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An Investigation into the Benefits of EDGE Residential Estates in Terms of Real-World Savings

Aiden van Wyk, Isobella van der Merwe and Saul Nurick

Urban Real Estate Research Unit (URERU), Department of Construction Economics and Management, University of Cape Town, Cape Town, South Africa

ABSTRACT

In South Africa, the EDGE certification for green residential buildings, managed by the Green Building Council South Africa (GBCSA), is still developing. The study set out to examine the impact of EDGE-certification on electricity savings of residential buildings and how these savings can be converted into financial benefits. Quantitative research was the overarching research methodology, where a single case study approach was conducted using descriptive statistics. The single case study is situated in Gauteng, South Africa, and consisted of 503 EDGE-certified residential units. The research concluded that EDGE-certified residential units in Gauteng generate electricity savings, which when converted into monetary values can be transformed into real-world savings using different investment vehicles. In this study, real-world savings is defined as the tangible and measurable financial benefits realised from efficiencies associated with green buildings. The study found that such investments, including the use of the hypothetical EDGE Alternative Investment Fund (EAI Fund), result in real-world savings, demonstrating the financial benefits of EDGE certification for owner occupiers in the South African property market.

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Green buildings; edge certification; residential buildings; electricity savings; investment vehicles; financial benefits

Introduction

This study investigates the impact of EDGE (Excellence in Design for Greater Efficiencies)) certification pertaining to electricity savings of residential buildings, and how these savings could be converted into a form of wealth creation for the owner/residents. Green building certification is a relatively recent development in South Africa, with the first green office building obtaining certification in 2009, based on the Green Building Council South Africa (GBCSA) Green Star SA tool (Danie et al., 2020; GBCSA, 2023; Nurick & Cattell, 2013; Nurick et al., 2015). The EDGE certification rating tool, introduced to South Africa in the mid-2010s, is specifically for residential buildings, unlike the earlier Green Star SA tool used for commercial properties. A green building meets specific criteria related to the construction and property management processes that focus on the environmentally efficient use of resources, making it eligible for certification (Oguntona et al., 2019).

Given South Africa's recent experiences with electricity shortages and rising costs, the study highlights how EDGE certification, combined with solar photovoltaic solutions, offers an opportunity for substantial electricity savings and potential wealth creation (Ojo-Fafore et al., 2018). The synergy of EDGE certification underpinned by large scale mid to high income residential development has created an opportunity to leverage off electricity savings to be converted into a form of wealth creation.

Rationale

The formal establishment of the green building sector began in the UK with BREEAM (Building Research Establishment Environmental Assessment Method) in 1992 (Awadh, 2017). It then expanded in the United States in the late 1990s, marking the inception of a movement that rapidly spread to other developed real estate markets in Europe, Australasia, and Asia during the early 2000s. South Africa, a developing country, adopted green building practices more slowly (Simpeh & Smallwood, 2018). The Green Building Council South Africa (GBCSA) was established in 2007, with

CONTACT Aiden van Wyk VWYAID001@myuct.ac.za Urban Real Estate Research Unit (URERU), Department of Construction Economics and Management, University of Cape Town, Cape Town, South Africa

significant assistance from the Green Building Council Australia (GBCA). The delay in South Africa's adoption of green building protocols can be attributed to the country's focus on other pressing built environment issues, such as addressing infrastructure deficiencies and inequality stemming from the apartheid era (Venter et al., 2020). Despite these initial delays, the formation of the GBCSA has accelerated the certification process within South Africa's commercial property sector. By 2023, the GBCSA had awarded certifications to 1,000 Green Star SA buildings (GBCSA, 2023), illustrating a significant shift towards sustainable building practices.

The Excellence in Design for Greater Efficiencies (EDGE) certification system was introduced to the market in 2014 by the International Finance Corporation (IFC) (Isimbi & Park, 2022). Although EDGE can be applied to various real estate sectors globally, in South Africa, it is exclusively utilized for residential buildings. To achieve EDGE certification, a building must meet stringent criteria, including reducing energy consumption, water usage, and embodied energy in construction materials by at least 20% (Maeda & Dixon, 2023). This 20% reduction is measured not against the building's past performance, but against a baseline conventional building that EDGE defines using local climate, construction practices and typical materials (Maeda & Dixon, 2023). This focus underscores EDGE's role in promoting efficiency and sustainability in residential construction.

The growing demand for green buildings reflects an increasing environmental consciousness among individuals and organizations (Butera, 2010; Gou & Xie, 2017; Häkkinen & Belloni, 2011). People are seeking to reside and work in environments that minimize energy consumption, lower carbon emissions, and reduce resource depletion (Gou & Xie, 2017; Kibwami & Tutesigensi, 2016). Additionally, there is a heightened awareness of the relationship between building environments and occupants' well-being, which has fueled the demand for healthier and more comfortable living and working spaces (Elzeyadi, 2011; Milton et al., 2000; Nurick, 2022; Nurick & Thatcher, 2021a; 2021b; 2023; Zitars et al., 2021). Green buildings offer substantial energy and cost savings over their lifespan, which motivates users to seek out such properties for their long-term financial benefits, thus, driving demand (Ahn et al., 2013; Butera, 2010; Zhang et al., 2018).

The supply of green buildings is heavily influenced by the regulatory environment in which developers operate (Arif et al., 2012; Vierra, 2016). In numerous countries, regulatory frameworks such as building codes, energy-efficient standards, and various regulations have incentivized developers to pursue green building projects (Franco et al., 2021; Koeppel & Ürge-Vorsatz, 2007; Sayce et al., 2007). By achieving green building certification, developers and builders can distinguish themselves in the marketplace, which has led to an increase in the number of green projects (Andelin et al., 2015). The market demand for sustainable, healthy, and cost-efficient buildings has prompted developers to invest in green projects, thereby increasing the supply of such buildings (Shen & Faure, 2021).

The initial costs of developing green buildings can be higher than those of conventional buildings, as supported by a study by Ade and Rehm (2019a), which found a 12% cost premium for 6-Homestar certification in New Zealand, based on actual construction cost data from 718 single-family homes. However, the increasing demand for green buildings has led to economies of scale that help narrow the cost gap (Hydes & Creech, 2000; Larsson & Clark, 2000). Recent studies suggest these premiums are becoming more manageable, for example, Kempf (2023) found that MINERGIE-certified buildings in Switzerland had cost premiums typically ranging from 1.6% to 5.1% which may be offset by increased rental yields. Developers are motivated by the growing affordability of green buildings, as well as the financial incentives, tax benefits, and reduced operating costs associated with projects over their lifecycle (Scofield, 2009). The availability and accessibility of green building materials and technologies also play a crucial role in influencing the market supply of green buildings (Nelms et al., 2005). Advances in renewable energy systems, energy storage solutions, smart building operations, and sustainable materials have made it increasingly feasible and cost-effective for developers to undertake green building projects (Kohler & Lützkendorf, 2002).

