 195,00	4 Star SA	New Vantage Properties
Nelson Mandela Square Office Towers,	p	227	R 195,00	4 Star SA	New Vantage Properties
Nelson Mandela Square Office Towers,	p	227	R 195,00	4 Star SA	New Vantage Properties
Norwich Close	A	11040	R 130,00	Not certified	JHI Properties
Norwich Close	A	92	R 130,00	Not certified	Office Place

Norwich Close	A	207	R 130,00	Not certified	Office Place
Norwich Close, Sandton	A	266	R 130,00	Not certified	Rent Spice
Norwich Close, Sandton	A	569	R 140,00	Not certified	Knight Frank
Norwich Close, Sandton	A	569	R 140,00	Not certified	Knight Frank
Norwich Close, Sandton	A	332	R 140,00	Not certified	Knight Frank
Norwich Close, Sandton	A	570	R 140,00	Not certified	Knight Frank
Norwich Close, Sandton	A	332	R 140,00	Not certified	Knight Frank
Norwich Close, Sandton	A	332	R 130,00	Not certified	Knight Frank
Norwich Place, 2nd Floor, Office 01 & 03, 2 Norwich Close,	A	741	R 135,00	Not certified	New Vantage Properties
Office Tower	A	4899	R 155,00	Not certified	JHI Properties
Opposite JSE	A	102	R 147,00	Not certified	Office Place
Opposite JSE	A	112	R 147,00	Not certified	Office Place

Ornico House	A	976	R 125,00	Not certified	Anvil
Ornico House, Side Pocket	A	258	R 95,00	Not certified	Anvil
Pareto House,	A	1370	162.83	Not certified	New Vantage Properties
Pinmill Farm - Ex Futurity	A	110	R 120,00	4 Star SA	Anvil
Pinmill Farm - Ex Industrial Base Mineral	A	629	R 120,00	4 Star SA	Anvil
Pinmill Farm - Ex Cyest	A	1402	R 120,00	4 Star SA	Anvil
Pinmill Farm - Block E, Ground Floor	A	701	R 120,00	4 Star SA	Anvil
Protea Place 1a	AAA	45 000		4 Star SA	New Vantage Properties
Protea Place 1 , 1st Floor, Northwing	AAA	860	R 165,00	4 Star SA	New Vantage Properties
Protea Place 1 ,	AAA	860	R 165,00	4 Star SA	Anvil
Protea Place 2,	A	824	R 190,00	Not certified	Knight Frank
Protea Place 2,	A	548	R 190,00	Not certified	Knight Frank
Protea Place 2,	A	860	R 165,00	Not certified	Knight Frank

Protea Place 6,	A	1,778	R 160,00	Not certified	Knight Frank
Protea Place 6,	A	1,793	R 155,00	Not certified	Knight Frank
Protea Place 6,	A	1,783	R 160,00	Not certified	Knight Frank
Protea Place 6,	A	791	R 160,00	Not certified	Knight Frank
Protea Place 6, 2nd Floor,	A	1793	R 160,00	Not certified	New Vantage Properties
Protea Place 8A	A	6400	R 155,00	Not certified	JHI Properties
Protea Road 85	A	200,93	R 135,00	Not certified	Renprop Commercial
Pybus RD, Sandton	A	500	R 125,00	Not certified	Space Online Group
Pybus Road 112, Sandton	A	90	R 80,00	Not certified	Office Place
Pybus Road 112, Sandton	A	90	R 80,00	Not certified	Office Place
Pybus Road 4	A	11069	R 240,00	Not certified	New Vantage Properties
Pybus 4, Offices on Katherine	A	13000	R 240,00	Not certified	JHI Properties

