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A Financial Simulation for Investment Appraisal in Solar Panels at Fast-food Chains: A Case Study of McDonalds, South Africa

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by

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DECLARATION

I, Sharanam Sharma Abbana, declare that this dissertation is a representation of my own work in conception and execution. This work has not been submitted in any form for another degree at any university or institution of higher learning. All information cited from published or unpublished works has been acknowledged.

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APPROVAL FOR FINAL SUBMISSION

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Dr Haruna Maama	Date

DEDICATION

To the dream and the potential that
my parents and my late grandmother saw in me.

I dedicate this dissertation to my parents, Manoj and Shyama Abbana,
and my late grandmother, Sheila Gumbheer.

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~ May the Mother bless you all in abundance ~

ABSTRACT

The sun is a significant source of inexhaustible free energy with the least adverse impact on the atmosphere. In order to overcome the adverse environmental effects and other issues connected with fossil fuels combustion, many nations have been compelled to investigate and develop environmentally-friendly options that are renewable in order to keep up with the growing demand for energy.

This study was motivated by South Africa's current electrical energy crisis and frequent load-shedding situations. Despite a global push towards renewable energy, South Africa presently relies on coal-fired power plants for more than 90% of its electrical energy. Currently, above-inflationary electrical energy tariffs are expected to increase. One of the renewable energy sources available is solar photovoltaic (PV) energy. The aim of this study was to financially simulate and appraise solar energy investment for McDonalds, an intensive fast-food restaurant energy consumer, to assess the feasibility of the investment.

This study was quantitative in nature that simulated a census of 125 McDonalds Drive-Thru restaurants across South Africa. The data was derived from public domains such as a solar PV watts calculator from National Renewable Energy Laboratory (NREL) and solar system online commercial quotes from Treetops which is a solar system South African based installation company. Thereafter, the data was inputted in the study's investment appraisement.

The findings of the financial simulated investment appraisal prove to be lucrative for McDonalds South Africa to undertake the investment in solar energy. The investment is rewarding in the longer-term compared to the shorter-term considering the initial outlay.

The simulation process and the investment appraisal in this study contributes to the knowledge base of the South African fast-food sector and can be adapted and used by businesses to evaluate the feasibility of a solar energy investment.

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ACRONYMS

AC	Alternating Current
COVID-19	Coronavirus disease
CSP	Concentrated Solar Power
DC	Direct Current
FV	Future Value
GRA	Green Restaurant Association
GW	Gigawatt
HAWEP	High Altitude Wind Energy Potential
HVAC	Heating, Ventilation and Air-Conditioning
IRR	Internal Rate of Return
KWh	Kilowatts per Hour
MRP	Mr Price Group
NPV	Net Present Value

NREL	National Renewable Energy Laboratory
NZE	Net Zero Energy
RES	Renewable Energy Sources
ROI	Return On Investment
SEFA	Sustainable Energy Fund for Africa
Solar PV	Solar Photovoltaic

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 Background

The current modern world still heavily relies on fossil fuels, such as oil, natural gas, and coal in comparison to other sources of energies namely modern renewable sources, traditional biomass and nuclear power (Ikram 2021). Research has shown that fossil fuels are finite and could last until the next century (Olivier 2015; Khan, Hasan, Islam, Alim, Asma, Hassan and Ali 2018; Xiao, Simon and Pregger 2019). There is a growing consensus that fossil fuel consumption is unsustainable and is contributing towards climate change and global warming. It is widely recognised that the rise of anthropogenic greenhouse gas emissions into the atmosphere, mainly as a result of energy generation and consumption from fossil fuels, have drastically increased to approximately 76% of the earth's surface over the last decade (Denchak 2019).

Businesses, as major energy consumers, with bigger carbon footprint than other consumers, contribute significantly to the gas emissions. Therefore, businesses are looking into initiatives by which they can reduce their carbon footprint and be more environmentally responsible by using renewable energy in their operations. Businesses have also experienced increased energy costs due to government intervention through introduction of measures such as carbon taxes. The commercial electrical energy consumption increased by over 500% in the 21st century as compared to the 20th. This was due to solid economic growth, increased demand and GDP (Hirsh and Koomey 2015; Ruan, Wu, Zheng, Zhong, Kang, Dahleh, Sivaranjani and Xie 2020). Recently, one of the most common methods adopted to achieve a reduction in energy consumption and carbon footprint is through capital investment in solar panels (Gielen, Boshell, Saygin, Bazilian, Wagner and Gorini 2019).

Fast-food restaurants are amongst one of the highest energy intensive buildings in the modern era (Jo, Choi and Taylor 2020; Johnson 2021). The fast-food sector utilises an average of 82000 GW of electrical energy annually which is roughly 2.5 times more energy that other types of commercial establishments (Almeida 2018; McCorquodale

2019). Energy is a fixed cost that is necessary for the operation of the fast-food sector unlike variable costs such as ingredients and labour (Welter 2012; Jo, Choi and Taylor 2020).

The expansion of renewable energy sources is significant to the South African government. This is obvious in the fact that the Department of Energy (2017) has indicated that 17.8 GW of new renewable energy generation is planned until 2030, in addition to what is already being generated by all existing and committed plants. New renewable electrical energy generation has the greatest allocation of all new generation types. In South Africa, there are already changes in the way energy is produced, supplied, transformed, and used (Olivier 2015; Semelane, Nwulu, Kambule and Tazvinga 2021a).

Research has proven that investment in solar photovoltaic (PV) has been profitable and will also reduce the emission of carbon dioxide in the future (Olivier 2015; Welsh 2017; Al Garni 2018; Gianmarco 2018). According to Kumar (2020), several nations have embraced this technology to safeguard the environment. Within South Africa, it has been established that companies have become more inclined to make this capital investment, as the advantages have been staggeringly prevalent. With advantages such as a decreased carbon footprint, a greener economy, as well as significant cost reduction, many organisations such as the giant retailer, Makro have subscribed to this capital investment (Lineque 2018).

There are various benefits in the installation of solar panels by businesses; firstly, the sustainable use of power by which related costs can be reduced in a shorter time frame in comparison to any other common use of renewable energy. Secondly, there will be a reduction of carbon emissions as solar energy is clean and will slow down the rate of destruction to the environment. Thirdly, although the initial capital investment will be high, the cost savings in the long run will exceed the projected value of the initial costs (Kumar 2020; Webb, de Silva and Wilson 2020).

As energy prices continue to increase, solar panels are becoming an even more feasible and cost-effective investment for South African businesses. According to The Solar Future (2019), although it may result in a considerably elevated original outlay, it can be recouped on an average scale after five to eight years, resulting in an appealing internal rate of return (IRR), particularly given that solar energy is then free after the investment recoupment period. However, expenditure information reports show that Eskom's cost of energy has risen to R1.97 kWh compared to a drop in the average price of solar power which is currently 52% of the cost of traditional coal-based energy (CityPress 2018; Eskom 2020).

Whilst considering South Africa's above-inflationary increase in electrical energy tariffs and frequent load-shedding situations, the need for alternative resources to produce electrical energy has become a must (CityPress 2018). However, one must weigh out whether a capital investment in solar energy on the longer-term is viable compared to the national grid. Hence, a financial perspective is necessary in order to avoid pointless debt in these challenging economic times (Creutzig, Agoston, Goldschmidt, Luderer, Nemet and Pietzcker 2017; Kabir, Kumar, Kumar, Adelodun and Kim 2018).

McDonalds are one of the leading fast-food giants across the globe (Rajawat, Kee, Malik, Yassin, Shaffie, Fuaat, AlDosari and Santoso 2020). This giant aims to reduce global greenhouse gas emissions (Maze 2020). As from 2019, there has been investments in renewable energy such as wind and solar power. In 2020, McDonalds opened its first zero carbon-energy restaurant operated solely on solar power (Maze 2020). They intend to continue to reduce their carbon footprint and find significant solutions in the race against climate change. International climate control policy goals require massive decarbonisation of this energy system (Petrovich, Hille and Wüstenhagen 2019).

This study adopted McDonalds as a case study due to the fact it being a multinational organisation and over the recent years, they have been trying to reduce their electrical energy consumption by adopting various renewable energy methods. It reduced its electrical energy usage from 2295 GW in 2016 to 1420 GW in 2017 (Gutierrez 2021). As mentioned previously, it recently opened its first zero carbon-energy restaurant in USA, however this is much more needed in South Africa on a larger scale considering the country's electrical energy crisis and plight (Maze 2020).

Investment appraisal is a numerical representation of a business's operations in the past, present, and predicted future. Appraisals like the one in this study, which is a hybrid of a financial simulation process developed integrated with investment appraisal techniques, are meant to be used for decision-making of a proposed new project which is utilised in strategic planning to run simulations, assess the costs of new initiatives, set budgets, and allocate company resources (Kopp 2020; ESFC 2021).

As businesses matures and grows around the world, solar energy is becoming a more lucrative subject of investment for investors hence an investment appraisal can be shown to investors and lenders to see how viable solar energy investment is (ESFC 2021).

Olivier (2015) developed a financial model for a dairy farm whereby the author measured the actual consumption of the electrical energy consumed through meters. Nevertheless, this model requires a lot of time, is costly and not flexible to different locations.