Real-world savings refer to the tangible and measurable financial benefits that individuals, businesses, or communities can achieve through various actions, initiatives, and behavioral changes (Grigoli et al., 2014). It is further defined as the benefits realised by owner-occupiers, as opposed to simulated or predicted savings generated through design-phase modelling. These savings reflect the performance of green buildings under normal use conditions and are a critical factor in assessing the tangible value of green certifications such as EDGE. These tangible benefits align with findings by Kats (2003), who highlights significant energy cost reductions in green buildings under normal operating conditions. Green buildings are designed with a strong emphasis on sustainability and energy efficiency, aiming to minimize environmental impact while providing a healthy and comfortable indoor environment (Zhang et al., 2018). The extent of savings realized through green buildings can vary depending on factors such as design, location, building occupancy, and the quality and quantity of green building features and initiatives implemented (Zhao et al., 2016). Energy-efficient measures, including innovations in appliances, insulation, lighting, heating, and HVAC systems, contribute to reductions in energy bills and operational costs (Chwieduk, 2003).

Furthermore, green buildings are recognized for their ability to reduce energy and water usage, as well as lower operational and maintenance costs, which are key benefits highlighted in the literature (Eichholtz et al., 2010; Kats, 2003). Research conducted by Zhao et al. (2016), which involved analyzing similar residential units based on location and the application of energy-efficient retrofit technologies, supports the notion and research conducted by Abidin and Powmya (2014) and Low et al. (2014), of increased returns on investment associated with green buildings. Their study revealed that units meeting the Home Energy Rating Systems (HERS) standard achieved an annual reduction of 6.8 kWh in energy consumption per square foot, equating to an annual saving of $0.80. In the context of American homes, green building technologies could result in up to 43% annual savings in energy consumption and expenditures (Zhao et al., 2016). Earlier research by Turner and Frankel (2008) similarly found that LEED-certified buildings in the US achieved an average energy savings of 28% compared to baseline figures. This body of research underscores the significant financial and environmental benefits associated with green building practices.

Underpinned by the relevant literature, a theoretical model was constructed. The theoretical model displayed in Figure 1 illustrates the fact that green buildings are a subset of sustainable buildings. Sustainable building is a broad and interconnected concept that focuse on maintaining the long-term health and balance of economic, social, institutional and environmental development. It emphasizes the need to consider how different aspects of society and the natural world are linked, and how our actions support or disrupt this balance over time (Abdelfattah, 2020). Green buildings have a narrower focus compared to that of sustainable buildings and represent a key subset of sustainability efforts as they specifically concentrate on designing, constructing and operating structures in ways that reduce environmental impact, improve energy efficiency and promote

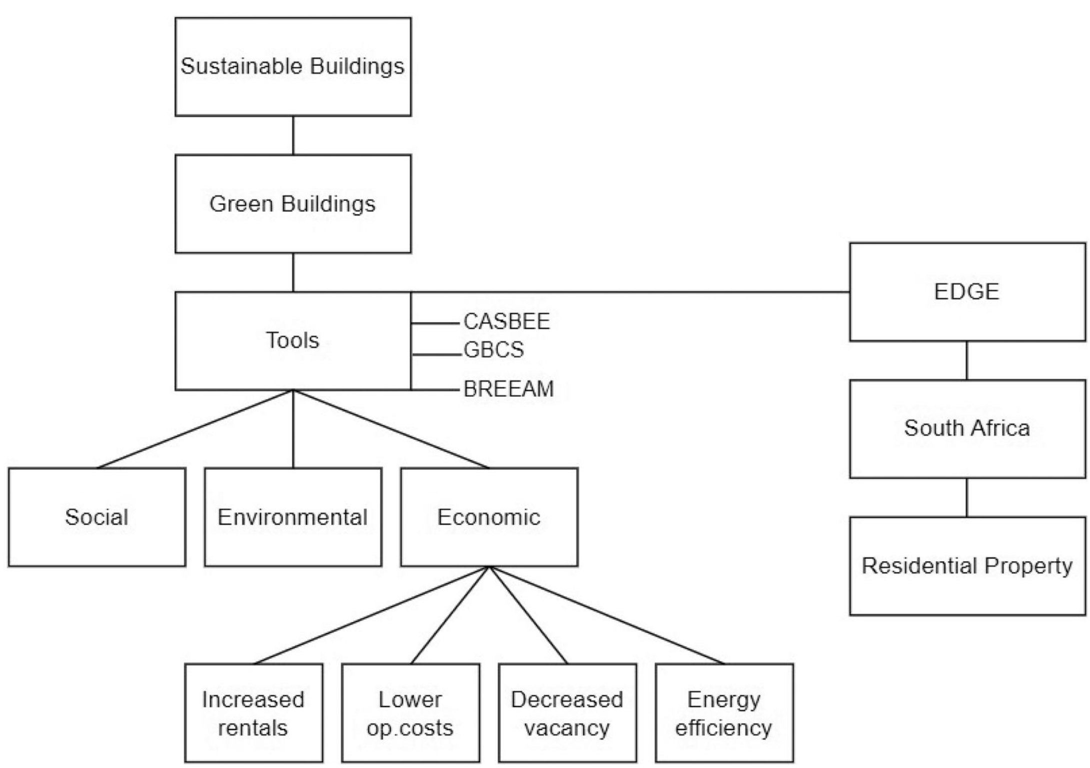

Figure 1. Theoretical Model based on the literature. *Sources:* Authors construct (2024).

healthier living environments (Awadh, 2017). For a building to be regarded as green, it typically needs to achieve recognition through a certification system (Sinha et al., 2013). There are many certification tools used in the industry, with CASBEE, BREEAM and GBCS examples of such. The EDGE certification tool is one tool used throughout South Africa and focusses solely on residential properties (GBCSA, 2023). The benefits attributed to the economic aspect of green buildings, namely, increased rentals, decreased vacancy, lower operational costs and energy efficiency are included in the theoretical model (Darko et al., 2017; Falkenbach et al., 2010; Häkkinen & Belloni, 2011). In addition to these traditional economic advantages, recent research also highlights a reduction in risk premiums and improved risk-return profile for green buildings compared to conventional counterparts. For example, McGrath (2013) found that eco-certified office properties in the US had capitalisation rates 0.4 percentages points lower than non-certified, indicating reduced investment risk. Similarly, Kempf and Syz (2022) reported a 0.56% lower capitalisation rate for sustainable residential buildings in Zurich.

Method and Hypothesis

The synergy of EDGE certification underpinned by large scale mid to high income residential development has created an opportunity to leverage off electricity savings to be converted into a form of wealth creation. This has resulted in the following research hypothesis:

EDGE certified residential developments in South Africa (Gauteng Province) create increased electricity savings, and these benefits can be converted into real-world savings. The null hypothesis states that there are no monetary savings associated with EDGE certification.