Rivonia, 1st Floor	A	699	R 160,00	Not certified	New Vantage Properties
Rivonia Rd 66, Sandton,	A	208	R 160,00	Not certified	Office Place
Rivonia Rd 66, Sandton,	A	306	R 165,00	Not certified	Knight Frank
Rivonia Road 90 , Sandton,	P	1,1	R 189,00	4 Star SA	Knight Frank
Rivonia Road 90 , Sandton,	P	1100	R 189,00	4 Star SA	JHI Properties
Rivonia Road 90 , Sandton,	P	8500	R 258,00	4 Star SA	JHI Properties
Rivonia Road 96 , The Central 5th Floor Option 1	P	340	R 257,00	4 Star SA	Anvil
Rivonia Road 96 , The Central 5th Floor Option 2	P	338	R 257,00	4 Star SA	Anvil
Rivonia Road 96 , The Central 5th Floor Option 3	P	363	R 257,00	4 Star SA	Anvil
Rivonia Road 96 , The Central 5th Floor Option 4	P	339	R 257,00	4 Star SA	Anvil
Rivonia Road 102, Sandton	AAA	338	R 215,00	4 Star SA	Knight Frank
Rivonia Road 102, Sandton	AAA	933	R 215,00	4 Star SA	Knight Frank
Rivonia Road 102, Sandton	AAA	417	R 215,00	4 Star SA	Knight Frank
Rivonia Road 102, Sandton	AAA	984	R 215,00	4 Star SA	Knight Frank

Rivonia Road 102, Sandton	AAA	899	R 215,00	4 Star SA	Knight Frank
Rivonia Road 102, Sandton	AAA	1,311	R 215,00	4 Star SA	Knight Frank
Rivonia Road 102, Sandton	AAA	1,188	R 215,00	4 Star SA	Knight Frank
Rivonia Road 102, Sandton	AAA	1,161	R 215,00	4 Star SA	Knight Frank
Rivonia Road 102, Sandton	AAA	1,259	R 215,00	4 Star SA	Knight Frank
Rivonia Road 102, Sandton	AAA	534	R 215,00	4 Star SA	Knight Frank
Rivonia Road 102, Sandton	AAA	170	R 215,00	4 Star SA	Office Place
Rivonia Road 102, Sandton	AAA	179	R 200,00	4 Star SA	Office Place
Rivonia Road 102, Sandton	AAA	175	R 200,00	4 Star SA	Office Place
Rivonia Road 129 , Sandton	A	9285	R 258,00	4 Star SA	JHI Properties
Rivonia Road 129 , Sandton	A	1604	R 257,00	4 Star SA	Anvil
Rivonia Road 129 , Sandton	A	1592	R 258,00	4 Star SA	JHI Properties
Rivonia Road 129 , Sandton	A	1442	R 258,00	4 Star SA	JHI Properties
Rivonia Road 129 , Sandton	A	1441	R 258,00	4 Star SA	JHI Properties
Rivonia Road 129 , Sandton	A	1614	R 258,00	4 Star SA	JHI Properties
Rivonia Road 150, Building 3,	A	3080	R 125,00	Not certified	New Vantage Properties

Rivonia Rd 165, Sandton	A	145	R 75,00	Not certified	Anvil
Rivonia Road 187, East Block,	A	2094	R 125,00	Not certified	New Vantage Properties
Rochester Place,	B	129	R 145,00	Not certified	Knight Frank
Rochester Place,	B	231	R 145,00	Not certified	Knight Frank
Rochester Place,	B	226	R 130,00	Not certified	Knight Frank
Rochester Place,	B	295	R 130,00	Not certified	Knight Frank
Rochester Place,	B	200	R 130,00	Not certified	Knight Frank
Rochester Place,	B	462	R 145,00	Not certified	Knight Frank
Rochester Place,	B	439	R 130,00	Not certified	Knight Frank
Sandhurst Office Park, Portion Building 2, Ground Floor,	A	450	R 165,00	Not certified	New Vantage Properties
Sandhurst Office Park ,	A	450	R 165,00	Not certified	Knight Frank
Sandhurst Office Park ,	A	7900	R 158,00	Not certified	Black Pepper Properties

Sandown Erven 159-162	A	631	R 148,00	Not certified	JHI Properties
Sandown Mews, East Building- 1st Floor,	A	759	R 145,00	Not certified	New Vantage Properties
Sandown Mews, East Building- 1st Floor,	A	211	R 145,00	Not certified	Anvil
Sandown Mews, East Building- G Floor,	A	595	R 145,00	Not certified	Anvil
Sandown Mews, East Building- G Floor,	A	294	R 145,00	Not certified	Anvil
Sandown Mews, East Building- 1st Floor,	A	637	R 145,00	Not certified	Anvil
Sandown Mews, East Building- 2nd Floor,	A	1720	R 145,00	Not certified	Anvil
Sandown Mews, East Building- 3rd Floor,	A	1686	R 145,00	Not certified	Anvil
Sandown Mews, East Building- 4th Floor,	A	100	R 145,00	Not certified	Anvil
Sandown Mews, East Building- G Floor,	A	222	R 145,00	Not certified	Anvil
Sandown Mews, East Building- 4th Floor,	A	1122	R 145,00	Not certified	Anvil

