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

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Abstract

The certification of green residential buildings is in its infancy in the South African property market, compared to the commercial property sector. The Green Building Council South Africa (GBCSA) uses EDGE to certify residential buildings. The purpose of the research was to identify if electricity savings in EDGE-certified residential units could be converted into some form of wealth creation. A single case study was analysed comprising an EDGE-certified residential estate containing 503 units in Gauteng, South Africa. A quantitative analysis method was conducted in the form of descriptive statistics, where electricity usage was analysed. The reduced electricity (KWh) usage was converted into a monetary amount (Rands) for one-, two- and three-bedroom units. The electricity savings were invested into either government bonds (risk-free investment), or the property's mortgage/loan to reduce the repayment period. The duration of the original loan period where no payments were required (due to a reduced payment period) was used to invest the sum of the electricity savings and the notional loan repayments into a fictional balance fund – EDGE Alternative Investment Fund (EDGE AIF). The research found that real-world savings are experienced by property owners, which is critical in developing real estate markets.

Keywords: EDGE, green buildings, residential, wealth creation, real-world savings (RWS).

1. Introduction

The purpose of the research was to investigate the impact of EDGE 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 relatively new in South Africa, compared to developed markets. The first green office building obtained certification in 2009 based on the Green Building Council South Africa (GBCSA) Green Star SA tool (Danie et al., 2020; GBCSA, 2022). The EDGE rating tool, which focuses on water, materials and energy, entered the South African market in the mid-2010s and is only applied to residential buildings. If a building achieves at least 20% savings in these three criteria, then EDGE certification will be awarded (EDGE, 2024). A green building addresses certain criteria that pertain to the construction process and property management that relate to the environmentally efficient use of resources, resulting in eligibility for certification (Oguntona et al., 2019).

For the last fifteen years, South Africa has experienced an increasing electricity generation shortage, resulting in scheduled blackouts, casually referred to as load shedding. Furthermore, the cost of electricity has increased at above inflationary levels for the last decade. This electricity shortage and price increase have accelerated the demand for solar photovoltaic (PV) electricity solutions for residential properties (Ojo-Fafore et al., 2018), which is supported by the South African climate, i.e., large quantities of sunlight. The synergy of EDGE certification underpinned by large-scale mid to high-income residential development has created an opportunity to leverage 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.

2. Literature Review

The formal establishment of the green building sector started in the United States in the late 1990s. This was quickly followed in the early 2000s in other developed real estate markets in Europe, Australasia, and Asia. As a developing country, South Africa has been slower (Simpeh and Smallwood, 2018) in formally adopting green building protocols. The GBCSA was established in 2007, partially with the assistance of the Green Building Council Australia (GBCA). One of the main contributing factors for the delayed participation in the green building sectors was that there were other built environment priorities, such as addressing infrastructure and inequality challenges as a result of the legacy of apartheid (Venter et al., 2020). However, the establishment of the GBCSA led to an accelerated number of certifications within the South African commercial property sector (Nurick and Cattell, 2013; Nurick et al., 2015), and as of 2023, there were 1,000 Green Star SA certified buildings (GBCSA, 2023).

The Excellence in Design and Greater Efficiencies (EDGE) certification system was brought to market in 2014 by the International Finance Corporation (IFC) (Isimbi and Park, 2022). While EDGE can be used for any real estate sector, it is exclusively applied to the residential sector in South Africa. For a building to achieve EDGE certification it must reduce energy consumption, water usage and embodied energy in construction materials by at least 20% (Maeda and Dixon, 2023).