A single case study using a quantitative approach was adopted to achieve the research objectives. The methodology employed includes the analysis of an EDGE-certified (level 1) residential property development located in Gauteng province, South Africa. This development consisted of 503 single-storey units—comprising 219 one-bedroom (46 m^2), 232 two-bedroom (64 m^2), and 52 three-bedroom (80 m^2) dwellings—which formed the primary sample used for analysis. The initial set of units for the estate development was released in 2020, with the dataset used in this analysis covering the period from April 2022 to March 2023.

Electricity consumption and savings data for each unit type were provided by a prominent property company. The raw data consisted of energy usage (kWh) for each residential unit, recorded at 30-minute intervals (e.g., 12:00–12:30) daily for a twelve-month period. A year-long analysis was conducted to ensure that the study accounted for seasonal variations, as different times of the year significantly impact weather conditions and, in turn, electricity demand. Therefore, a data set for a typical month equated to approximately: $n = 2$ (30-minute intervals) $\times$ 24 (hours) $\times$ 30 (days) $\times$ 503 (units) = 724,320. This yielded approximately 8.7 million data points for the twelve-month period of analysis. These data points represent a detailed and comprehensive dataset, capturing variations in electricity consumption across different times of the day, seasons, and weather conditions. This extensive dataset allowed for more robust statistical analysis and a deeper understanding of consumption trends throughout the year.

A statistical analysis in the form of forecasting and trend analysis was conducted on the collected data. Descriptive statistics were used for analysis, which is optimal for analysing large data sets. This statistical technique provides a concise summary of the data and offers further insights (Fisher & Marshall, 2009). The main purpose of descriptive statistics is to identify patterns and relationships that emerge after analysis (Hayes, 2023).

To calculate the savings for EDGE-certified residential units, a baseline was established by comparing electricity usage (kWh) between non-EDGE properties (sourced from company and municipal data) in Gauteng and the residential units in the EDGE-certified development. The baseline data for non-EDGE homes was obtained from records supplied by the same property company that provided the EDGE data. Although exact unit sizes for the non-EDGE sample were not provided, it is reasonable to assume comparability since both EDGE and non-EDGE data were extrapolated from units that allowed for direct comparison. Moreover, the company's internal analysis directly compared EDGE and non-EDGE developments, providing a practical basis for comparison.

The difference in electricity usage was used to determine the saved portion. A monetary value (cost per kWh in South African Rand) was applied to calculate the monetary savings across all three-unit types for a potential investor.

Quantitative analysis in the form of financial modelling was conducted to assess whether the differences associated with EDGE certification can be translated into real-world savings. These savings were then used as additional payments towards the EDGE-certified property's loan/mortgage, resulting in a reduction in the loan term.

To further explore wealth creation, a hypothetical balanced investment fund—the EDGE Alternate Investment (EAI) Fund—was created, modelled after similar funds available in the South African market. The electricity savings, along with mortgage repayments for periods without payment (resulting from the reduced loan term), were invested and then discounted back to the start of the loan term, assuming an annual inflation rate of 5%. The real-world savings were then used to calculate the Real-World Savings (RWS) Loan ratio, which was calculated by dividing the present value of the EAI fund investment by each respective original loan amount.

This research approach was considered appropriate, as similar methodologies have been used by other researchers (Ade & Rehm, 2019b; Dwaikat & Ali, 2016; Le Jeune et al., 2013; Sundayi et al., 2015) in the field of green building and utility assessment, where a single case study is utilized for its unique characteristics and substantial sample size for quantitative analysis. The unit of analysis was the EDGE-certified residential units to assess their impact on real-world savings for the owners/residents.

Findings and Analysis

The case study analysed is in Gauteng, South Africa, and has a total of 503 units, which comprised of 219 one-bed units, 232 two-bed units, and 52 three-bed units. The development is owned by a prominent property company, listed on the JSE, with a portfolio of over 70 developments in Gauteng, Western Cape and KZN. The company has achieved six Africa and Arabia Property Awards.

The average monthly electricity consumption for the one-, two- and three-bedroom units in the EDGE certified development for the twelve-month period was, 184.81 kWh, 222.76 kWh, and 229.23 kWh, respectively, as shown in Table 1. Electricity consumption was highest during the months of May to August, which correspond with the coldest average monthly temperatures over the 10-year climate period analysied (Weather Underground, 2023). This correlation strongly suggests that the increased energy usage is driven primarily by heating demand during the colder winter period. Additionally, the interannual variability of monthly average temperatures was investigated, with the observed standard deviations ranging between approximately 0.8 °C and 1.3 °C, indicating a relatively low to moderate level of variability (Weather Underground, 2023).

Table 1. Average electricity consumption per EDGE unit type per month.

Month	One Bed	Two Bed	Three Bed
Apr-22	202.71	203.93	218.17
May-22	227.20	245.91	239.11
Jun-22	274.88	291.15	244.01
Jul-22	287.27	301.92	250.39
Aug-22	221.51	258.16	278.91
Sep-22	199.40	227.50	205.52
Oct-22	193.71	185.45	159.41
Nov-22	125.08	194.77	221.74
Dec-22	112.38	191.50	214.98
Jan-23	119.54	188.07	240.47
Feb-23	111.22	171.57	210.86
Mar-23	142.82	213.22	267.22
Average Consumption (1 Year)	184.81	222.76	229.23

Sources: Authors construct (2024).

Table 2. Average electricity for non-EDGE residential units.

	Spend per month:	R/kWh	kWh per month
Non-EDGE One Bedroom	R 365.58	1.4809	246.86
Non-EDGE Two Bedroom	R 516.92	1.4809	349.06
Non-EDGE Three Bedroom	R 739.26	1.4809	499.12

Sources: Authors construct (2024).

The average cost of electricity for the same non-EGDE residential typologies was acquired (City Power, 2020) to determine the baseline in terms of costs and usage (kWh). Table 2 provides a summarized breakdown. The cost per kWh was R1.4809, resulting in monthly usage (kWh) amounts for the one-, two- and three-bedroom units of 246.86 kWh, 349.06 kWh and 499.12 kWh, respectively.

This resulted in electricity consumption savings for each typology of 62.05 kWh (one bedroom), 126.29 kWh (two bedroom) and 269.96 kWh (three bedroom). The average consumption savings were calculated as the difference between the EDGE and non-EDGE residential units as shown in Tables 1 and 2. To calculate the monthly monetary savings between the EDGE and non-EDGE residential units, 2023 prices were used, which are charged by the South African national power supplier, ESKOM. According to the 2023/24 ESKOM charges report, residential units that use less than 600kWh per month are charged R2.5354 per kWh. This results in monthly savings for the EDGE certified units of R157.33 (one bedroom), R320.21 (two bedroom) and R684.47 (three bedroom), with annual figures calculated using a factor of 12. The monthly and annual savings per typology for the EDGE certified units are shown in Table 3.