Sandown Valley Crescent. Unit 4	AAA	596	R 140,00	Not certified	New Vantage Properties
Sandown Valley Crescent 3	AAA	840	R 155,00	Not certified	Knight Frank
Sandown Valley Crescent 3, North Tower, 1st Floor,	AAA	840	R 155,00	Not certified	New Vantage Properties
Sandown Valley Crescent 3,2nd Floor, , South Tower	AAA	840	R 155,00	Not certified	New Vantage Properties
Sandown Valley Crescent. Unit 4	AAA	1200	R 140,00	Not certified	Ashbrook
Sandton City Office Tower	P	87	R 202,00	4 Star SA	Office Place
Sandton City Office Tower	P	93	R 197,00	4 Star SA	Office Place
Sandton City Office Tower	P	188	R 197,00	4 Star SA	Office Place
Sandton City Office Tower	P	189	R 197,00	4 Star SA	Office Place
Sandton City Office Tower,	P	206	R 160,00	4 Star SA	Knight Frank
Sandton City Office Tower,	P	362	R 160,00	4 Star SA	Knight Frank
Sandton City Office Tower,	P	700	R 155,00	4 Star SA	Knight Frank
Sandton City Office Tower,	P	290	R 155,00	4 Star SA	Knight Frank
Sandton City Office Tower,	P	235	R 160,00	4 Star SA	Knight Frank
Sandton City Office Tower,	P	203	R 160,00	4 Star SA	Knight Frank

Sandton City Office Tower,	P	259	R 160,00	4 Star SA	Knight Frank
Sandton City Office Tower,	P	201	R 155,00	4 Star SA	Knight Frank
Sandton City Office Tower,	P	272	R 155,00	4 Star SA	Knight Frank
Sandton City Office Tower,	P	545	R 155,00	4 Star SA	Knight Frank
Sandton Close Two,	A	243	R 130,00	4 Star SA	JHI Properties
Sandton Close 2	A	157	R 125,00	4 Star SA	Office Place
Sandton Close 2	A	207	R 125,00	4 Star SA	Office Place
Sandton Close Two,	A	495	R 135,00	4 Star SA	Knight Frank
Sandton Close Two,	A	386	R 133,00	4 Star SA	Knight Frank
Sandton Close Two,	A	243	R 130,00	4 Star SA	Anvil
Sandton Drive 100, Sandton,	A	200	R 150,00	Not certified	Office Place
Sandton Eye, 1st Floor	A	989	R 247,00	Not certified	Anvil
Sandton Eye, 11th Floor	A	250	R 198,00	Not certified	Anvil
Sandton Eye, 11th Floor	A	989	R 247,00	Not certified	Anvil
Sinosteel Plaza	AAA	64	R 190,00	Not certified	Office Place

Sinosteel Plaza	AAA	81	R 175,00	Not certified	Office Place
Sinosteel Plaza	AAA	97	R 175,00	Not certified	Office Place
Sinosteel Plaza	AAA	105	R 175,00	Not certified	Office Place
Sinosteel Plaza	AAA	109	R 190,00	Not certified	Office Place
Sinosteel Plaza	AAA	119	R 175,00	Not certified	Office Place
Sinosteel Plaza	AAA	135	R 175,00	Not certified	Office Place
Sinosteel Plaza	AAA	151	R 168,00	Not certified	Office Place
Sinosteel Plaza	AAA	194	R 185,00	Not certified	Office Place
Sinosteel Plaza	AAA	205	R 175,00	Not certified	Office Place
Sinosteel Plaza	AAA	209	R 175,00	Not certified	Office Place
Sinosteel Plaza	AAA	224	R 195,00	Not certified	Office Place
Sinosteel, 159 Rivonia Road, Sandton	AAA	224	R 195,00	Not certified	New Vantage Properties