Semelane *et al.* (2021a) on the other hand assessed the feasibility of manufacturing solar panels inhouse. They did not take into account if one had to invest in solar energy and whether it will be worthwhile.

The study's investment appraisal is feasible, viable and purposive. The study in other words, is a hybrid of a financial simulation process developed integrated with capital budgeting techniques. It is flexible to any location and can work with a range of electrical consumption based on demand.

1.2 The research problem

Over the past decade, South Africa has had stable growth in the demand for electrical energy due to healthy economic growth and an increase in population. However, the growth in demand coupled with aging energy infrastructure and corruption experience resulted in a situation of regular load-shedding, a system used to relieve stress on the primary energy source when electricity demanded exceeds the supply from the primary power source (Eskom 2019). Further escalations in load-shedding were expected when the country went into level five lockdown during the COVID-19 pandemic in 2020 (Zayed 2020).

Fast-foods chains globally are facing a decline in demand due to COVID-19 (Nhamo, Dube and Chikodzi 2020). As governments globally increasingly promulgated legislation for social distancing and lockdowns, most restaurants were shut down for sit-in meals and were operating at a minimum of 50% capacity. Fast-food restaurants were impacted and this resulted in significant financial losses, unprecedented liquidity challenges as well as direct and indirect job losses (Nhamo, Dube and Chikodzi 2020; Businesstech 2021; Thulasiraman, Nandagopal and Kothakota 2021).

Fast-food restaurants are amongst the most energy-intensive structures in the contemporary period (Jo, Choi and Taylor 2020). McDonalds, a fast-food restaurant chain, is a huge energy consuming organisation incurring high energy costs with 225 restaurants throughout South Africa (Sawe 2019; WorldAtlas 2019). In South Africa, electrical energy is a costly commodity as there have been high increases in energy price in recent years (CityPress 2018; Inglesi-Lotz and Ajmi 2021). McDonalds, as an energy intensive organisation, faces huge risks in terms of their sustainability and reduced profitability due to the above-inflationary increases in energy and related production costs, regular load-shedding, alongside a decline in current demand (CityPress 2018; Sawe 2019; Maze 2020; Nhamo, Dube and Chikodzi 2020; Zayed 2020; Inglesi-Lotz and Ajmi 2021).

With a declining fast-food sector alongside with frequent load-shedding and COVID-19, the shift from traditional sources of energy to solar energy is vital in South Africa as the country’s current economy is gloomy and is still on the road to recovery (Phelan 2018; Shahsavari and Akbari 2018; Zayed 2020).

1.3 Aim and objectives of the study

The aim of this study is to financially simulate an investment appraisal for solar energy at freestanding McDonalds fast-food restaurants in South Africa.

The study’s objectives are to:

- To simulate a financial appraisal for solar energy investments at McDonalds Drive-Thru restaurants on a national level;
- Examine the provincial dynamics of solar energy investments at McDonalds Drive-Thru restaurants;
- Recommend a profitable solar energy investment for McDonalds Drive-Thru restaurants on a national and provincial basis.

1.4 Significance of the study

Fast-food restaurants are considered as high energy consumers which results in high energy fixed costs (Jo, Choi and Taylor 2020). Hence, in South Africa, there is a struggle to meet the demand for energy which results in abnormal energy price hikes. It is anticipated that in the fast-food sector, many thousands of restaurants are facing closure as they are experiencing liquidity challenges due to movement restrictions imposed by the government in the recent year and the declining economy due to COVID-19 (Businesstech 2021). This research uses McDonalds as a case study to determine the advantages in investing in solar PV. Therefore, the study may benefit the entire fast-food sector.

A stakeholder such as the government will tend to benefit from this study as to encourage people and commercial establishments to invest in solar as this is smart thinking and being environmentally conscious for businesses and turns out to be a characteristic of being a developed country. This study can assist the country's primary source of electrical energy provider to cope with the current demand and can also contribute to South Africa's current economic recovery.

Various other stakeholders which is the management of McDonalds and researchers may be encouraged to invest both time and money in this field of study. The simulated financial appraisal can be used as a tool by the stakeholders to attract investors and funders if the solar energy investment is worthwhile. It can also help the stakeholders to accelerate the progress in the current world.

1.5 Research design

The research design is a comprehensive plan for finding answers to meet the research objectives (Kumar 2018).

Taking into consideration the aim of the study, the methodology adopted was an explorative quantitative approach consisting of solar panel simulations. A financial simulation and investment appraisal was conducted on all free-standing McDonalds located throughout the nine provinces in South Africa. It made use of evaluations derived from a typical McDonalds restaurant load curve, solar panel PV watts calculator and online commercial solar panels quotes, available on the public domain to assess the investment's feasibility through simulations in this study.

This study targeted a population of 225 McDonalds outlets throughout South Africa. Sekaran and Bougie (2019) define a population as a group of individuals or objects which can be finite or infinite in a given context. In studies like this, the population may consist of the entire population, but the study derived a finite census and made use of 125 McDonalds Drive-Thru across South Africa as a Drive-Thru is a better indication of a freestanding building than that of a McDonalds restaurant in a mall. The census derived was non-probabilistic as they were selected with regards to the purpose of the study.

The financial data gathered from the data collection was used to evaluate the solar energy investment at McDonalds. The Monte Carlo simulation theory adopted allowed a realistic estimation on the selected simulated outputs. The methodology used to analyse the solar energy investment is based on the financial theory of capital budgeting (Gianmarco 2018). The financial data was used to determine the payback period, return on investment (ROI), net present value (NPV) and the internal rate of return (IRR). The combination of these four capital budgeting techniques formed part of the study's financial appraisal used to assess the feasibility of the solar energy investment at McDonalds.

1.5.1 Delimitation

The delimitation of the study relates to the population. The population of the study consists of 225 McDonalds restaurants throughout South Africa. The research, however limited the census to 125 McDonalds Drive-Thru restaurants across
South Africa explained in detail in chapter three. ‘Drive-Thru’ is already associated with the name and place of the McDonalds which are available on public domains hence making it easy to identify, for example, *McDonalds uMhlanga Drive-Thru* (GoogleEarth 2021; GoogleMap 2021). In order to identify all the freestanding McDonalds restaurants in South Africa, a Drive-Thru is considered to be an adequate indicator in an aspect of a freestanding building. In other words, it will not be feasible to consider a McDonalds restaurant inside a mall because it is associated with the mall (it will be more likely for the mall to consider in investing in solar energy) and is not a free-standing restaurant as compared to the one of a Drive-Thru.

1.6 Organisation of the dissertation

This study comprises of five chapters with chapters two, three and four primarily focusing with the study’s objectives. The dissertation guidelines and an overview of the subsequent chapters are as follows:

Chapter One - Introduction

The overall synopsis of the research study is presented in this opening chapter. It presents the study’s background, research problem, research aim and objectives. It also makes mention of the study’s methodology, significance, financial simulation and the investment appraisal.

Chapter Two - Literature Review

Chapter two presents a review of literature related to the study’s research objectives. Literature is reviewed on solar panels from different perspectives, South Africa’s energy crisis, fast-foods, McDonalds, types of solar systems, factors influencing electrical energy usage and lastly a financial aspect alongside with the study’s adopted theory.

Chapter Three - Research Methodology

This chapter describes the research design and methodology that will be used for the simulation process. The financial simulation and investment appraisal is discussed alongside with validations of chosen research methods and the analysis used.

Chapter Four - Empirical Results

The fourth chapter covers the study's three objectives and the investment appraisal. The findings are displayed in graphics and tables. It commences with the data collection and analysis. Thereafter, it provides an overview of McDonalds South Africa solar investment findings and then ultimately moves to a provincial analysis.

Chapter Five - Summary, Conclusions and Recommendations

Finally, the last chapter presents an overview of the study, conclusions and recommendations. The chapter concludes with limitations of the study followed by suggestions for future research.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The preceding chapter contextualised the current research study by outlining the background, the problem statement, the study's aim and objectives, methodology and the structure of the dissertation. In this chapter, a review of previous studies on investments in solar panels and its feasibility thereof, have been consulted to have a detailed insight on the current modern age progress in parallel with the fast-food sector in South Africa.

The chapter is structured as follows: firstly, the discussion about renewable energy sources. Secondly, the discussion about solar panels including different geographical locations. Thirdly, a review of factors that influence electrical energy consumption, followed by an explanation of the capital budgeting techniques and the management accounting theories. Thereafter, the chapter concludes with the conceptual framework and a summary of the chapter.

2.2 A review of renewable energy sources

Global warming, environmental hazards, and energy security concerns are together causing changes which led to the rapid evolution of renewable energy sources (RESs) around the world due to their environmental friendliness (Haes Alhelou, Golshan and Siano 2021). The following subsections discuss the different types of RESs which includes wind energy, geothermal energy, biomass energy and solar energy.

2.2.1 Wind energy

Wind energy is growing throughout the world. China seems to be leading the wind market. The high altitude wind energy potential (HAWEP) project in China has seen promising results but still requires some technological revolution and innovation (Li, Wang and Zhang 2021).

Ayodele and Ogunjuyigbe (2016) and Rae and Erfort (2020) researched on the potential that wind energy has in South Africa. It is currently an expensive source of energy to invest and maintain. However, both of the studies arrived at similar conclusions, that is technological advancements in the wind energy sector would lead to reduced costs in the future.