The electricity savings shown in Table 3 were used to show how wealth can be created for the owner/residents of the EDGE certified residential units. A scenario of using the monetary savings as an additional contribution to the monthly loan/mortgage repayment was simulated. This required establishing a market price and loan parameters for each of the residential typologies in the EDGE certified development. The prices for each of the units were provided by a single case study, where they were selling one-bedroom units for R700,000, two-bedroom units for R950,000- and three-bedroom units for R1,000,000. The same loan parameters were assumed for each of the units. A loan-to-value (LTV) ratio of 80% for twenty years at the prime interest rate (11.75%) for non-EDGE units and prime less 1% (10.75%) for EDGE units was used. The reduced interest rate can be justified as banks are starting to offer green finance for certified properties (Kempf & Syz, 2022; Lorenz and Lützkendorf, 2008; McGrath, 2013). The loan parameters resulted in monthly loan/mortgage repayments of R6069, R8236 and R8670 for the one-, two- and three-bedroom units, respectively. Table 4 provides a breakdown of the loan variables for each typology plus an increased monthly payment when the electricity savings are added to the monthly payments, as per the loan parameters.

Table 3. Monthly and annual monetary savings for the EDGE certified units.

Unit Type	Monthly Savings Average	Annual Savings Average
One Bedroom	R 157.33	R 1,888
Two Bedroom	R 320.21	R 3,842
Three Bedroom	R 684.47	R 8,214

Sources: Authors construct (2024).

Table 4. Loan/mortgage details for each of the EDGE certified typologies.

Unit Type	One Bedroom	Two Bedroom	Three Bedroom
Purchase Price	R 700,000	R 950,000	R 1,000,000
Deposit (20%)	R 140,000	R 190,000	R 200,000
Loan Amount (LTV 80%)	R 560,000	R 760,000	R 800,000
Monthly Payment	R 6068.76	R 8236.17	R 8669.66
EDGE Electricity Saving	R 157.33	R 320.21	R 684.47
Increased Monthly Payment	R 6226.09	R 8556.38	R 9354.12

Sources: Authors construct (2024).

The increased loan/mortgage payment due to the electricity savings results in a reduction in the loan term where the increased payments form part of a loan structure at prime less 1% (10.75%). The EDGE resident/owner pays off their loan/mortgage faster due to both the increased loan payments and lower cost of finance. The reduction in loan term for each of the three typologies would be 56 months (one bedroom), 61 months (two bedrooms) and 77 months (three bedrooms). The reduction in loan term is shown in Figures 2–4, where each of the EDGE certified typologies is compared the amortization of a loan for the same non-EDGE unit that does not contain any form of electricity savings building components, where the cost of finance is the prime interest rate (11.75%).

One of the benefits of a reduced loan term that relates to wealth creation is interest saved on the loan/mortgage payments that did not occur due to the contribution of the electricity savings for the owners/residents of the EDGE certified residential units. When the same loan parameters are applied the respective interest savings for the one-, two- and three-bedroom units are R81,748, R129,221 and R204,807, as shown in Table 5.

The EDGE Alternative Investment (EAI) Fund was derived from other balanced funds currently offered in the South African investment market. A balanced fund is a type of mutual fund that owns a combination of both stocks and bonds, where stocks generally derive wealth from capital appreciation, while bonds

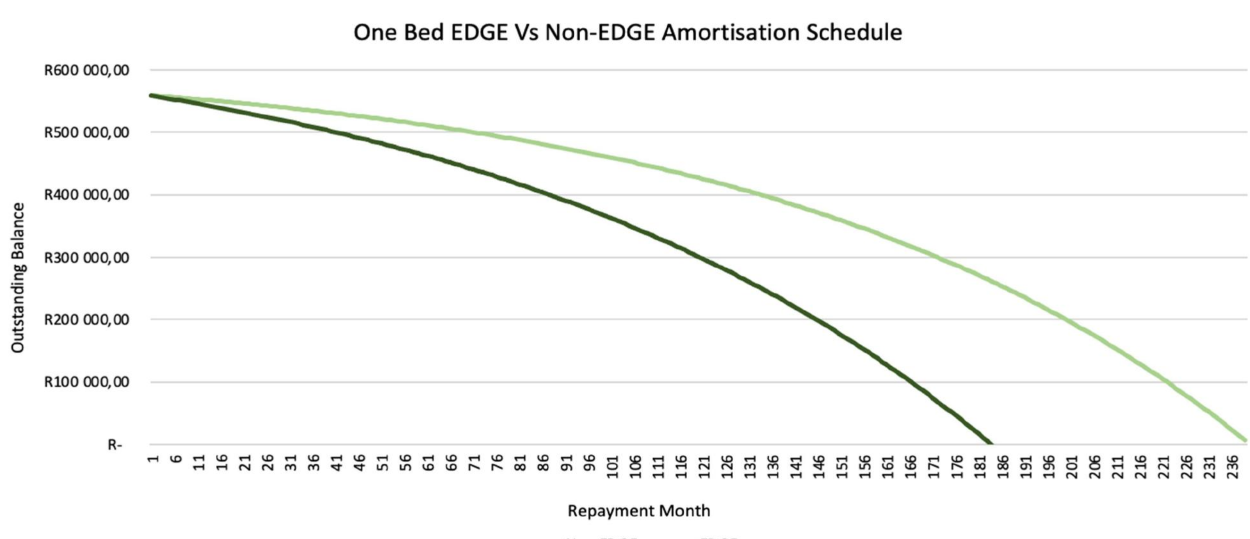

Figure 2. One bedroom EDGE unit vs non-EDGE unit. *Sources:* Authors construct (2024).