The demand for green buildings is growing in accordance with the increased environmental awareness of individuals and organisations (Butera, 2010; Häkkinen and Belloni, 2011; Gou and Xie, 2017). Users seek to live and work in buildings with reduced energy consumption, carbon emissions and resource exhaustion (Kibwami and Tutesigensi, 2016; Gou and Xie, 2017). Occupants are also aware of the link between buildings and well-being, as this awareness has increased the demand for buildings with healthier and more comfortable living and working conditions (Milton et al., 2000; Elzeyadi, 2011; Zitars et al., 2021; Nurick and Thatcher, 2021a; Nurick and Thatcher, 2021b; Nurick, 2022; Nurick and Thatcher, 2023). Building users aim to reduce operating costs and increase savings, as green buildings provide significant energy and cost savings over the long term, and thus the savings potential drives the demand for green buildings (Butera, 2010; Ahn et al., 2013; Zhang et al., 2018). The supply of green buildings is predominantly influenced by the regulatory environment in which developers operate (Arif et al., 2012; Vierra, 2016). In many countries, developers have been incentivised to develop green buildings using building codes, energy-efficient standards, regulations and legislation (Koeppel and Ürge-Vorsatz, 2007; Sayce et al., 2007; Franco et al., 2021). Developers and builders can differentiate themselves in the market by obtaining green building certification and reaching industry standards which has resulted in an increased supply of green projects (Andelin et al., 2015). Developers respond to the market demand for green buildings created by individuals who seek to live and work in sustainable, healthy and cost-efficient buildings by investing in green projects and increasing supply (Shen and Faure, 2021). The costs of developing a green building can be higher than conventional (non-green) buildings; however, as the demand increases, economies of scale result in the cost gap narrowing (Hydes and Creech, 2000; Larsson and Clark, 2000; Nubi, 2000). Developers are motivated by the increasing affordability, financial incentives, tax benefits, and lower operating costs associated with green buildings over their life cycle (Scofield, 2009). The availability and accessibility of green building materials and technologies influence the supply of green buildings to the market (Nelms et al., 2005). Improvements in renewable energy systems, energy storage devices, smart building operations, and sustainable materials have enabled developers to create feasible, scalable, and affordable projects (Kohler and Lützkendorf, 2002).

Real-word savings refers to tangible and measurable reductions or financial benefits that individuals, businesses, or communities can achieve through various actions, initiatives, and changes in behaviour (Grigoli et al., 2014). Green buildings are designed and constructed with a focus on sustainability and energy efficiency, aiming to minimise environmental impact while providing a healthy and comfortable indoor environment (Zhang et al., 2018). The extent of savings achieved through green buildings can vary depending on factors such as design, location, occupancy of the building and the quantity and quality of the implemented green building features and initiatives (GBFIs) (Zhao et al., 2016). Chwieduk (2003) stated that energy-efficient measures such as the innovation of appliances, insulation, lighting, heating, and HVAC systems can all lead to savings in terms of energy bills and operational costs. Furthermore, it was observed that real-world savings, in terms of a reduction in energy and water usage and lower operational and maintenance costs, are identified as the main benefits of green buildings (Kats, 2003; Eichholtz et al., 2010). A study conducted by Zhao et al. (2016), where similar residential units were selected based on location and their application of energy-efficient retrofit technologies, supports the concept of increased returns researched by Abidin and Powmya (2014) and Low et al. (2014). Another selection requirement was that the units meet the green building standard of Home Energy Rating Systems (HERS). The study by Zhao et al. (2016) published the following results: the annual reduction in observed energy consumption per square foot was 6.8 kWh, which equated to an annual saving of $0.80. A typical American home, as defined by the US Department of Energy (DOE), with green building technologies could save up to 43% annually in terms of energy consumption and energy expenditure (Zhao et al., 2016). Earlier research conducted by Turner and Frankel (2008) produced similar findings in the US from a sample of LEED-certified buildings, which saved 28% on average in energy savings compared to the baseline figures.

To date, there is a gap in the literature that pertains to research in the field of EDGE-certified residential properties in the South African market. The body of knowledge relating to green building in South Africa has focused on Green Star SA, i.e., commercial buildings. This is due to a relatively large amount of empirical data from multiple large property-owning companies. Furthermore, there are very few companies that develop/own a significant stock of EDGE certified residential buildings located in South Africa. Additionally, there is a vast difference between Green Star SA and EDGE, where the former has nine assessment categories (GBCSA, 2024) while the latter comprises three assessment categories (EDGE, 2024), respectively. Therefore, the lack of historical data on EDGE-certified buildings in South Africa and the difference in assessment categories underpinning Green Star SA and EDGE has resulted in the need for research in EDGE-certified residential buildings.

3. Method

The overarching research method was an analysis of a single case study comprising an EDGE-certified (level 1) residential property development located in the Gauteng province, South Africa. The development contained 503 units, where 219 one-bedroom, 232 two-bedroom, and 52 three-bedroom units were the substantive sample used for analysis; all the units were the same age, identical size per bedroom category, and were fitted with the same electricity fixtures and fittings.

Electricity consumption and savings data was provided for analysis for each of the unit typologies by the development company. This research approach was deemed appropriate, as other researchers have used similar methodologies (Le Jeune et al., 2013; Sundayi et al., 2015; Dwaikat and Ali, 2018; Ade and Rehm, 2019) in the field of green building and utility assessment where a single case study has been used due to its unique characteristics and containing a significant sample set for quantitative analysis. The unit of analysis was the EDGE-certified residential units to assess the impact on real-world savings for the owner/residents.