2.2.2 Geothermal energy

Geothermal energy is a renewable source of energy which is eco-friendly and sustainable. It is formed from the heat generated beneath the Earth's crust. This type of energy does not seem to be part of South Africa's future renewable energy plans, however research has shown there is potential for this type of energy (Dhansay, Musekiwa, Ntholi, Chevallier, Cole and De Wit 2017; Lebbihiat, Atia, Arıcı and Meneceur 2021).

2.2.3 Biomass energy

Biomass energy is referred to any plant or animal material used to produce electrical energy. There has been several arguments stating whether biomass energy improves or just worsens the environmental conditions. There has not been much research on biomass energy in South Africa during the recent years (Konuk, Zeren, Akpınar and Yıldız 2021; Zafar, Sinha, Ahmed, Qin and Zaidi 2021).

2.2.4 Solar energy

Solar energy is a vast and limitless source of energy. This energy is extremely inexpensive and can be multi-purposeful with low maintenance costs (Yu, Tang, Chau, Nazar, Ali and Iqbal 2021). Studies have investigated mostly European countries and China as the latter is considered to be leading in the solar sector (Al Garni 2018; Yu *et al.* 2021).

Yu *et al.* (2021) explored the role of that solar energy plays in mitigating carbon dioxide emissions. They envisaged ten countries which were developed economies. The results showed that nine out of the ten countries have an effective impact in mitigating pollution. The question arises as to why developing economies were not involved in this type of study if one has to look at a global perspective?

On the other hand, Al Garni (2018) analysed grid-connected solar PV systems in Saudi Arabia. The findings of the study did indicate that there is much growth in sub-Saharan economies which are still developing in the field of solar energy.

2.3 Review of solar panels

Solar panels are panels mounted with solar cells which are exposed to the radiation of the sun to generate electrical energy. Solar energy is one of the modern day renewable energy sources (Oxford 2021).

2.3.1 Solar power systems

Solar power systems which consist of solar panels convert solar energy into electrical energy, either directly through solar photovoltaics (PV), indirectly through concentrated solar power, or a mix of the two types (Vant-Hull 2021).

2.3.1.1 Different types of solar systems

There are two main technologies that produce electrical energy from the sun: concentrated solar power (CSP) and solar photovoltaic (PV) technology. Currently, PVs are applied worldwide as compared to CSP (Mmushi 2016; Sayed, El-Shimy, El-Metwally and Elshahed 2019).

2.3.1.1.1 Concentrated solar power (CSP)

Concentrated solar power systems makes use of the sun’s energy indirectly using thermochemical reactions and devices to produce heat which is thereafter used to produce electrical energy. It is capable of generating utility-scale electrical energy, however CSP plants require high levels of technological advancement and capital (Awan, Zubair, Praveen and Bhatti 2019).

2.3.1.1.2 Solar PV systems

PV systems function totally opposite from CSP and generate electrical energy directly through solar photovoltaic cells. The solar cells convert the sunlight into an electric current using the photovoltaic effect which is the generation of voltage and electric current in the material upon exposure to sunlight. Solar panels have a useful life for about 25 years and thereafter the production starts to decline or alternatively are disposed (Vargas and Chesney 2021). The useful life of an asset, in this study, solar panels, is an accounting estimate of how long the panels will likely be in service for the purpose of generating revenue at a low cost or saving on electrical utilities (Kenton 2020). The three main types of solar PV are: grid-tied, grid and hybrid and lastly off-grid (Sayed *et al.* 2019).

Grid tied PV systems have solar panels that provide some or even most of their energy needs during the day, while still being connected to the local utility electrical grid network during the night. This is more common in both households and businesses (Mmushi 2016; Sayed *et al.* 2019). The diagram below shows an example of a grid tied PV system:

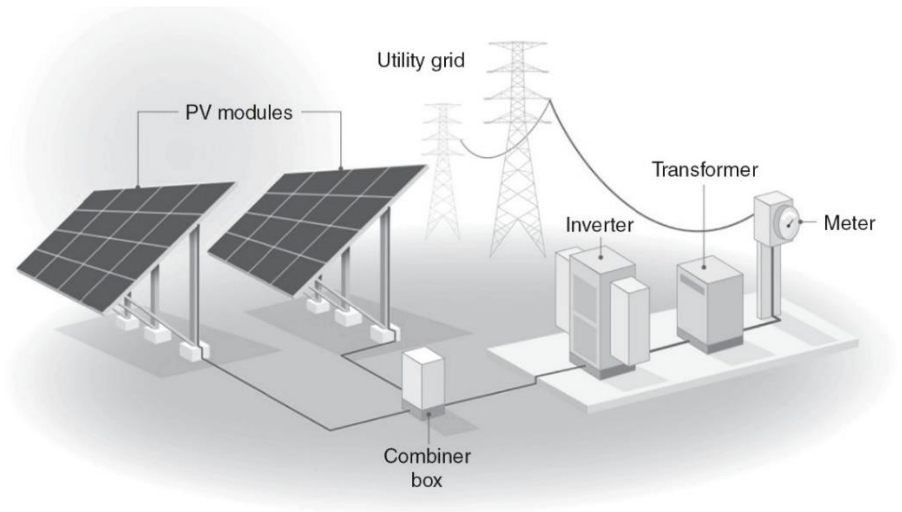


Figure 2-1: Grid tied PV system

Source: (Gevorkian 2017)

Modern hybrid systems combine solar and battery storage in one. This means being able to store solar energy generated during the day and using it at night which eradicates the reliance on electrical energy provided by the power utility (Mmushi 2016; Sayed *et al.* 2019). The illustration below displays a hybrid solar system:

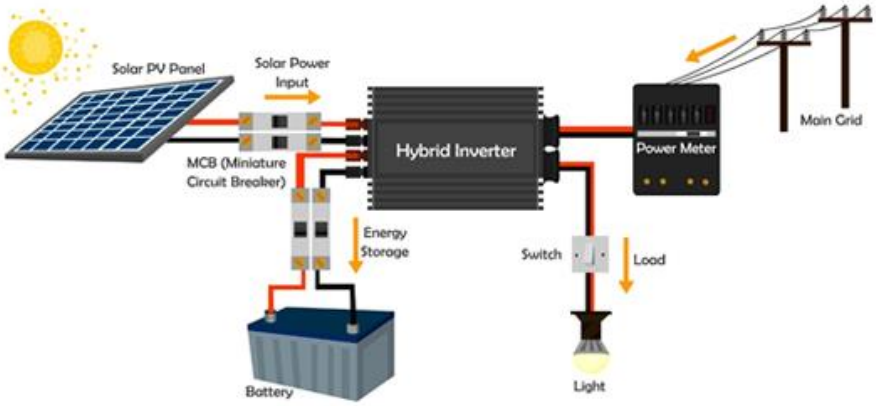


Figure 2-2: Hybrid system

Source: Innov8energy (2021)

An off-grid solar system is not connected to the electricity grid and designed accurately to generate enough energy all the way through. The off-grid is mainly implemented in the rural areas of developed and developing countries whereby people make sole use of the Solar PV system for their own consumption (Mmushi 2016; Sayed *et al.* 2019). Figure 2-3 below depicts an off-grid solar system:

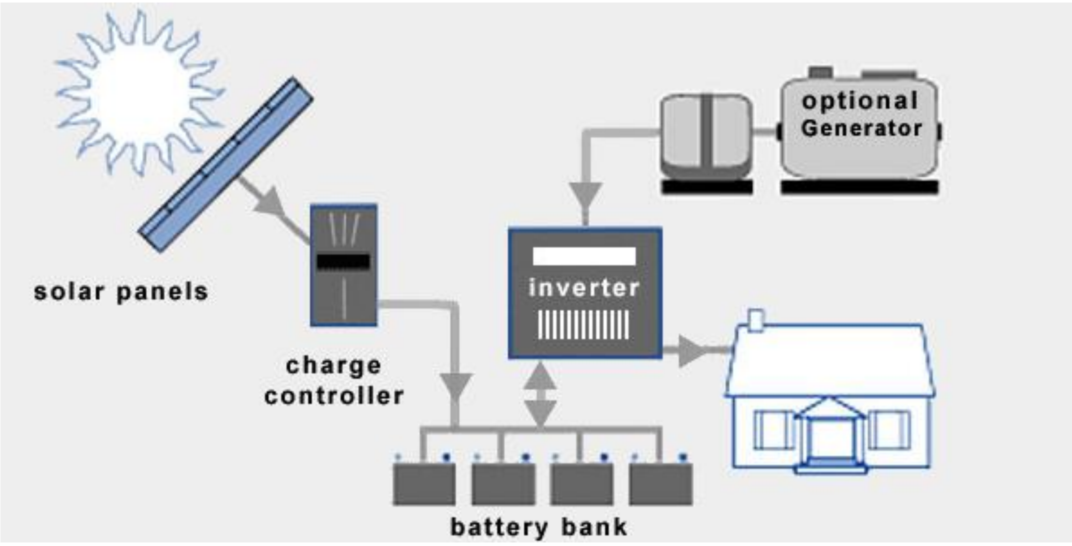


Figure 2-3: Off-grid solar system

Source: Jabvasolar (2021)

2.3.1.2 Different components of Solar PV systems

2.3.1.2.1 Solar cells

Solar cells are an electronic device which convert sunlight directly into electrical energy through a photovoltaic effect. They are basically the building blocks of solar panels. Solar cells are classified as photovoltaic regardless of whether they are powered by sunlight or artificial light. Studies have shown that solar cells last for about 25 to 30 years and thereafter the production starts to decline (Bagher, Vahid and Mohsen 2015; Rabaia, Abdelkareem, Sayed, Elsaid, Chae, Wilberforce and Olabi 2021).