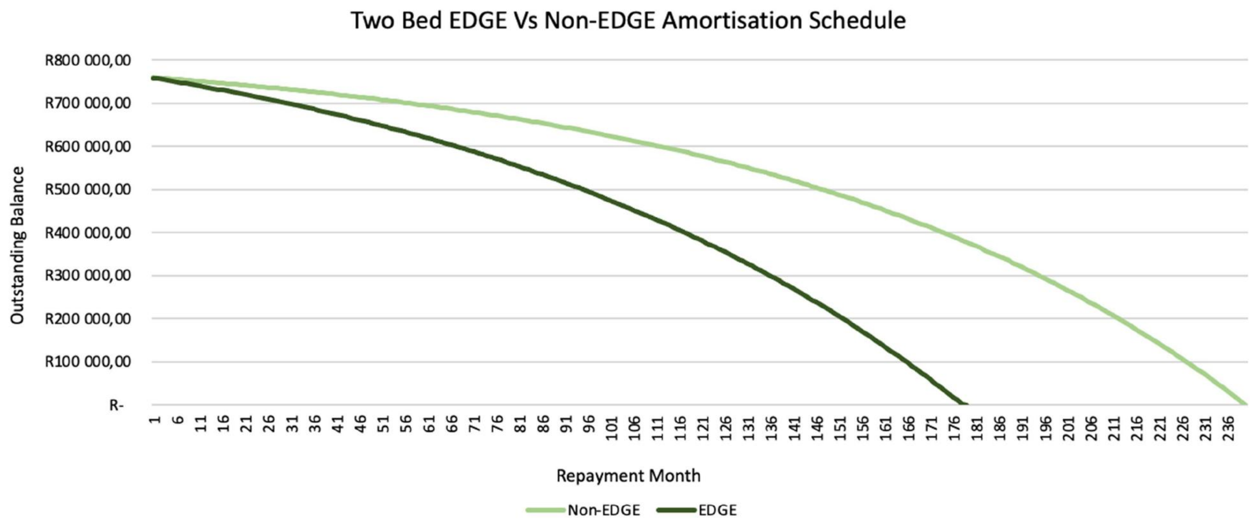

Figure 3. Two bedroom EDGE unit vs non-EDGE unit. *Sources:* Authors construct (2024).

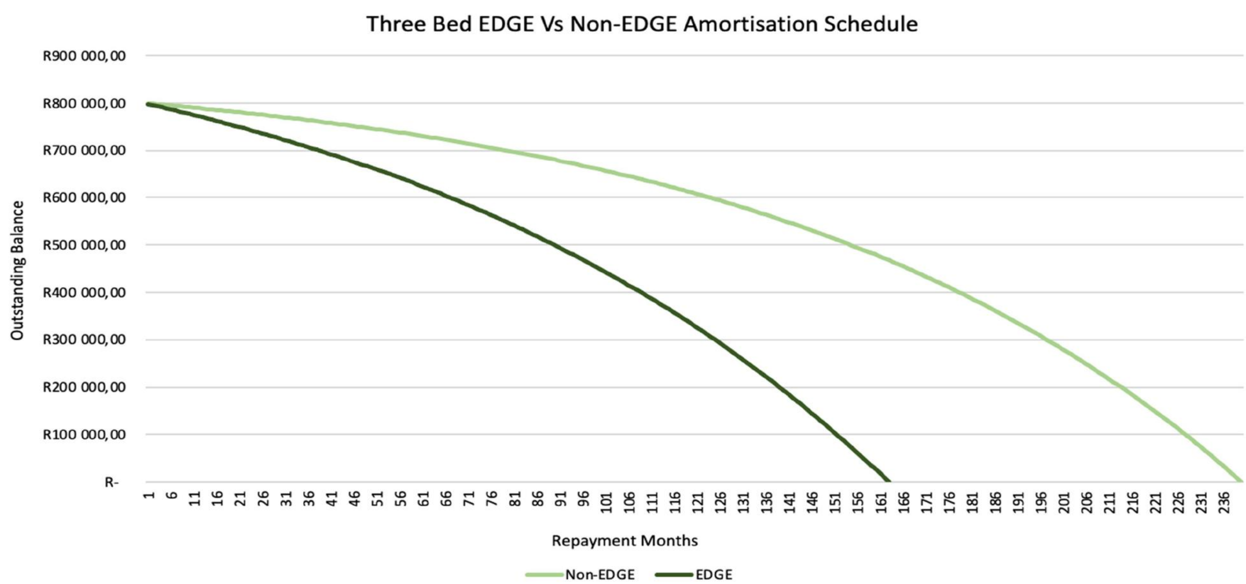

Figure 4. Three bedroom EDGE unit vs non-EDGE unit. *Sources:* Authors construct (2024).

Table 5. Interest savings for each of EDGE typology.

Unit Type	One Bedroom	Two Bedroom	Three Bedroom
Term Reduction (months)	56	61	77
Interest saved	R 81,748	R 129,221	R 204,807

Sources: Authors construct (2024).

are income producing assets (Cairns, 2015). As shown in Figure 5, the asset allocation of a typical balanced fund comprises approximately 55% equity (local and offshore), 30% bonds, and the remaining 15% are invested locally and internationally in cash, property and commodities.

To establish an approximate return for the EAI Fund, the top performing South African balanced funds were assessed. While the funds are predominantly invested in South African investment vehicles, this is not a restrictive feature but rather a reflection of the research focus at the time. The Balanced Fund already includes offshore exposure, ensuring a degree of diversification within the portfolio. Additionally, while the investment management platform is based in South Africa, the structure allows for flexibility and global diversification. According to Allan Gray (2025), South African Balanced Funds

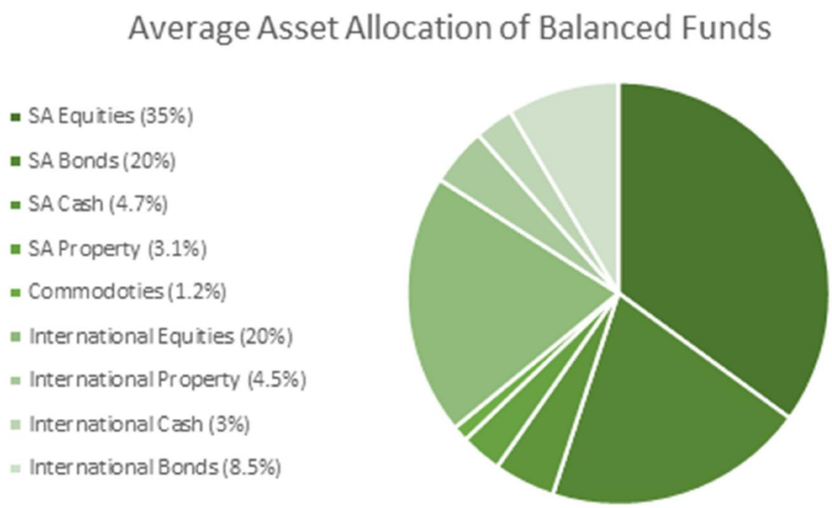

Figure 5. Average allocation of assets by prominent balanced funds. Sources: Authors construct (2024).

Table 6. Average return of prominent balanced funds compared to an average benchmark.

Average Return of Balanced Funds	
Balanced Fund	Returns Since Inception
Fund A	8.78%
Fund B	15.00%
Fund C	11.80%
Fund D	8.24%
Average Top Performers	10.96%
Average Benchmark	7.71%
Final Value	9.50%

Sources: Authors construct (2024).

$$FV = PMT\,x\,\frac{(1+i)^n - 1}{i}$$

Figure 6. Future value of an ordinary annuity.

are generally permitted to invest up to 45% of their assets offshore. Based on the averages used to calculate the returns of the top-performing Balanced Funds in South Africa, it is likely that these funds maintained offshore exposure close to the 45% limit.