Descriptive statistics was the method of analysis, which was optimal for analysing a significantly large data set. This statistical technique provides a concise summary of the data for analysis and further insight (Fisher and Marshall, 2009). Furthermore, the main purpose of descriptive statistics is to identify patterns and relationships that appear once the analysis has been conducted (Hayes, 2023).

The raw data comprised energy usage (kWh) for each residential unit, for 30-minute intervals (e.g., 12h00-12h30) per day for a twelve-month period (1 April 2022 – 31 March 2023). The analysis over a year took into consideration the seasonal changes, and thus the corresponding demand for electricity. Therefore, data set for a typical month equated to approximately: n = 2 (30-minute intervals) x 24 (hours) x 30 (days) x 503 (units) = 724,320. This yielded approximately 8.7 million data points for the twelve-month period of analysis.

To calculate the savings for EDGE-certified residential units, a baseline was required in relation to non-EDGE-certified residential properties. The difference in electricity usage (kWh) between non-EDGE properties (derived from municipal sources) in Gauteng and the residential units in the EDGE-certified development used in the research were used to determine the saved portion of electricity. A monetary (South African Rand) amount (cost per kWh) was applied to calculate the monetary savings across all three typologies. The savings were used as additional payments into the EDGE certified property's loan/mortgage, which resulted in a reduction in the loan term. A fictional balance investment fund was derived, the EDGE Alternate Investment (EAI) Fund, which is based on similar balanced funds currently offered in the South African market. The electricity savings plus the loan/mortgage repayment for the periods where there were no payments (towards the end of the loan term) were invested and discounted back to the beginning of the loan term, assuming annual inflation of 5% per annum. This present value (PrVa) was compared to the original loan/mortgage on the property to calculate the Real-World Savings (RWS) Loan Ratio.

4. Findings and Analysis

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.

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

Month	One Bedroom	Two Bedroom	Three Bedroom
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 kWh	184.81	222.76	229.23

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 summarised 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.

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)

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). The monthly and annual savings per typology for the EDGE-certified units are shown in Table 3.

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

Unit Type	Monthly Savings	Annual Savings
One Bedroom	R157.33	R1,888
Two Bedroom	R320.21	R3,842
Three Bedroom	R684.47	R8,214

Sources: Authors construct (2024)

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 monetary savings as an additional contribution to the monthly loan/mortgage repayment was simulated. This required establishing 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 the 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. The reduced interest rate can be justified as banks are starting to offer green finance for certified properties (Lorenz and Lutzkendorf, 2008). The loan parameters resulted in monthly loan/mortgage repayments of R6,069, R8,236 and R8,670 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 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 6,068.76	R 8,236.17	R 8,669.66
EDGE Electricity Saving	R 157.33	R 320.21	R 684.47
Increased Monthly Payment	R 6,226.09	R 8,556.38	R 9,354.12

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 terms 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 terms is shown in figures 1, 2 and 3, where each of the EDGE-certified typologies is compared to the amortisation 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%).