When the sun shines on the solar panels, an electric field is created. The generated energy goes to the panel's edge and into a conductive wire. The electricity is carried by the conductive wire to the inverter, where it is converted from direct current (DC) to alternating current (AC), which is used to power buildings (Bagher, Vahid and Mohsen 2015; Rabaia *et al.* 2021).

2.3.1.2.2 PV array

A single solar cell produces a very small amount of energy. The cells are connected in series and parallel to form modules which produce the required voltage. PV panels are made up of connected modules. Any required voltage can be attained by connecting these panels together to form the whole PV array (Mahela and Shaik 2017).

2.3.1.2.3 Convertors (DC-DC) and Invertors (DC-AC)

A DC-DC convertor is a circuit that transforms the direct current from one voltage level to the required level. It is basically the flow of electrical energy in only one direction (Mahela and Shaik 2017).

Thereafter an inverter is required to convert the DC energy from the PV array to AC to obtain electrical energy. Inverters can be connected to the local utility grid, stand alone or can be both (Mahela and Shaik 2017).

2.3.2 A Global review

During 2017, more solar panels were installed worldwide as compared to other power generation technology. Schmela (2018) stated that solar power alone saw more new ability arrayed than fossil fuels and nuclear power put together. Solar energy almost doubled its capacity in contrast to wind power, which is illustrated in Figure 2-4.

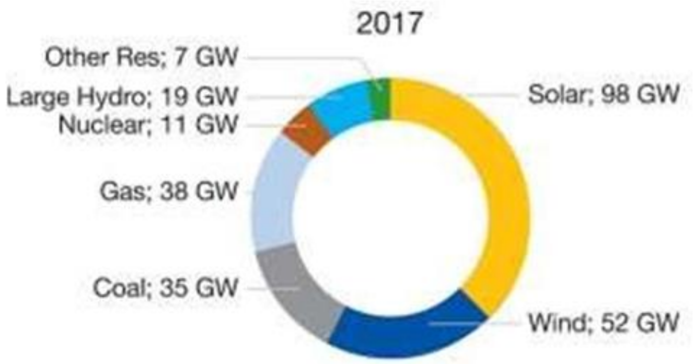


Figure 2-4: Installation of power generating technologies in 2017

Note: 1 GW (Gigawatt) – 1 billion Watts
Source: Schmela (2018)

The figure above depicts the different technologies and their expected net addition of generating capacity in 2017. The extent to which solar energy dominated, not only in the context of renewables but across all generating sources, sends a powerful statement. The 98GW of solar installations vastly outnumbers the 52GW of wind and the net 70GW of all fossil fuel technologies. In 2017, solar accounted for 38 percent of all net new electrical energy capacity added globally (Schmela 2018).

The aim of Welsh's (2017) study was to understand what type of return on investment a PV system can provide in a South Carolina residential area. The study used an investment simulation and a solar PV watts calculator provided by NREL to calculate the Internal Rate of Return and Net Present Value on the simulated areas. The author concluded that tilting of the solar panels has minimal effects on the financial return, and that it is viable in the longer run (Welsh 2017).

Saavedra, Galvis, Mesa, Banguero, Castaneda, Zapata and Aristizábal (2021) reviewed the current state of the globe's renewable energy generation. The authors identified that many developed countries such as China, USA and Germany are the leading countries in the installation of solar PV systems and are attempting to advance these technologies. Furthermore, they suggested that solar systems short-term and initial costs are staggeringly high, but in the medium and long-term, they can prove to be the most beneficial.

The developing economies are energy poverty stricken in many parts of the world. More than two billion still do not have reliable energy sources and rely mainly on traditional biomass energy such as wood and other solid fuels (Shahsavari and Akbari 2018). However, many of these developing countries have realised that reliable and sustainable modern energy is a key factor for development. The governments are trying to reduce their dependence on fossil fuels by including laws, economic encouragement, tax incentives, more research and development in the solar energy field (Dobrotkova, Surana and Audinet 2018; Shahsavari and Akbari 2018).

2.3.3 An African review

The vast majority of rural areas in many African countries lack access to electrical energy. Most of these countries still rely on fossil-fuel powered generators to supply their basic electrical demands (Shahsavari and Akbari 2018). According to studies, solar energy systems could be the answer to powering the whole continent (Assadeg, Sopian and Fudholi 2019; Ukoba, Fadare and Jen 2019) .

Ukoba, Fadare and Jen (2019) measured the performance of solar systems in a typical African residential building. The results showed that the solar PV model has a very elevated prospect in powering Africa. Thereafter the authors stated that solar energy can also contribute positively to socio economic factors which can improve quality of life.

Assadeg, Sopian and Fudholi (2019) assessed solar system performances in the Middle East and North Africa. Their study modelled four cities through a hybrid model which was used to estimate the solar radiation. The outcomes of the model indicated that there is substantial amount of solar radiation available and that an economic analysis should be carried out to assess the feasibility of a solar system.

Al Garni (2018) appraised different solar PV system configurations through a techno-economic feasibility analysis at Saudi Arabia as a case study. The author ran the simulations through a software named Matlab and concluded that solar PV power plants can be solely run without being connected to the grid and there is no shortage of solar energy in African countries (Al Garni 2018).

Common to the aforementioned studies is an indication that there is so much potential available in Africa that is yet to be exploited in the solar renewable energy sector.

2.3.4 A South African review

South Africa is the 12th largest carbon dioxide emitter globally and is also accountable for more than half of Africa's emissions. Coal contributes to more than 90% of electrical energy production. Fossil-fuel combustion is the major source of producing carbon dioxide in South Africa (Shahsavari and Akbari 2018).

In 2011, the South African Renewables Initiative ('SARI') was introduced to promote renewable energy solutions that would later bring social and financial advantages to the country (Ndlovu and Inglesi-Lotz 2019). Based on research conducted in South Africa, people are mostly interested in greener and cost-effective alternatives which led to the Department of Energy (2017) to rethink and diversify the country's energy mix (Ndlovu and Inglesi-Lotz 2019).

South Africa, being a tropical and developing country has the perfect setting for solar investment and the ability to contribute more towards a sustainable environment (Semelane *et al.* 2021a). Both households and businesses can contribute towards a greener environment as solar PV can provide sufficient energy and is proven to reduce their monthly expenditure (Kumar 2020). Additionally, it does not pollute the environment, which is a very useful alternative for fossil fuels and is a worthy investment (Unwin 2020).

Semelane *et al.'s* (2021a) study adopted a local South African municipality as their case study and did not explore the South African commercial side. The authors mentioned that South Africa needs to start considering phasing out coal and evaluated the cost and feasibility of manufacturing solar panels in-house.

Semelane, Nwulu, Kambule and Tazvinga (2021b) also reviewed South Africa on a broader perspective. The study examined the economic factors of producing solar systems locally which will also lead to job creation countrywide. The deduction from this study is that Semelane *et al.* (2021b) indicated that solar panels can impact positively on South Africa's Gross Domestic Product significantly.

Olivier (2015) developed a financial model to evaluate solar energy in dairy farms in the Free State. The author actually measured the electrical energy consumption over a specific period. It was both a qualitative and quantitative study whereby alongside with model, the researcher had conducted interviews. The study concluded by stating that dairy farms should consider the option of investing in solar energy (Olivier 2015).

In the light of the above South African review, literature has shown that studies of this nature are very limited.

2.3.4.1 South Africa's electrical energy utility – Eskom

Eskom Holdings Limited (Eskom) is a South African public electrical energy utility founded by the South African government in 1923 (Jonathan, Mafini and Bhadury 2020). Eskom supplies majority of the nation's electrical energy. Coal-fired power plants generate 90% of South Africa's electrical energy. Over the past decade, the Eskom power plants have been overloaded, causing the electrical energy system to become unstable and unsustainable (Dewa, Van Der Merwe and Matope 2020). Eskom has the option of increasing its supply energy or to lower its demand for electrical energy. This is when Eskom introduced load-shedding, which is the interruption of an energy supply (Niselow 2019).

South Africa has been facing a series of temporary electrical energy shutdown in the recent years. Eskom has been employing load-shedding on a rotational basis during many hours in a day affecting most parts of the country owing to its incapacity to meet the energy demand and to prevent uncontrolled blackouts. Load-shedding is a last-resort intervention when the energy demand exceeds the supply (Gehringer, Rode and Schomaker 2018).

Load-shedding was and continues to be a catastrophe for consumers and businesses across South Africa. Therefore, both the commercial and private sector are seeking alternative methods to obtain energy during load-shedding (Naidoo 2019). Many businesses chose to produce their electrical energy using generators, although this is still insufficient (Mbomvu, Hlongwane, Nxazonke, Qayi and Bruwer 2021). Currently, with petrol prices close to record high levels, running a generator is expensive and does not provide nearly enough energy to keep all the lights on (Naidoo 2019).