The average annualised return since inception of four of the tops performing balanced funds in South Africa was found to be 10.96%. This value was then compared to the base line value for the average annualised return associated with all balanced funds in South Africa, which is 7.2% over the past ten years. Table 6 shows a final annualised return of 9.5% was therefore extrapolated and used to calculate possible returns earned by the EAI Fund.

Upon full repayment of the mortgage, when the present value (PV) of the loan reaches zero, the homeowner's debt obligation is considered fulfilled. The funds previously allocated to monthly mortgage payments can then be redirected toward investing in the EAI Fund. The electricity savings that contributed to accelerating the mortgage repayment can also be invested. Together, these freed-up cash flows, comprising former mortgage payments and electricity savings, are invested in the EAI Fund for the duration of the mortgage term reduction associated with each housing typology, as presented in Table 5.

For the one-bedroom units, R6226 would be invested monthly for 56 months, the two-bedroom units, R8556 invested monthly for 61 months and R9354 invested monthly for 77 months. This would result in a future value (FV) for the EAI Fund for each of the typologies. Applying an annualised return of 9.5%, each typology generated a FV of R436,619 (one bedroom), R667,631 (two bedrooms) and R986,914 (three bedrooms). The FV's were calculated using an ordinary annuity formula, as shown in Figure 6.

Where:

FV = Future Value, PMT = Payment (loan/mortgage payment + electricity saving), i = Annualised return of EAI Fund (9.5% p.a.), n = Reduction term for loan/mortgage

Figure 7 shows how the EAI Fund investment grows for each respective unit's investor.

Upon computing the FV investment of each unit, the subsequent step involved determining the present-day equivalent of these values. When computing the PV as seen in Figure 8, the discount rate employed

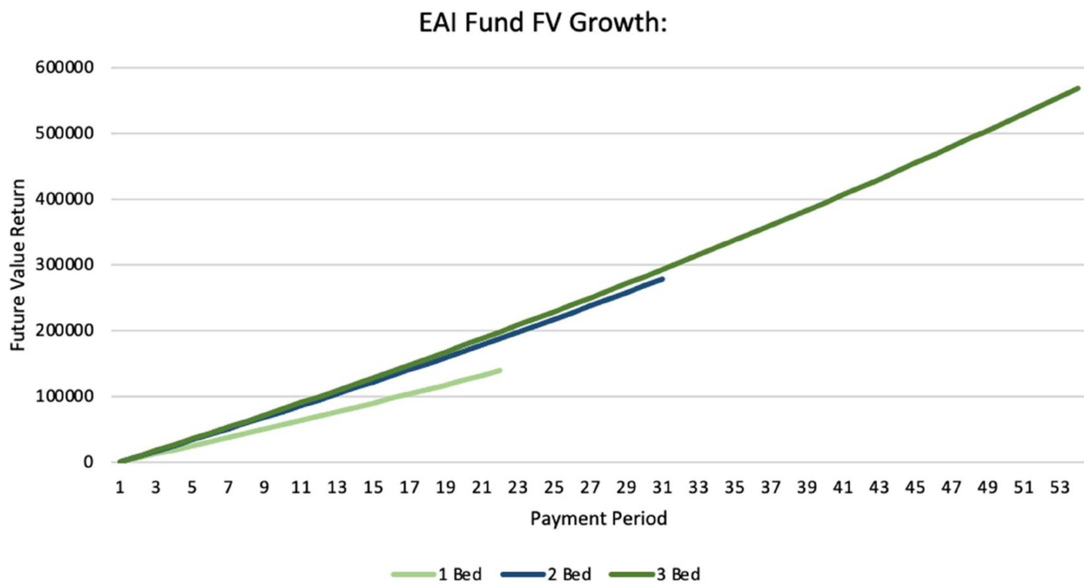

Figure 7. The future value growth of investors of each unit type. *Sources:* Authors construct (2024).

$$PrVa = \frac{FV}{(1+i)^n}$$

Figure 8. Present value formula.

$$RWS = \frac{PrVa\ (EAI\ Fund)}{Loan_{unit}}$$

Figure 9. Real World Savings (RWS) loan ratio formula.

was equivalent to the inflation rate, thereby enabling the determination of the actual current-day monetary worth. The inflation rate in Gauteng for July 2023 was at the 4.3% mark, fitting the Central Bank 3%–6% target (Statistics South Africa, 2023). An inflation figure of 5% was therefore used in the analysis. The findings were that the PV of the EAI Funds FV's were R 164,557.09 for the 1-bed investor, R 251,622.98 for the two-bed investor, and R 371,957.77 for the 3-bed investor.

Where:

PrVa = Present Value, FV = Future Value (EAI Fund contributions), i = Inflation Rate (5% p.a.), n = Original Loan Term (20 years)

The PrVa and the original loan amounts are used to calculate a new financial indicator – Real World-Savings (RWS) Loan Ratio, as shown in Figure 9.

Where:

RWS = Real World Savings Loan Ratio, PrVa = Present Value for EAI Fund Contributions, Loan = Original Loan Amount, Unit = Unit Type in the EDGE certified development

Table 7. RWS loan ratio breakdown.

	One Bedroom	Two Bedroom	Three Bedroom
FV of EAI Fund	R 436,619	R 667,631	R 986,915
PrVa of EAI Fund	R 164,557	R 251,623	R 371,958
Loan Amount	R 560,000	R 760,000	R 800,000
RWS Loan Ratio	29.39%	33.11%	46.49%

Sources: Authors construct (2024).

Table 7 presents the RWS loan ratios for the one-, two-, and three-bedroom units, which were 29.39%, 33.11%, and 46.49% respectively. The RWS loan ratio for the two- and three-bedroom units indicate that in today's money, the EAI Fund returns equate to a third and almost half of the respective loan amounts (Table 7).

Conclusion

EDGE certification in residential housing offers substantial benefits, primarily through significant reductions in electricity consumption. The study's findings indicated that EDGE-certified units achieved notable monthly savings: 1-bedroom units reduced consumption to an average of 184.81 kWh, 2-bedroom units to 222.76 kWh, and 3-bedroom units to 229.23 kWh, resulting in monetary savings of R157.33, R320.21, and R684.45 per month, respectively. These savings can be utilized in various ways to enhance residents' financial well-being. For example, applying monthly savings to mortgage repayments could significantly reduce loan terms, leading to considerable financial savings. Investing unused loan repayments into a theoretical EDGE Alternative Investment (EAI) Fund could generate substantial returns, further enhancing real-world savings.

Table 8. Summary of key findings in research.