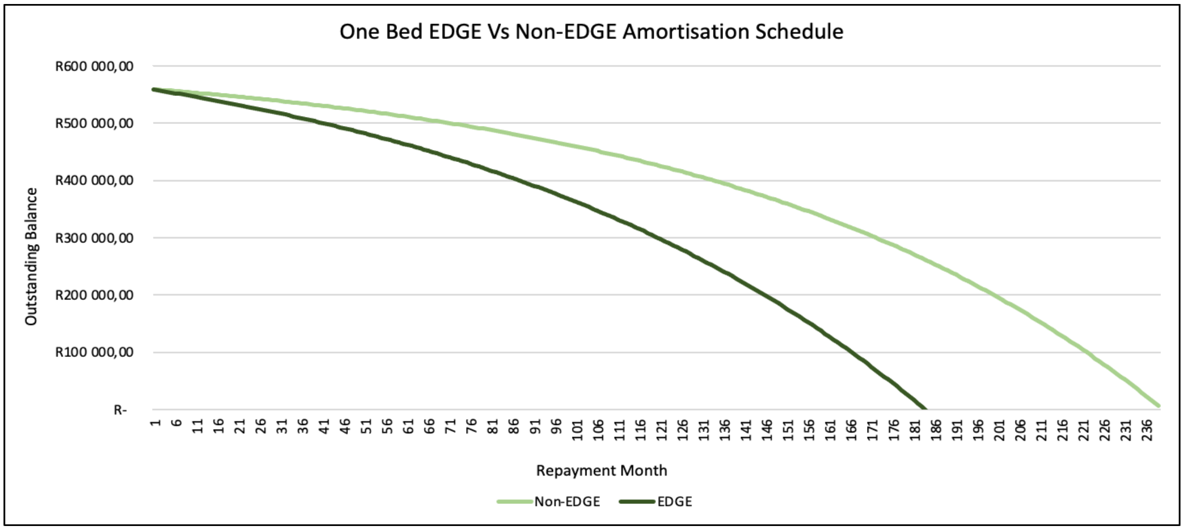

Figure 1: One Bedroom EDGE Unit vs non-EDGE Unit
Sources: Authors construct (2024)

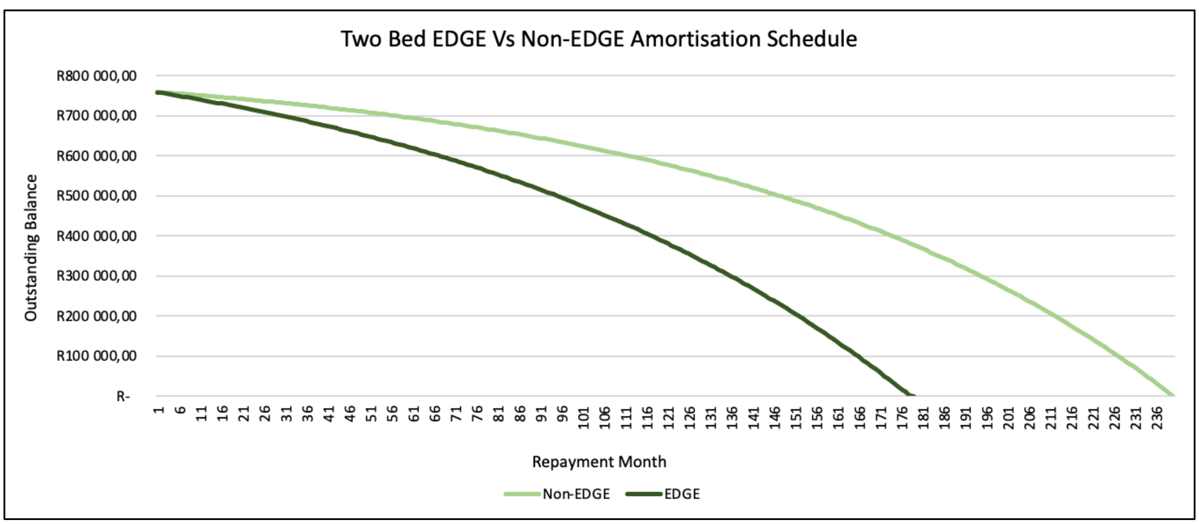

Figure 2: Two Bedroom EDGE Unit vs non-EDGE Unit
Sources: Authors construct (2024)