Strathvon 11	A	107	R 136,00	Not certified	JHI Properties
Sun International,	AAA	1,291	R 161,00	Not certified	Knight Frank
Sun International,	AAA	1,221	R 161,00	Not certified	Knight Frank
The Forum	AAA	79	R 180,00	Not certified	Office Place
The Forum	AAA	179	R 180,00	Not certified	Office Place
The Forum	AAA	85	R 180,00	Not certified	Office Place
The Forum	AAA	1,219	R 165,00	Not certified	Knight Frank
The Forum	AAA	549	R 180,00	Not certified	Knight Frank
The Forum	AAA	674	R 175,00	Not certified	Knight Frank
The Forum	AAA	239	R 180,00	Not certified	Knight Frank
The Forum	AAA	623	R 175,00	Not certified	Knight Frank
The Forum	AAA	1,007	R 165,00	Not certified	Knight Frank

The Forum	AAA	770	R 165,00	Not certified	Ashbrook
The Forum, 3rd floor,	AAA	1007	R 165,00	Not certified	New Vantage Properties
The Grayston,	P	50000	R 240,00	Not certified	JHI Properties
The Maslow Office Park	A	35000	R 275,00	4 Star SA	Anvil
The Place	P	1,377	R 199,00	3 Star SA	Knight Frank
The Place	P	601	R 190,00	3 Star SA	Knight Frank
The Place	P	869	R 199,00	3 Star SA	Knight Frank
The Place	P	528	R 199,00	3 Star SA	Knight Frank
The Place, 1st Floor.	P	1377	R 199,00	3 Star SA	New Vantage Properties
The Place, 3rdt Floor.	P	1377	R 199,00	3 Star SA	New Vantage Properties
Transafrica House, 1st Floor	A	339	R 160,00	Not certified	Anvil
Transafrica House, 1st Floor	A	389	R 160,00	Not certified	Anvil
Upper Grayston	A	167	R 145,00	Not certified	Office Place
Upper Grayston	A	178	R 125,00	6 Star SA	Office Place

Upper Grayston, Building E (phase 3),	A	298	R 155,00	6 Star SA	Knight Frank
Upper Grayston, Building E (phase 3),	A	441	R 155,00	6 Star SA	Knight Frank
Upper Grayston, Building E (phase 3),	A	558	R 155,00	Not certified	Knight Frank
Upper Grayston	A	234	R 160,00	Not certified	Officebook
Upper Grayston -Block D ,	A	167	R 145,00	Not certified	New Vantage Properties
Upper Grayston -Block A ,	A	240	R 160,00	Not certified	Anvil
Upper Grayston Office Building	A	989	R 145,00	Not certified	JHI Properties
Upper Grayston Office Park- Brydens	A	691	R 200,00	Not certified	JHI Properties
Werksman Attorneys,	AAA	1003	R 200,00	Not certified	JHI Properties
39 ,41 ,43 Wierda W	A	2944	R 95,00	Not certified	Black Pepper Properties
Wierda Road West 36 , Sandton	B	164	R 123,00	Not certified	Office Place
Wierda Road West 36 , Sandton	B	164	R 124,00	Not certified	Office Place

Wierda Road West 36 , Sandton	B	153	R 123,00	Not certified	Office Place
West Street 115, Alexander Forbes, Sandown	P	700	R 215,00	4 Star SA	Anvil
West Street 138 , Sandton	A	349	R 160,00	Not certified	Knight Frank
West Street 138 , Sandton	A	388	R 160,00	Not certified	Officebook
West Street 138 , Sandton	A	598	R 160,00	Not certified	Officebook
West Street 138, 2nd Floor,	A	388	R 160,00	Not certified	New Vantage Properties
West Street 138, Sandton	A	986	R 160,00	Not certified	JHI Properties
West Street 140, Option1	P	400	R 237,00	4 Star SA	Anvil
West Street 140, Option 2	P	500	R 237,00	4 Star SA	Anvil
West Street 140, Option 3	P	600	R 237,00	4 Star SA	Anvil
West Street 140, Option 12	P	10000	R 237,00	4 Star SA	Anvil
West Street 140, 1st Floor, North Tower	P	1108	R 237,00	4 Star SA	Anvil
West Street 140, 2nd Floor, North Tower	P	2322	R 237,00	4 Star SA	Anvil