	Unit type		
	One Bed	Two Bed	Three Bed
Average Consumption (per year):	184.81 kWh	222.76 kWh	229.23 kWh
Savings (kWh):	62.05 kWh	126.29 kWh	269.96 kWh
Monthly Savings:	R 157.33	R 320.21	R 684.47
Annual Savings:	R 1887.98	R 3842.49	R 8213.60
Unit Purchase Price:	R 700,000	R 760,000	R 800,000
Loan Amount (LTV 80%):	R 560,000	R 760,000	R 800,000
Non-EDGE Monthly Repayment:	R 6068.76	R 8236.17	R 8669.66
EDGE Monthly Repayment:	R 6226.09	R 8556.38	R 9354.12
Non-EDGE mortgage period (Months):	240	240	240
EDGE mortgage period (Months):	184	176	163
Reduced period (Months):	56	61	77
FV of EAI Balanced Fund:	R 436,618.95	R 667,630.68	R 986,914.69
PV of EAI Balanced Fund:	R 164,557.09	R 251,622.98	R 371,957.77
Loan Saving Ratio:	29.39%	33.11%	46.49%

Sources: Authors construct (2024).

The rise of green buildings, especially in the residential sector with a high proportion of owner-occupiers, introduces a new avenue for wealth creation via electricity savings. In South Africa, where government-provided electricity is unreliable and costs are rising above inflation, this potential is particularly significant. Research indicates that EDGE-certified residential units with photovoltaic installations can achieve significant electricity savings compared to non-EDGE-certified units. These savings can be converted into monetary savings, which can then be used to service real estate debt at potentially lower borrowing costs, leading to accelerated debt repayment and opportunities for future investments.

The introduction of a new real estate indicator, the Real-World Savings (RWS) Loan Ratio, underscores the potential for wealth creation through early loan settlement. The acceptance of the research hypothesis suggests that wealth creation in the form of real-world savings is achievable through electricity savings in EDGE-certified residential developments.

The study, focused on a single case in Gauteng, South Africa, encompassed 503 residential units of three different types. There is potential for this research to be replicated in other EDGE-certified developments across South Africa, where climatic conditions and electricity costs vary. Additionally, future research could explore different levels of EDGE certification, such as EDGE Advanced (level 2) and EDGE Zero Carbon (level 3), to further understand the benefits and potential savings (Table 8).

The Empirical Model

Drawing upon the discoveries presented, revisions, depicted in red, were implemented to the theoretical model in Figure 1. Subsequently, an empirical model was developed and is illustrated in Figure 10.

In the empirical model, an extension was made to be specific to the research, which is based on a single case study of residential units in Gauteng. Therefore, a Gauteng extension was made to the EDGE residential component. Electricity savings, an extension of energy savings, was explored throughout the research for different unit types (1-bed, 2-bed and 3-bed). Therefore, a link was created between electricity savings and energy savings from the previous theoretical model. The savings generated were then invested into different investment vehicles to create real-world savings. These investment options, specific to the research, were mortgages and balanced funds, and are illustrated via a link from electricity savings. The investment options were assessed. As the mortgage duration is reduced through the increase of monthly payment instalments attributed to EDGE savings, this leads to more contributions being made to the EAI fund. The RWS loan ratio, which is representative of the creation of real-world savings, is therefore an extension of both the mortgage and balanced fund investment vehicles. The positive results are therefore drivers to purchasing and investing in EDGE-certified residential properties.

Sensitivity Analysis

Our initial sensitivity analysis focuses on varying the price per kWh of electricity. The base case uses a rate of R2.5354 per kWh, which serves as the foundation for the remainder of our analysis. By adjusting the electricity price by approximatelyR0.50, we assess the sensitivity of long-term savings to changes in energy costs. When the electricity price is reduced to R2.00 per kWh, the Real -World Savings (RWS) ratio decreases slightly, reflecting the lower cost of electricity and its impact on

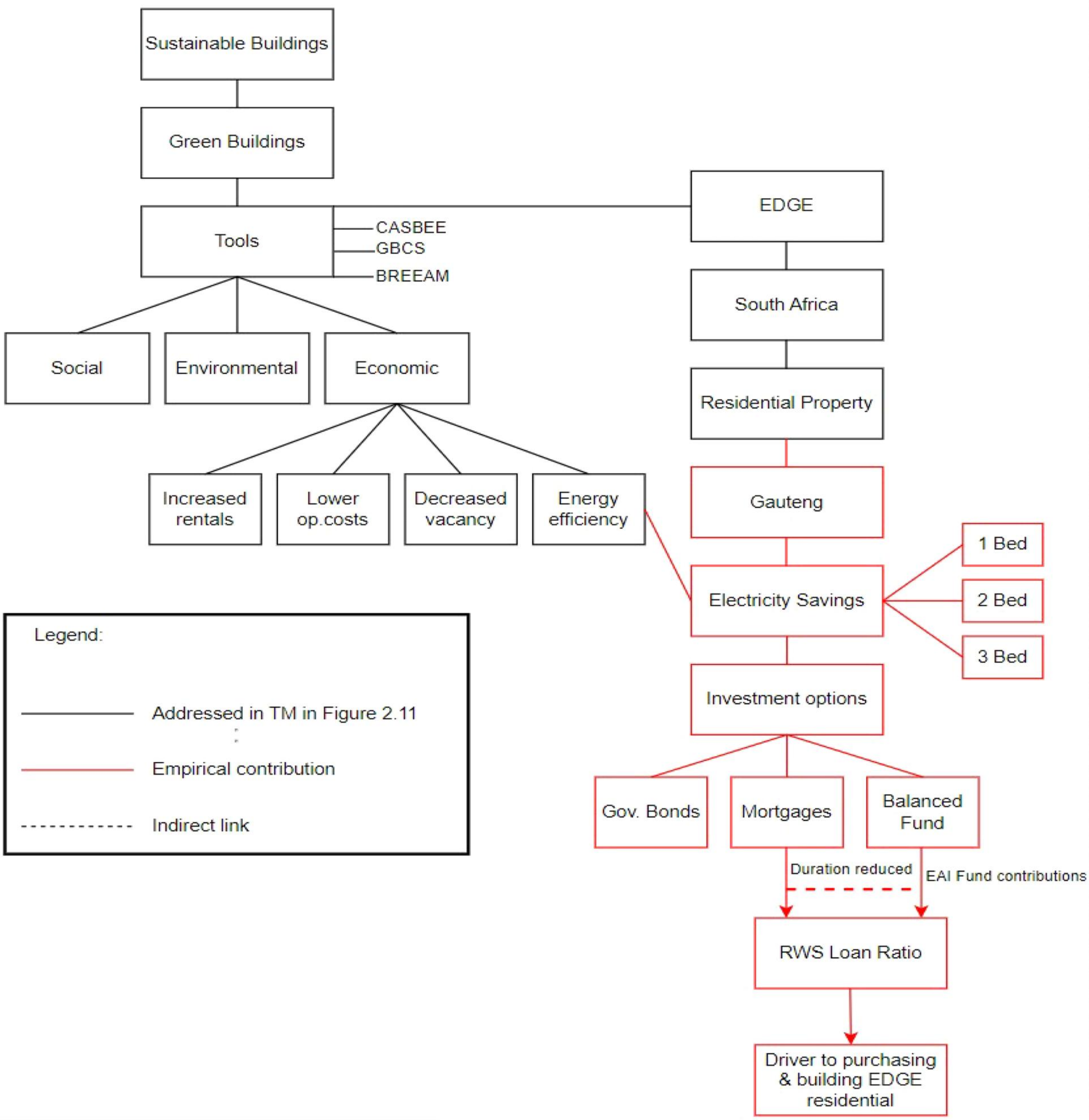

Figure 10. Empirical Model based off data analysis. *Sources:* Authors construct (2024).

projected savings. Increasing the electricity price to R3.00 per kWh leads to a rise in the Real-World Savings (RWS) ratio, highlighting the tangible benefits of green buildings in environments with higher energy costs. It is clear from the sensitivity analysis that the small price change has not had a significant impact on the Real-World Savings Ratio (Table 9).