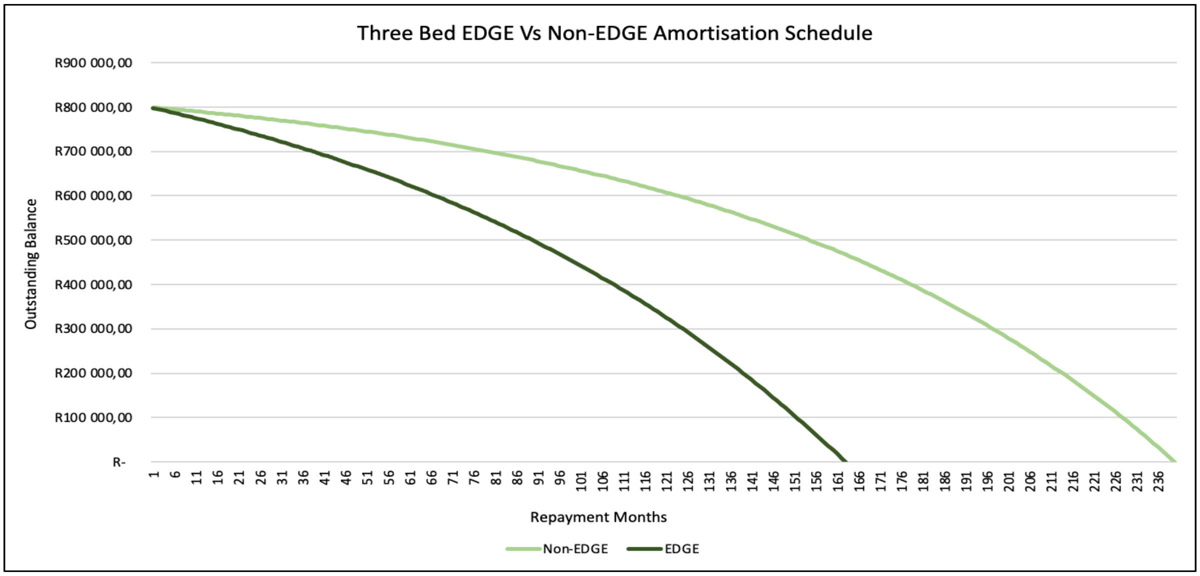

Figure 3: Three Bedroom EDGE Unit vs non-EDGE Unit
Sources: Authors construct (2024)

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.

Table 5: Interest savings for each 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)

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 are income producing assets (Cairns, 2015). 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. The average annualised return since inception of four of the top 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. A final annualised return of 9.5% was therefore extrapolated and used to calculate possible returns earned by the EAI Fund. The loan/mortgage payments plus the electricity savings would be invested in the EAI Fund for the term reduction for each of the typologies, as shown in Table 5. For the one-bedroom units, R6,226 would be invested monthly for 56 months, the two-bedroom units, R8,556 invested monthly for 61 months and R9,354 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 below.

Future Value of an Ordinary Annuity =

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

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*

The next step is to determine the present value (PrVa) of the EAI Fund in relation to the original loan/mortgage for each typology. The PrVa is calculated assuming an annual inflation rate of 5% p.a. (Statistics South Africa, 2023), which is substituted in the formula shown below. The PrVa for the EAI Fund investments for each of the typologies is R164,557 (discounting R436,619 at 5% p.a. for twenty years), R251,623 and 371,958 for the one, two and three-bedroom units, respectively.

Present Value Formula =

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

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 below. The RWS loan ratio for the one-bedroom units was 29%, which means that in today's money, the EAI Fund returns represent slightly over a quarter of the loan amount (assuming the original loan parameters). The RWS loan ratios for the two and three-bedroom units were 33% and 46%, respectively. The RWS loan ratio for the two and three-bedroom units indicates that in today's money, the EAI Fund returns equate to a third and almost half of the respective loan amounts (table 6).

Real World Savings (RWS) Loan Ratio Formula =

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

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 6: 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%

5. Conclusion

Wealth creation through real estate was historically viewed through the lens of income and capital returns. The emergence of green buildings, specifically in the residential sector where there is a high proportion of owner/occupiers, provides an opportunity for wealth creation via electricity savings. There is untapped potential within South Africa where the supply of government provided electricity is unreliable, and the costs are increasing at above inflationary levels. The research has indicated that EDGE-certified residential units that have photo voltaic installations are able to yield electricity savings, which can be converted into monetary savings when compared to similar non-EDGE-certified residential units. The monetary savings can be used to contribute to service potentially cheaper (cost of borrowing) real estate debt, which could ultimately result in accelerating debt erosion before the original loan term reaches maturity. This early debt settlement provides future investment opportunities through other investment vehicles, which was exhibited via the application of a hypothetical balanced fund for owner/occupiers in an EDGE-certified development known as the EDGE Alternative Investment (EAI) Fund. A new real estate indicator, the Real-World Savings (RWS) Loan Ratio was introduced, which shows the relationship, in terms of present value (PrVa) between wealth creation due to early loan settlement and the original loan amount. Therefore, the findings and analysis provide evidence for the strong adoption of the research hypothesis, as there is a potential for wealth creation in the form of real-world savings as a result of electricity savings via EDGE-certified residential developments.

The research focused on a single case study in Gauteng, South Africa that contained 503 residential units comprising three typologies. There is an opportunity for the research to be replicated in other EDGE-certified developments in South Africa, where the climate and the cost of electricity vary. Furthermore, there is potential to replicate the research for different levels of EDGE certification, specifically EDGE level 2 (Advanced) and level 3 (Zero Carbon).

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In Memory

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Winner of multiple academic awards – a quiet, humble, and highly intelligent student who was a pleasure to supervise.

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