West Street 140, 9th Floor, South Tower	P	1208	R 237,00	4 Star SA	Anvil
West Street 140, 10th Floor, South Tower	P	1201	R 237,00	4 Star SA	Anvil
West Street 140, Sandton	p	12231	R 225,00	4 Star SA	JHI Properties
West Street 145, Ground Floor	A	251	R 190,00	Not certified	Black Pepper Properties
West Street 145, Ground Floor	A	451	R 190,00	Not certified	Black Pepper Properties
West Street 145, 2nd Floor	A	1192	R 190,00	Not certified	Black Pepper Properties
West Street 145, 3rd Floor	A	1400	R 190,00	Not certified	Black Pepper Properties
West Street 145, 3rd Floor	A	1206	R 190,00	Not certified	Black Pepper Properties
West Street 150, Sandton	A	12401	R 190,00	Not certified	JHI Properties
West Street 165, Sandton	A	15,22	R 158,00	Not certified	Knight Frank
West Street 165, Sandton	A	1,762	R 160,00	Not certified	Knight Frank
West Street 165, Sandton	A	250	R 160,00	Not certified	Knight Frank

West Street 165, Sandton	A	12690	R 160,00	Not certified	Knight Frank
West Street 165, Sandton	A	12690	R 160,00	Not certified	Anvil
West Street 165, Sandton	A	1762	R 160,00	Not certified	Anvil
West Street 165, Sandton	A	250	R 160,00	Not certified	Anvil
West Street 165, Sandton	A	15220	R 160,00	Not certified	Anvil
West Street 165, Sandton	A	15220	R 160,00	Not certified	New Vantage Properties
West Street 165, Sandton	A	15220	R 160,00	Not certified	JHI Properties
West Street 165- ABLAND-,	A	17770	R 158,00	Not certified	JHI Properties
Wierda Court	AAA	102	R 147,00	4 Star SA	Office Place
Wierda Court	AAA	580	R 126,00	4 Star SA	Black Pepper Properties
VDARA- 1st floor suite 3,	A	301	R 190,00	Not certified	New Vantage Properties
VDARA- 1st floor suite 3,	A	4000	R 208,00	Not certified	Black Pepper Properties

Vunani Office Park	A	525	R 125,00	Not certified	JHI Properties
Vunani Office Park	A	164	R 125,00	Not certified	Anvil
1st on Fifth. Block B 2nd Floor,	A	570	R 140,00	Not certified	New Vantage Properties
58 -60 A, Wierda Rd East, Sandton	A	5101	R 110,00	Not certified	Anvil
58 -60 A, Wierda Rd East, Sandton	A	2550	R 110,00	Not certified	Anvil
102 4th Str. Sandton	A	690	R 110,00	Not certified	Ashbrook
147 5th Avenue, Sandton	A	358	R 110,00	Not certified	Officebook
151 On 5th	A	2703	R 140,00	Not certified	JHI Properties
151 On Fifth	A	570	R 140,00	Not certified	Knight Frank
151 On 5th, Block B, 1st Floor	A	569	R 140,00	Not certified	Anvil
151 On 5th, Block B, 1st Floor	A	3413	R 140,00	Not certified	Colliers International
151 On 5th, Block 1, 1st Floor	A	331	R 140,00	Not certified	Anvil

Appendix B: List of Green Star SA projects

BUILDING	PROPERTY TYPE	AREA/M²	LOCATION	STAR RATING	OWNER	PROJECT TYPE	DATE CERTIFIED
Alice Health Club	Health Club	3800	Alice Lane Phase 1, Cnr of Fredman Drive & 5th Street, Sandton	4	Virgin Active	Interiors Tool	Feb-16
1 Discovery Place	Offices	147000	Corner of Rivonia and Katherine Street, Sandton	5	The Discovery Joint Venture	Office Design v1	Sep-17
10 Riviera Road	Offices	1257,92	10 Riviera Road, Houghton	4	Growthpoint Properties	Existing Building Performance Tool v1	Sep-16
102 Rivonia	Offices	41 225	102 Rivonia Road, Sandton	4	Eris Property Group	Office v1	Feb-16
102 Rivonia, Block B	Offices	40 718	102 Rivonia Road, Sandton	4	Eris Property Group	Office v1	Jan-14
12 Alice Lane	Offices	8771.5	12 Alice Lane, Sandton	4	Growthpoint	Existing Building Performance Tool v1	Jun-17
15 Alice Lane	Offices	22 459	15 Alice Lane, Sandton	4	Zenprop Property Holdings	Office v1	Aug-14
24 Peter Place	Offices	4233,32	Cnr Katherine & Westbrook, Kramerville, Sandton	4	Growthpoint Properties Limited	Existing Building Performance Tool v1	Oct-16
25 Rudd Road	Offices	3233	25 Rudd Road, Illovo	4	Growthpoint Properties	Existing Building Performance Tool v1	Sep-16
34 and 36 Fricker Road	Offices	4844	34 and 36 Fricker Road, Illovo	4	Growthpoint Properties	Existing Building Performance Tool v1	May-17
37 Melrose Boulevard	Offices	20 470	Erf 181 Portion 4, Melrose Boulevard, Melrose Arch	4	Melrose Arch Investment Holdings	Office v1	Jan-12
4 Fricker Road	Offices	4805	4 Fricker Rd, Illovo	4	Growthpoint Properties	Existing Building Performance Tool v1	May-17
4 Stan Road	Offices	5 227	No.4 Stan Road, Sandown, Sandton	4	Sharmane Investments (Pty) Ltd	Office v1	Nov-15