Literature also shows that Eskom being a state-owned entity and also a monopoly over the recent years attempted to resist growth of renewable energy in the supply mix of electrical energy (Ting and Byrne 2020). The coal-mining sector alongside the traditional manner of producing electrical energy substantially influences the country's economy. However, studies revealed that despite the resistance to change,
South Africa has witnessed tremendous growth in the renewable energy sector (Constantinides and Slavova 2020; Ting and Byrne 2020).

2.3.4.2 Implemented solar panels in South Africa

Makro (2021) is a retailer of largely general merchandise and non-perishable groceries for home, leisure and business use. Makro, which has one of South Africa's largest retail warehouses, has taken the initiative to reduce global warming and its impact on the economy through the investment in Solar PV panels in its parking lots (Naidoo and Botsi 2021). According to Farmers' Weekly (2016, 2021), Makro estimated that the solar PV installation, which is entirely carpark mounted, will produce approximately 709 500kWs of electrical energy a year and account for an estimated 20% of the store's total annual energy consumption. This in turn implies that the Solar PV panels are a lucrative investment that benefits Makro on a large scale. Lineque (2016, 2018) states that since the installation of solar panels on the Carnival store parking lot in Gauteng, the company has reduced its CO2 emissions by 192,861 kgs, saving 105,197 kgs of coal and 266,888 litres of water, which also significantly reduces its harmful environmental impact.

Another is the Mr Price (MRP) Group Head Office which is situated in Durban. MRP is a popular South African fashion clothing retailer (Gunkel 2019). As mentioned in the Group's sustainability report (2017) that the installation of a Solar PV system can further demonstrate MRP's dedication to energy efficiency. The system was designed to produce about 286 000 kWh of clean energy annually and is guaranteed to generate energy for the next 25 years, decreasing the carbon footprint of the Group by 305 tons of annual CO2 emissions. With this capital investment in place, the Group has benefited significantly and the head office has surpassed the updated target rate of 50%.

Lastly, Robben Island, a tourist attraction in Cape Town, has traditionally been driven by diesel generators. Approximately 600 000 litres of diesel were used annually, resulting in large expenses for the island's management and the island's fragile natural environment. As a result, it was decided to implement a Solar PV system on the island. A combination of tourism, de-salination plant and local site means that every year Robben Island uses more than two million kWh of electricity (Simon 2019; Taruvinga 2019). The Solar PV system involves several components that produces nearly one million kWh of electricity annually, significantly minimising the cost of buying diesel, ferrying it to the island and using it to produce electrical energy. The Solar PV system ensures that the island considerably reduces its use of fossil fuel by nearly 250,000 litres of diesel annually. It results in a reduction of about 820 tonnes in the Island's carbon emissions, as well as excellent economic savings. Furthermore, it is said that the scheme will continue to operate for approximately 20 years (Pallett 2017).

2.4 Fast-food restaurants

Fast-food restaurants can be defined as a specific type of restaurant that serves fast-food meals and are known for their quick service (Shumba and Zindiye 2018). They have been identified as one of the most energy-intensive commercial establishments. When compared to a conventional office, a restaurant consumes more than twice as much energy per square foot (Jo, Choi and Taylor 2020).

Both cooking and refrigeration systems have to work against one another to achieve their separate goals in a typical fast-food restaurant. Refrigeration on average accounts for the highest share of consumption estimated at 40%. Kitchen, stoves, ovens, ventilation systems, hot water and space cooling combined consume 50%. Surprisingly, lighting only consumes on average around 6% and the 4% is consumed by other general appliances (Barbara, Gatt and Yousif 2019).

The fast-food sector are one of the most inefficient sectors from a sustainability standpoint. Many fast-food restaurants have now recognised the importance of supporting environmental sustainability efforts by transforming to eco-restaurants (Jo, Choi and Taylor 2020). An eco-restaurant utilises different renewable energy sources such as solar panels to cut down the energy costs and carbon emissions (Higgins-Desbiolles and Wijesinghe 2018).

Consumers are becoming more concerned about fast foods environmental practices, as seen by the ‘green dining' trend, which has led to the formation of the Green Restaurant Association (GRA 2021). The GRA was established in 1990 with the ambition of creating a sustainable restaurant industry.

There are seven criteria whereby a restaurant needs to abide by to be certified a green restaurant (GRA 2016, 2021):

1. Water efficient
2. Sustainable durable goods and building materials
3. Sustainable food
4. Waste reduction and recycling
5. Energy
6. Reusables and environmentally preferable disposables
7. Chemical and pollution reduction

These seven standards in general also represents the characteristics of a modern and evolved fast-food restaurant. Energy efficiency is one of the areas that really needs to improve in today’s fast-food sector (Higgins-Desbiolles and Wijesinghe 2018; Jo, Choi and Taylor 2020).

Little research has been carried out on the link between solar panels and fast-food restaurants (Özgen, Binboğa and Güneş 2021). The literature search was conducted on domains such as ScienceDirect, Scopus, Elsevier, Google Scholar, Taylor and Francis, with only 1,510 research articles that included at least one or more of the keywords 'solar panels' and 'fast-foods'.

2.4.1.1 A McDonalds review

McDonalds is an American fast-food restaurant and is one of the leading trademarks worldwide reaching 120 countries with around 35 000 restaurants (Rajawat *et al.* 2020). The first stand-alone restaurant was opened in 1948 in San Bernardino, California after Mac and Dick McDonald had seen great success in the 1930's with their drive-in hotdog stand (Nuque-Joo, Kim and Choi 2019). In South Africa, there are 225 restaurants across all nine provinces (WorldAtlas 2019).

McDonalds offers a variety of fast-foods such as hamburgers, cheese burgers, French fries, milkshakes and desserts (Kee, Ho, Ho, Lee, Ma and Yin 2021). It has a business-leading policy in the fast-food market which to serve customers with fresh food with a minimum waiting period alongside low-prices. They also adopt a "First In, First Out" approach which relates to a quick consumer turnover (Nuque-Joo, Kim and Choi 2019; Kee *et al.* 2021).

McDonalds outlets have sit-ins and drive-thru. Normally the free-standing McDonalds have the drive-thru (Nuque-Joo, Kim and Choi 2019). With the sit-ins, the customer has his meal within the restaurant, whilst with the drive-thru, the customer orders and drives through and picks up his meal (Shumba and Zindiye 2018). After the COVID-19 pandemic, there has been acceleration in demand towards drive-thru and delivery. Becker, Haas, Kuehl, Marcos and Venkataraman (2020) surveyed and analysed that after the COVID-19 outbreak, the shift from traditional sit-ins moved to drive-thru and delivery by over 40 percent.

The organisation takes on its corporate social responsibility seriously and is trying to positively impact climate change. McDonalds completed its first zero carbon-energy restaurant in 2020, located near Disney's All-Star Resorts in Florida, which is designed to create enough solar energy to cover 100% of its energy needs annually. It intends to use the Florida restaurant as an example to reach out to all the other restaurants globally. It has upcoming projects which involve both wind and solar energy (Maze 2020).

Literature on zero-emissions buildings has grown recently (Wells, Rismanchi and Aye 2018; Johnson 2021). For instance, Johnson (2021) reviewed a net-zero energy building analysis for McDonalds USA. The definition of a commercial building and restaurant has definitely evolved into zero-emissions with the modern era (Wells, Rismanchi and Aye 2018).

Johnson's (2021) results are displayed in Figure 2-5 depict a McDonalds building's ideal net-zero energy (NZE) scenario. Solar energy is numerically the biggest contributor in a net-zero ideal building. Energy conservation measures which relate to upgrades, repairs and replacements reports at 22%. The NZE deficit which is normal due to the fact of seasonal changes estimated at 18%. Lastly, heating, ventilation and air conditioning (HVAC) reduction help at 11% in a zero-emissions building.

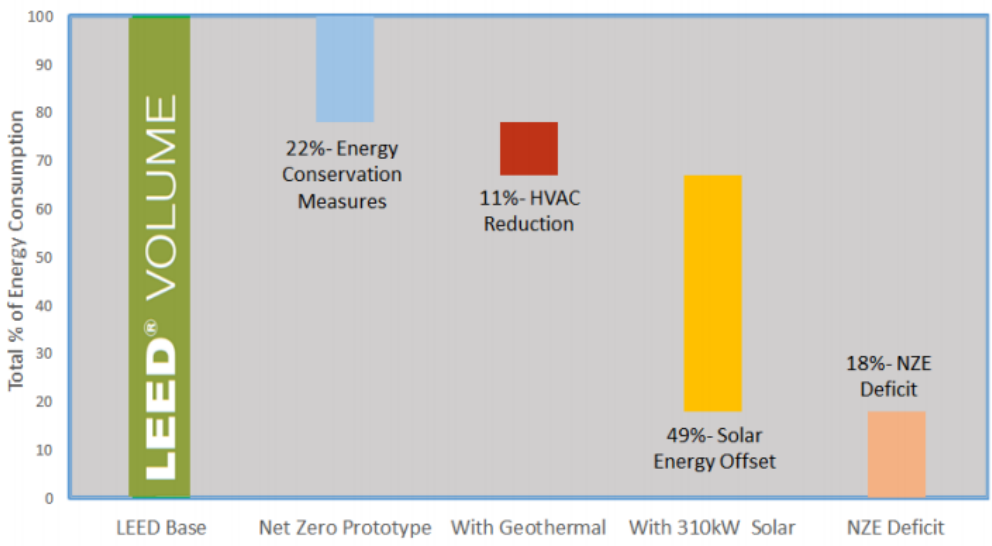


Figure 2-5: Net Zero Energy (NZE) ideal building scenario

Source: (Johnson 2021)

2.5 Factors that influence electrical energy usage

There are several factors that impact energy usage. Firstly, the infrastructure of an organization has a domino effect which means the bigger its size, the more electrical energy it is likely to consume. Secondly, the energy generation is a critical factor in South Africa. Due to healthy economic growth in the past decade, the local utility Eskom, has not been able to meet the current demand hence resulting in frequent load-shedding situations (Dewa, Van Der Merwe and Matope 2020). Thirdly, the weather also has a significant influence on energy consumption. A typical example would be when its warm, the air conditioner is turned on whilst if it gets cold, heaters are turned on wherein both appliances are great consumers of energy (Utility 2021).