Our final sensitivity analysis examined the impact of varying the expected return of the EDGE Alternative Investment Fund. A 1% decrease in the expected return resulted in a reduction in the RWS Ratio of 0.71% for the one-bedroom unit, 0.87% for the two-bedroom unit, and 1.58% for the three-bedroom unit. Conversely, increasing the expected return by 1% to 10.5% led to corresponding increases in the RWS Ratio of 0.73%, 0.90%, and 1.65% for the one-, two-, and three-bedroom units, respectively. These results highlight the sensitivity of real-world savings to changes in expected returns, with higher returns enhancing the financial benefits of EDGE-certified units (Table 10).

Study Limitations

This study is subject to several limitations. Firstly, EDGE certification is a relatively new development in

Table 9. Real-World Savings ratio using varying electricity prices.

Scenario	Metric	One Bed	Two Bed	Three Bed
Base Case	FV of EAI Fund	R 436,618.95	R 667,630.68	R 986,914.69
	PV of EAI Fund	R 164,557.09	R 251,622.98	R 371,957.77
	Loan Amount	R 5 60,000.00	R 760,000.00	R 800,000.00
	RWS Loan Ratio	29.39%	33.11%	46.49%
Decreased Electricity Price	FV of EAI Fund	R 434,289.06	R 662,354.62	R 971,665.02
	PV of EAI Fund	R 163,678.98	R 249,634.49	R 366,210.33
	Loan Amount	R 560,000.00	R 760,000.00	R 800,000.00
	RWS Loan Ratio	29.23%	32.85%	45.78%
Increased Electricity Price	FV of EAI Fund	R 438,640.75	R 672,209.05	R 1,000,147.79
	PV of EAI Fund	R 165,319.08	R 253,348.52	R 376,945.18
	Loan Amount	R 560,000.00	R 760,000.00	R 800,000.00
	RWS Loan Ratio	29.52%	33.34%	47.12%

Sources: Authors construct (2024).

Table 10. Sensitivity analysis using varying rates of return.

Unit Type	Return Rate	Future Value	Present Value	RWS Ratio
1-Bed	8.5%	R 426,113.14	R 160,597.56	28.68%
1-Bed	9.5%	R 436,618.95	R 164,557.09	29.39%
1-Bed	10.5%	R 447,453.88	R 168,640.66	30.11%
2 Bed	8.5%	R 650,025.76	R 244,987.87	32.24%
2 Bed	9.5%	R 667,630.68	R 251,622.98	33.11%
2 Bed	10.5%	R 685,840.85	R 258,486.20	34.01%
3 Bed	8.5%	R 953,478.03	R 359,355.84	44.92%
3 Bed	9.5%	R 667,630.68	R 371,957.77	46.49%
3 Bed	10.5%	R 1,021,833.40	R 385,118.26	48.14%

South Africa, and the body of local literature on this topic is still emerging. This limited availability of local research can constrain the depth of contextual understanding and the ability to benchmark findings against other studies. The study is based on data from a single property company, focusing exclusively on a case study of 503 EDGE-certified residential units in Gauteng. This narrow scope may restrict the applicability of the results. The specific characteristics of the case study, including the regional context and the unique attributes of the property development, might not be representative of EDGE-certified buildings in other areas with different climatic or socio-economic conditions.

Additionally, the dataset covers a period of only two years. This limited timeframe may not capture long-term trends or seasonal variations in electricity consumption and financial outcomes. As a result, the study might not fully reflect the potential long-term benefits or challenges of EDGE certification.

One limitation of this study is the lack of availability of raw data on non-edge electricity consumption. Instead, the analysis relied on a summarized table provided by the property management company, which was based on their previous research. While this restricted the ability to perform granular analysis, the provided data was deemed sufficiently reliable for the purposes of this study.

Furthermore, the research employs a quantitative approach, analysing electricity savings and financial benefits through statistical methods. While this approach provides valuable numerical insights, it does not explore qualitative factors such as resident satisfaction, management practices, or contextual nuances. These qualitative aspects could offer a more comprehensive understanding of EDGE certification's impact and are therefore excluded from this analysis.

Further research could investigate the rebound effect and performance gap in energy-efficient buildings, focusing on whether EDGE homes use more energy than expected or deliver higher comfort at a lower cost. This study found that electricity consumption in EDGE-certified units was consistently lower than in comparable non-certified units, suggesting that increased efficiency did not lead to higher overall energy use. No evidence of a performance gap was observed between expected and actual electricity consumption in EDGE-certified units. However, factors such as occupant behaviour, usage patterns, or climatic variability could influence outcomes, especially as EDGE-certified properties become more widespread.

A key consideration is the potential for self-selection bias, where environmentally conscious or financially astute individuals may be more inclined to purchase EDGE-certified homes. Such residents may exhibit behavioural patterns—such as lower energy consumption—that contribute to the observed electricity savings, making it challenging to fully isolate the impact of the building's inherent efficiency. However, given the substantial sample size of approximately 200 units, the influence of individual outliers, such as particularly conscientious homeowners, is likely to be diluted. This reduces the likelihood that the results are skewed by a typical occupant behaviour. Nonetheless, future research could benefit from employing matched sampling techniques to more precisely distinguish between building-level performance and occupant-driven effects.

Finally, reliable data on the average construction costs of EDGE-certified buildings compared to non-EDGE buildings was not publicly available at the time of this study. As such, a direct cost comparison to inform investment conclusions could not be made. Future research would benefit from access to this data to more comprehensively evaluate the financial feasibility of EDGE certification at the construction phase.

Despite these limitations, the study contributes significant insights into the financial advantages of EDGE certification. To build on this research, future studies should consider broader datasets, longer timeframes, and mixed methods approaches to incorporate both quantitative and qualitative dimensions. A further point of research would be to include a study using other utilities, such as water. This would provide a more holistic view of EDGE certification's effects and enhance the generalizability and applicability of the findings.

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Data Availability Statement

The data is available at this link.

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