4 Stan Road	Offices	5 227	No.4 Stan Road, Sandown, Sandton	4	Sharmane Investments (Pty) Ltd	Office v1	Jun-16
50 Wierda Road	Offices	2362	50 Wierda Road West, Illovo	4	Growthpoint Properties Limited	Existing Building Performance Tool v1	Jul-16
8 Melville Road		3 882	8 Melville Road, Illovo	4	Edge Properties (Pty) Ltd	Office v1	Mar-15
8 Rivonia Road	Offices	5325	43 Central Avenue Cnr Rivonia Road, Illovo	4	Growthpoint Properties	Existing Building Performance Tool v1	Jun-17
82 Grayston	Offices	7358	82 Grayston Drive, Sandton	4	Growthpoint Properties Limited	Existing Building Performance Tool v1	Jun-17
90 Grayston Drive	Offices	21069	90 Grayston Drive, Sandton	4	Redefine Properties (Pty) Ltd	Office v1	Feb-14
90 Grayston Drive	Offices	21056	90 Grayston Drive, Sandton	4	Redefine Properties (Pty) Ltd	Office v1	Jul-15
90 Rivonia Road	Offices	43 975	90 Rivonia Road, Sandton	4	Redefine Properties (Pty) Ltd	Office v1	Mar-16
90 Rivonia Road	Offices	43 975	90 Rivonia Road, Sandton	4	Redefine Properties (Pty) Ltd	Office v1	Dec-15
Advocates Chambers	Offices	7163	CNR Fredman and West Street, Sandton	4	Growthpoint Properties	Existing Building Performance v1	Jun-17
Alexander Forbes, 115 West Street	Offices	41 000	115 West Street, Sandton	4	Zenprop Property Holdings	Public and Education Building PILOT	Aug-12
Alice Lane - Phase II	Offices	16 424	11 Alice Lane, Sandton	4	Abland (Pty) Ltd	Office v1	Feb-16
Alice Lane - Phase III	Offices	35 000	11 Alice Lane, Sandton	4	Abland (Pty) Ltd	Office v1	Dec-15
Alice Lane Building 1	Offices	16 765	Corner of 5th Street & Fredman Drive, Sandton	4	Abland Property Developers	Office v1	Feb-13
Alice Lane Building 2	Offices	16 414	Corner of 5th Street & Fredman Drive, Sandton	4	Abland Property Developers	Office v1	Dec-13

Atholl Towers	Offices	11593	129 Patricia Road, Sandton	4	ALW Estates	Office v1	Jul-15
Atrium on 5th	Offices	29533	Cnr 5th Street and Alice Lane	4	Liberty Group Limited	Office v1	Jun-14
Atrium on 5th	Offices	29557	Cnr 5th Street and Alice Lane	4	Liberty Group Limited and Pareto Limited	Office v1	Jul - 16
Capital Hill	Offices	8150	6 Benmore Rd, Sandton	4	Uvongo Falls No 26 (Proprietary) Limited	Office v1	Aug-14
Chiselhurston	Offices	2169	21 Impala Road, Chiselhurston	4	Growthpoint Properties Limited	Existing Building Performance Tool v1	Jul-16
Eastgate 20 - Design	Offices	5653	148 Katherine Street, Sandton	4	Tiber Projects (Growthpoint Properties)	Office v1	May-12
Eastgate 20 -As built	Offices	15943	148 Katherine Street, Sandton	4	Tiber Projects (Growthpoint Properties)	Office v1	Aug-15
Engen House	Offices	7500,94	Cnr. St Andrews and St. David Roads, Parktown	4	Growthpoint Properties Limited	Office v1	Jan-12
Eton Office Park	Offices	2169	Cnr Sloane Street, Bryanston	4	Growthpoint Properties Limited	Existing Building Performance Tool v1	Jul-16
Fredman Towers	Offices	14911	Corner Buten Road & Fredman Drive, Sandton	3	Growthpoint Properties Limited	Existing Building Performance Tool PILOT	Apr-15
Grayston Office Park	Offices	13632	Corner Peter Road and Grayston Drive, Sandown	4	Growthpoint Properties Limited	Existing Building Performance Tool PILOT	May-15
Grayston Place	Offices	4976	68 Grayston Drive, Sandton	4	Growthpoint Properties Limited	Existing Building Performance Tool v1	Jul-16
Group 5 Head Office - As built	Offices	24 661	Cnr Maxwell and Country Estate Rd,	5	ATTACQ Waterfall Investment (Pty) Ltd	Office v1	Dec-13