2.5.1 Size

On average, commercial buildings account from a range of 30% to 40% of a country's final electrical consumption. Majority of these structures have inefficiencies in energy use due to their physical nature. Many countries are adopting the ideology that all new constructions need to support the perception of being a nearly zero-energy building (Yildiz, Bilbao and Sproul 2017; D'Agostino and Parker 2018).

Tsai, Lin, Lin, Tung and Chiu (2018) studied the hospitality sector energy consumption in a particular geographical area which showed different usages due to the different sizes of buildings. The authors also established that multi-national corporations due to enhanced technologies used, are massive users.

2.5.2 Energy generation

Electrical energy consumption and economic production of businesses are influenced by a variety of factors, including urbanisation, climate, price, and government policy intervention. The main relationship between energy consumption and economic growth is directly linked. If demand and productivity increases, the consumption of energy will also surge accordingly (Chen, Pei and Zhao 2021).

Review investigations in South Africa have revealed that the country is experiencing a crisis in energy production, which has had significant implications. Economic growth and the price of electrical energy are the key determinant variables. Despite the fact that Eskom is a state-owned company, its tariffs are soaring (Al-Bajjali and Shamayleh 2018).

2.5.3 Weather

Related studies underline that weather factors play a crucial role in the electrical market. Weather is a determinant not just because renewable energy is sprouting and becoming a more important part of the energy generation process, namely solar and wind technologies but also because the energy market demand is significantly linked to weather (Mosquera-López, Uribe and Manotas-Duque 2017).

As the temperature rises, so will the demand for electricity, making it more difficult for those countries to meet their sustainable development goals. Empirical research has shown how temperature influences electrical energy demand in African countries, indicating that geographic locations and weather do influence energy usage (Ye, Koch and Zhang 2018; Buechler, Powell, Sun, Zanocco, Astier, Bolorinos, Flora, Boudet and Rajagopal 2020). On the same note, it was discovered that energy consumption contrasts between day and nightfall (Yao 2021).

2.6 Capital budgeting

Capital budgeting is the process of determining long-term finance requirements for various projects. The capital budgeting choice is critical since current investment decisions frequently determine a company's future return and profitability (Marimuthu and Du Toit 2017).

There are many techniques to appraise the feasibility of capital investment, but capital budgeting considers many factors when investing on a long-term basis. Capital budgeting is a process used for assessing potential long-term investments. It is mainly adopted for investments that are significant in amount which are used to invest in non-current assets (EduPristine 2018). These methods are easy to understand and take into consideration the time value of money. The common capital budgeting techniques are payback period, return on investment (ROI), net present value (NPV), and internal rate of return (IRR).

2.6.1 Payback Period

A payback period is the amount of time needed to recover the initial cost of an investment and is typically used to evaluate investments before undergoing them, by assessing the related risk (Marimuthu and Du Toit 2017).

A discounted payback period is when the initial cost of an investment equals the discounted value of the projected cash flows in other words when the cumulative net present value breaks even (Marimuthu and Du Toit 2017).

Related work shows the argument between a simple payback period and a discounted payback period. Time value of money is a critical criterion especially in the times of making an investment. A simple payback period might show a much faster payback whilst practically that might not be the case (Holland and Watson 1976; Gaylord and Hancock 2013; Alcorta, Bazilian, De Simone and Pedersen 2014; Hancock and Vivoda 2014; Sovacool, Hess, Amir, Geels, Hirsh, Medina, Miller, Palavicino, Phadke and Ryghaug 2020).

2.6.2 Return on investment

A return on investment aims to directly evaluate the amount of profit made on a given initial investment cost. It is determined by dividing an investment's profit or cash flow by its initial outlay and reported as a percentage (Marimuthu and Du Toit 2017; EduPristine 2018).

With such comprehensibility and versatility, it is a popular measure of an investment's profitability. If a ROI is positive, the investment is definitely beneficial whilst on the other hand a negative ROI is the contrary. High positive ROIs may be risk associated and low positive are risk averse (Fernando 2021b).

2.6.3 Net Present Value

Net present value is an indicator of how viable a potential investment is. Since cash flows occur over a period of time, due to time value of money, the funds have a certain value today. Thus, in order to sum the inflows and outflows, each cash flow must be discounted to a common point in time (Marimuthu and Du Toit 2017).

Studies show that NPV is one of most common methods used in project management and in maximising an investment's return. It considers time of value which is a must today. Factors such as inflation, economic recession, COVID-19 and many others influence the monetary value (Peymankar, Davari and Ranjbar 2021).

2.6.4 Internal Rate of Return

The internal rate of return is used to evaluate investments by estimating a rate of return which indicates the project's potential for profitability. Based on the IRR, a company will decide to either invest or not. It is basically a breakeven discounted rate (Marimuthu and Du Toit 2017).

IRR is a required second metric of profitability when coupled with NPV. IRR is calculated as a percentage whereas NPV is measured in monetary terms. Evaluating investments that appear to be similar in terms of profitability but differ in size or scope, these two metrics are necessary (Mellichamp 2017).

2.7 The conceptual framework

The study's investment appraisal is designed to measure the viability of investing in solar panels at McDonalds. This study endeavours that the financial simulations and investment appraisal precisely evaluates the feasibility of solar panels at McDonalds. The different types of solar panels have been mentioned and simulations are done at the different McDonalds across South Africa through the capital budgeting techniques. The study's financial simulation and investment appraisal is explained in detail in the methodology chapter.

The independent variables of the study are the capital budgeting techniques which form part of the investment appraisal. The dependent variable is the investment of Solar PV at McDonalds. The investment is dependent on the investment appraisal to test its viability. The study therefore established the following conceptual framework as depicted in Figure 2-6.

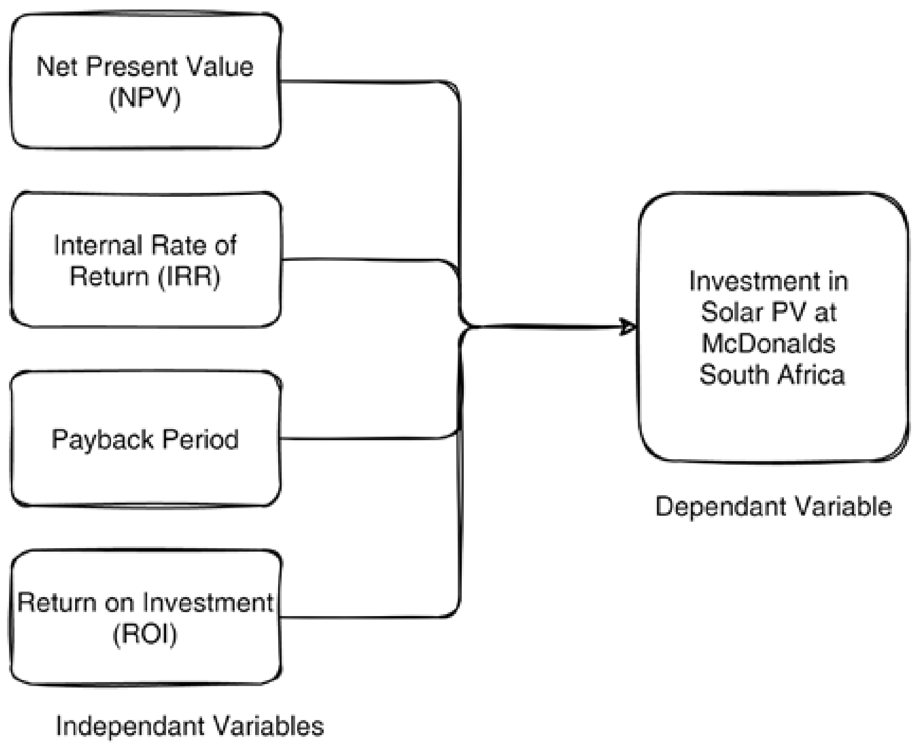


Figure 2-6: Conceptual framework diagram

Source: Own construction

2.8 Management accounting theories

2.8.1 Strong structuration theory

The structuration theory was published in 1984 by Giddens. In the past 20 years, the theory has been widely used but has faced criticism as it is problematic, complex and selective. However, in 2005, this theory was reviewed and debated by Stones which was then termed as the "Strong structuration theory" (Jack and Kholeif 2007; Smith 2019).