Group 5 Head office - Design	Offices	19369	Cnr Maxwell and Country Estate Rd,	5	ATTACQ Waterfall Investment (Pty) Ltd	Office v1	Feb-15
Illovo Corner	Offices	10194,37	Illovo, Sandton	3	Growthpoint Properties	Existing Building Performance Tool v1	Apr-17
Illovo Edge Phase 3	Offices	7 423	Illovo, Sandton	5	Mont Blanc Projects and Properties (Pty) Ltd	Office v1	Sep-15
Inanda Greens Business Park	Offices	40509,06	54 Wierda Road West, Illovo	4	Growthpoint Properties Limited	Existing Building Performance Tool v1	Nov-16
Inanda 1, 3 & 4	Offices	23196,2	15 Girton Road, Parktown,	4	Growthpoint Properties Limited	Office v1	Jun-17
Kirstenhof Office Park	Offices	2 669	1 Witkoppen Road, Paulshof,, Sandton	5	Growthpoint Properties Limited	Office v1	Apr-15
Monte Circle - Building A	Offices	4 614	64 Montecasino Boulevard, Fourways,	4	Abland (Pty) Ltd	Office v1	Jun-15
Monte Circle - Building B	Offices	4031	64 Montecasino Boulevard, Fourways,	4	Abland (Pty) Ltd	Office v1	Dec - 16
No. 1 Mutual Place	Offices	34956	107 RIVONIA ROAD, SANDOWN	5	Old Mutual Property	Office v1	Sep-16
Nedbank Phase II Design	Offices	45401	Sandton	4	Nedbank	Office v1	Oct - 09
Nedbank Phase II - As built	Offices	45401	135 Rivonia Road, Sandton	4	Nedbank	Office v1	Sep-10
Peter Place Office Park	Offices	8795	54 Peter Place, Lyme Park, Sandton	4	Growthpoint Properties	Existing Building Performance Tool v1	May-17
Pinmill Farm Office Park	Offices	22774	164 Katherine Street, Kramerville,	4	Growthpoint Properties	Existing Building Performance Tool v2	Jun-17
Riviera Road Office Park	Offices	4769,82	6-9 Riviera Road, Houghton	4	Growthpoint Properties Limited	Existing Building Performance Tool v1	Sep-16
Rosebank Tower	Offices	2 669	Rosebank, Sandton	4	Abland (Pty) Ltd	Office v1	Jan - 16

Sandown Erven 159-162	Offices	2514	Cnr Katherine & Westbrook, Kramerville, Sandton	4	Growthpoint Properties Limited	Existing Building Performance Tool v1	Oct-16
Sandton Close 2 Office Park	Offices	12 843.66	Cnr 5th Street, Sandton	4	Growthpoint Properties Limited	Existing Building Performance Tool v1	May-17
Sasol Place	Offices	65623	47 WIERDA ROAD WEST, WIERDA VALLEY, Sandton	5	Alchemy Property Developments and Projects (Pty) Ltd	Office v1	Oct-16
Standard Bank Benmore Gardens Shopping Centre	Offices	576	Benmore, Sandton	4	Standard Bank	Interiors Tool	Mar-17
Standard Bank Global Leadership Centre	Offices	18 830	15 Summit Road, Morningside	4	Standard Bank	Existing Building Performance Tool PILOT	Jul-15
Standard Bank Rosebank - Design	Offices	2 175	30 Baker Street, Rosebank	5	Standard Bank of SA Ltd	Office v1	Jul-12
Standard Bank Rosebank - As Built	Offices	44283	Rosebank, Sandton	5	Standard Bank of SA Ltd	Office v1	Sep-14
Standard Bank, Melrose Arch	Offices	500	Melrose Arch, Corner Corlett Drive and M1 Highway, Melrose	4	Standard Bank	Interiors Tool	May-17
The Place	Offices	30 000	1 Sandton Drive, Sandton	3	Growthpoint Properties	Existing Building Performance Tool PILOT	Apr-15
The Towers	Offices	12911,88	15 Alice Lane, Sandton,	4	Growthpoint Properties	Existing Building Performance Tool PILOT	Jun-17
Thebe House	Offices	3 622	166 Jan Smuts Avenue, Rosebank	4	Growthpoint	Existing Building Performance Tool v1	Sep-16
Upper Grayston Bld F - As built	Offices	2 175	126 Ann Crescent, Strathavon, Sandton	6	Tower Property Fund	Office v1	Mar-15
Wierda Gables	Offices	2196	54 Wierda Road Wes, Sandton	4	Growthpoint	Existing Building Performance Tool v1	Jul-16
WSP House – Bryanston	Offices	2095	199 Bryanston Drive - Bryanston, Sandton	3	WSP Africa	Existing Building Performance Tool PILOT	Dec-14

Appendix C: Regression Analysis Model 1

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,573555							
R Square	0,328965							
Adjusted R Square	0,315545							
Standard Error	32,66011							
Observations	511							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	10	261463,1	26146,31	24,51179	9,95E-38			
Residual	500	533341,5	1066,683					
Total	510	794804,7						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	120,4451	7,133319	16,88486	6,06E-51	106,4301	134,4601	106,4301	134,4601
AREA/M²	0,000664	0,000152	4,365871	1,54E-05	0,000365	0,000963	0,000365	0,000963
P-GRADE	48,16936	9,129593	5,276178	1,97E-07	30,23227	66,10645	30,23227	66,10645
AAA-GRADE	38,20343	8,476119	4,507184	8,19E-06	21,55023	54,85662	21,55023	54,85662
A-GRADE	19,9505	7,627684	2,615538	0,009178	4,964235	34,93676	4,964235	34,93676
6 Star SA	-14,5454	18,9898	-0,76596	0,444064	-51,855	22,76428	-51,855	22,76428
5 Star SA	-2,83548	11,45698	-0,24749	0,804631	-25,3452	19,67427	-25,3452	19,67427
4 Star SA	18,83088	4,323112	4,355863	1,61E-05	10,33718	27,32459	10,33718	27,32459
3 Star SA	9,622417	6,795702	1,415956	0,157411	-3,72923	22,97407	-3,72923	22,97407
AREA1	18,94666	5,422923	3,49381	0,000518	8,292136	29,60119	8,292136	29,60119
AREA2	18,35433	7,864685	2,333765	0,020003	2,902424	33,80623	2,902424	33,80623

Appendix D: Regression Analysis Model 2

Summary output								
Regression Statistics								
Multiple R	0,570319							
R Square	0,325264							
Adjusted R Square	0,315874							
Standard Error	32,65225							
Observations	511							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	7	258521,399	36932	34,64	2,0136E-39			
Residual	503	536283,27	1066,2					
Total	510	794804,669						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	120,2835	7,12980854	16,871	6E-51	106,275623	134,29137	106,27562	134,29137
AREA/M²	0,00066	0,00015206	4,3399	2E-05	0,00036117	0,0009587	0,0003612	0,0009587

P-GRADE	49,23142	9,04918548	5,4404	8E-08	31,4525607	67,010275	31,452561	67,010275
AAA-GRADE	38,07408	8,39165713	4,5371	7E-06	21,5870641	54,561097	21,587064	54,561097
A-GRADE	20,38451	7,61258708	2,6777	0,0077	5,42812213	35,340891	5,4281221	35,340891
4 Star SA	17,99716	4,19360704	4,2916	2E-05	9,75801424	26,236302	9,7580142	26,236302
AREA1	19,36885	5,40539616	3,5832	0,0004	8,74891518	29,988786	8,7489152	29,988786
AREA2	18,94137	7,83828209	2,4165	0,016	3,54156377	34,341175	3,5415638	34,341175