Related works deem that this theory is a fit-in for qualitative researchers. This theory makes use of ontological and empirical research. It refocuses and encourages to utilise up to date research in order to build new theoretical insights. This theory nevertheless does not really make use of future case study works as it is based on prior structural literature (Jack and Kholeif 2007; Jack 2017; Warren and Jack 2018).

This theory does not seem suitable as this study is quantitative and innovative in nature. Solutions of the modern age sometimes lies in experimenting and not by dwelling in the past.

2.8.2 Contingency theory

The contingency theory is extensively used to describe the characteristics of Management Accounting Systems (MAS) and has been widely endorsed in the management accounting field of research studies. This theory is broad as it encompasses managerial planning, evaluation and financial strategy (Kudanga 2018).

The effectiveness of this theory is extremely dependant on the factors such as technology, environment, unpredictability, size and features of the organisation. Contingency-based management accounting falls under mixed findings (Kudanga 2018). Considering that this study attempts to be more specifically quantitative and numerical, the contingency theory is unsuitable.

2.8.3 Real option theory

Finance academics have created the real option analysis as a way to value investments under uncertainty. This theory allows a quantitative approach to focus on specific investments and apply valuation models. It adds the variable of time into the valuation which results in the decision maker taking the right decision according to the right conditions. One of the key concepts have been the Monte Carlo simulation which has been broadly adopted over the recent years (Wu and Buyya 2015; Pattanayak, Prakash and Mohanty 2019).

2.8.3.1 Monte Carlo simulation

The Monte Carlo simulations theory derived its name from a famous gambling destination in Monaco, because different chances and outcomes are key to the theory as how casino games are also grounded (Kenton 2021). Stanislaw Ulam, a mathematician who worked on the Manhattan Project, was the first to invent the approach. Stanislaw kept himself occupied after the war whilst recovering from his brain surgery by playing endless rounds of solitaire. He became fascinated in plotting the results of each of these games in order to observe their distribution and calculate the chances of winning (Muralidhar 2003; Kenton 2021).

A Monte Carlo simulation is used to determine the results of an investment appraisal developed in order to carry out the financial analysis that includes the identified risk variables. This type of simulation is used to examine tough investment decisions in depth. It allows to get a complete statistical representation of the output variables while utilising multiple criteria at the same time. This study adopts the Monte Carlo simulation as it will add value to the study's investment appraisal (Gianmarco 2018).

The method in this study makes use of a census at different parameters of values that can be assumed by the input variables and calculating their output on the basis of the capital budgeting equations. The underlying factor in this case is a hybrid of a simulation process and capital budgeting techniques. In this thesis, the standard simulation involved 125 Drive-Thru across South Africa on the variables discussed in chapter three. After all, the financial simulation input shown in this study have been computed in the investment appraisal.

The first step is the definition of relevant input for the financial simulation. The input is broken down into two parts as shown in the next chapter, technical input and financial input. The technical input involves the simulation process from which the numbers derived will be used in the financial aspect. Thereafter, the investment appraisal was formulated on Microsoft excel spreadsheets (results displayed in chapter four and appendix). The results indicated whether the McDonalds South Africa should go ahead or not.

This strategy has been adopted because of its wide variety of usage in investment decisions (Gianmarco 2018). One can use this type of simulation to examine complex investment decisions at a level of detail determined by the modeller. It allows for one to get a complete statistical representation of the output variables while utilising many factors for the actual analysis. Furthermore, different parameter assumptions are to be tested in this study therefore shows the perfect fit-in for the Monte-Carlo simulation theory.

2.8.4 Capital structure theories

Modigliani and Miller (1958) originated and published the initial theory of capital structure which was the irrelevance theory. Thereafter, the irrelevance theory laid the foundation for several other capital structure theories. The basic objective of capital structure is to find the best balance of debt and equity that optimizes the company's value. Modigliani and Miller's (1958, 1963) main theories are known as MM Proposition I and II. The initial theory was revised due to criticism of not incorporating taxes (Zunckel 2018; Marimuthu 2019).

2.8.4.1 MM Proposition I without taxes

The irrelevance theory, published by Modigliani and Miller (1958), states that under perfect market conditions, which is, no corporate taxes, no bankruptcy costs, no transaction costs, and all market participants have equal information (no information asymmetry) which is the value of an unleveraged firm (a firm financed entirely with equity) is equal to the value of a leveraged firm (a firm which uses both debt and equity). To put it another way, in the absence of the aforementioned costs, the firm's worth is decided by its earnings power and the value of its assets, not by how investments are financed. This was referred to as the MM I theory (Zunckel 2018; Marimuthu 2019).

Therefore, the irrelevance theory is also elemental to the study’s investment appraisal. In other words, McDonalds could either fund the solar panels investment through equity or alternatively debt-fund. The study’s investment appraisal is to determine whether the investment in solar panels is feasible and not particularly as to how it is funded.

2.8.4.2 MM Proposition II with taxes

When there are corporate taxes, the higher the share of debt in the capital structure, the better because of the interest tax shield. Modigliani and Miller (1963) updated their original proposition to incorporate taxes in their model after realising that there was no perfect market, contrary to their earlier theory. They said that companies that use debt financing benefit from a tax break, with leveraged companies having a higher worth (Zunckel 2018; Marimuthu 2019).

The second proposition does not seem to be a fit-in because even though if McDonalds finances the solar panels through debt and incur finance charges, concurrently their electrical energy costs are going to decrease. In other words, the electrical energy savings might be greater than the finance charges as a result the interest tax shield would not really make a significant impact on the reduction of McDonalds taxable income.

2.9 Summary

This chapter presented a review of related work on solar panels. Empirical evidence has shown that there has been substantial growth in installing solar panels over the past few years. *"I think the future for solar energy is bright," (Salazar 2021).*

The next chapter focuses on the study's research methodological aspects.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

The preceding chapter reviewed the relevant literature on solar panels, McDonalds and the investment appraisal techniques. *"Research is to see what everybody else has seen and think what nobody has thought," (Szent-Gyorgyi 2015)*. The purpose of this chapter is to describe the methodology used to address the research aim which was to financially simulate an investment appraisal for solar energy at freestanding McDonalds fast-food restaurants in South Africa.

The research methodology focuses largely on the research design, the census, the research methods as well as research instruments that were used in data collection for the purposes of solving the problem statement. The chapter begins with the research method adopted to achieve the study's objectives justified by the research design. The subsequent sections outline the population, census and the research instruments used. This includes aspects such as data analysis, interpretation, reliability and the validity of the study.

3.2 Objectives of the study

This section explains the methods adopted to achieve each of the study's objectives:

The first objective is to simulate a financial appraisal for solar energy investments at McDonalds Drive-Thru restaurants on a national level. The factors selected were identified based on an empirical review of the literature as discussed in chapter two. Data relating to weather conditions, Eskom's tariff and the different parameters of electrical energy usage and size were inputted into the simulations (which consisted of National Renewable Energy Laboratory PV Watts calculator) of the McDonalds Drive-Thru restaurants solar energy investment. The recent commercial Eskom tariff was used and remained constant throughout the simulations. Different parameters of electrical usage consisting of a minimum consumption of 250 kWh, most likely consumption of 325 kWh and a maximum consumption of 400 kWh were used.

The second objective is to examine the provincial dynamics of solar energy investments at McDonalds Drive-Thru restaurants. All nine provinces, each individual Drive-Thru were financially simulated and appraised. The development of the study's financial simulation and investment appraisal which includes the study's inputs, method and assumptions is explained in detail below.

The last objective relates to the recommendation through appraisals of appropriate and profitable solar energy investments for McDonalds restaurants. This has been accounted through the financial simulation and the study's investment appraisal to establish the feasibility of the solar energy investment at McDonalds both on a national and a provincial basis.

3.3 The study's financial simulation and investment appraisal

An investment appraisal is used to analyse the sensitivity of a project's most critical indicators to the key input parameters (Tikhomirov and Plotnikov 2018). In this study, methods such as the Net Present Value, Payback period, Return on Investment and Internal Rate of Return, which were mentioned in the earlier chapter, were used to determine the viability of the solar panels investment. Therefore, an investment appraisal is a decision-making tool and has its own set of characteristics, strengths and flaws (Lai, Locatelli, Pimm, Tao, Li and Lai 2019).

A Monte Carlo simulation is used to evaluate and appraise solar energy investment profitability at McDonalds. The application of a numerical approach results in a more extensive interpretation of the investment decision. Monte Carlo simulations are the most widely used and appropriate technique in the financial sector for evaluating sound financial investments provided the assumptions are reasonable (Gianmarco 2018).

This study was based on financial simulations as mentioned below has been carried out at all the McDonalds Drive-Thru across South Africa's nine provinces and the phases of the study's methodology are shown in Figure 3-1.

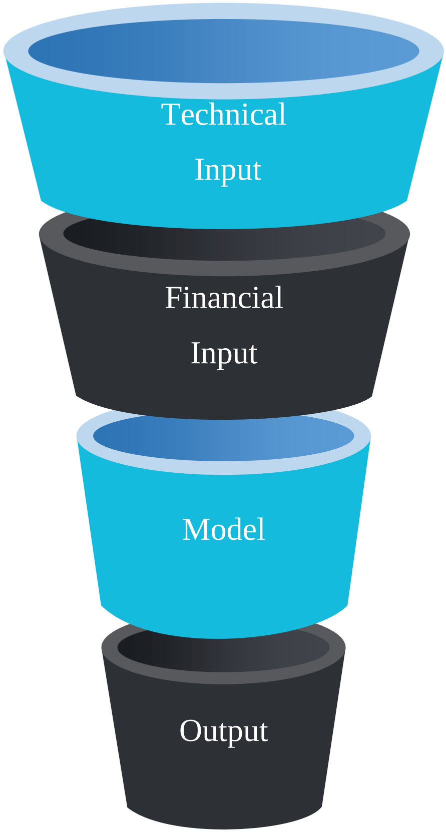


Figure 3-1: Study's methodology description

Source: Own Construction

The inputs for the financial simulation and investment appraisal as depicted in Figure 3-1 can be separated into two major categories, namely, technical and financial. There are also certain assumptions with regards to the investment appraisal that is discussed below.

The technical input consists of data which were available on public domain. The data consisted of McDonalds restaurant address, solar system size, electrical energy consumption, the total amount of solar energy depending on the location and finally the cost of the solar system which is explained further below in section 3.6.

The financial input of the appraisal consisted of the initial cost of the solar system, discounting rate and the annual electrical energy savings, which were derived from the National Renewable Energy Laboratory PV Watts calculator (NREL) and the Treetops website, which were needed for the capital budgeting techniques. On average, a typical South African McDonalds fast-food restaurant consumes from 250 to 400 kWh (Burger 2016). Therefore, the appraisal looked at three different levels of energy consumption with a minimum energy consumption level of 250 kWh, most likely energy consumption level of 325kWh and a maximum energy consumption level of 400 kWh.

The investment appraisal entailed the cash flow as well as discounted cash flow or in other words the electrical energy monies that McDonalds South Africa could save if they had to undertake the solar energy investment. The discounting rate is constant throughout the simulated appraisal at 7% which is the prescribed interest rate (SARS 2020).

The output presented the capital budgeting techniques calculated which are the net present value, the payback period and the internal rate of return which were used to assess the investment. Behringer (2016) provided a simple capital budgeting guideline for those charged with governance at an organisation to follow: invest in those projects with a positive net present value and reject those with a negative net present value. Capital budgeting theory therefore claims that if businesses abide by this rule, their decision-making will maximise the shareholder's wealth. Hence, these budgeted figures and results indicates if McDonalds South Africa should take on the solar investment.

3.3.1 Assumptions of the study

According to Leszczensky and Wolbring (2019), a simulation study must be anchored on specific assumptions. These assumptions place the study in a specific framework, which would make the study replicable. In view of this, the simulation was performed based on the following assumptions:

- Energy losses
  System losses are normal due to certain conditions at times. It is assumed to be constant throughout the year at a percentage rate of 14.08% of the net output (NREL 2021).

- Maintenance costs

  There might be a contingency of quality issues. If the system does not execute as anticipated over the stipulated time, then it might lead to maintenance, replacement and increased insurance costs.

- Eskom tariffs and interest rates

  These rates constantly fluctuate from time to time and are assumed to remain constant throughout this study.

- Depreciation

  Depreciation or wear and tear is not considered in this financial appraisal as it is a non-cash item.

- Discounting factor

  A discounting rate is taken as the prescribed interest rate at 7% (SARS 2020). This rate was used throughout this study to ensure uniformity as each organisation and companies faces different unique capital costs in their respective markets. Hence, the rate of 7% was relevant to McDonalds South Africa. The discounting of 7% was considered as interest on loans are tax deductible and at times, equity might be harder to raise internally (Stiglitz 1989; Vismara 2019).

3.4 Research paradigm

A research design addresses a study's objectives and lead the path taken in the research process in order to answer the research questions in a systematic or scientific manner (Sekaran and Bougie 2019).

Casual, descriptive, and exploratory research are the three most common forms of research designs (Sekaran and Bougie 2019). Causal studies are those that attempt to establish a link between various variables and occurrences. These studies are used to demonstrate the relationship between dependent and independent variables (Saunders, Lewis and Thornhill 2019; Sekaran and Bougie 2019). Statistical approaches are used in descriptive research to detect patterns in circumstances without demonstrating a causal relationship between the various parts. When a researcher wants to characterise the nature and characteristics of the trends under inquiry, then the descriptive study is recommended (Saunders, Lewis and Thornhill 2019; Sekaran and Bougie 2019). Exploratory studies, as the name implies, aim to delve into previously unexplored territory. This type of research allows for genuine, and trustworthy conclusions in the social sciences since it is based on reliable findings (Saunders, Lewis and Thornhill 2019; Sekaran and Bougie 2019).

This study was an exploratory study whereby an investment appraisal was done through a developed financial simulation of a case study of McDonalds to test the feasibility of a solar investment. This could contribute to the body of knowledge as it has not been done before.

The research onion (Saunders, Lewis and Thornhill 2019) was used to guide the selection of research methods in this investigation. The complete research process is depicted as an onion (Figure 3-2), which requires going through a succession of crucial processes in order to achieve the study's objectives (Saunders, Lewis and Thornhill 2019). Figure 3-3 is adapted to this study and each layer of the onion depicts each sub-section of the study's research design which is subsequently explained.

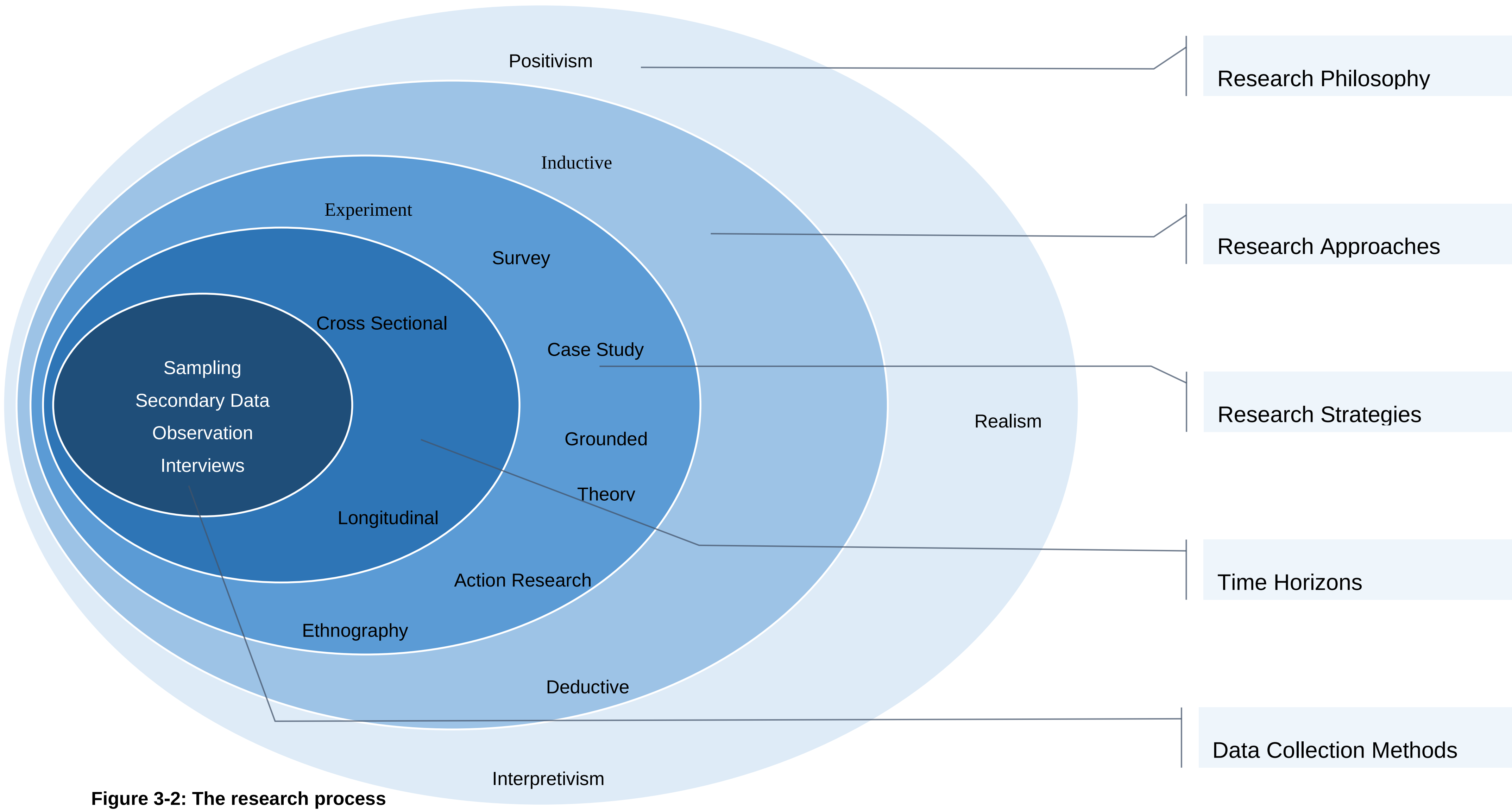


Figure 3-2: The research process

Source: Saunders, Lewis and Thornhill (2019)

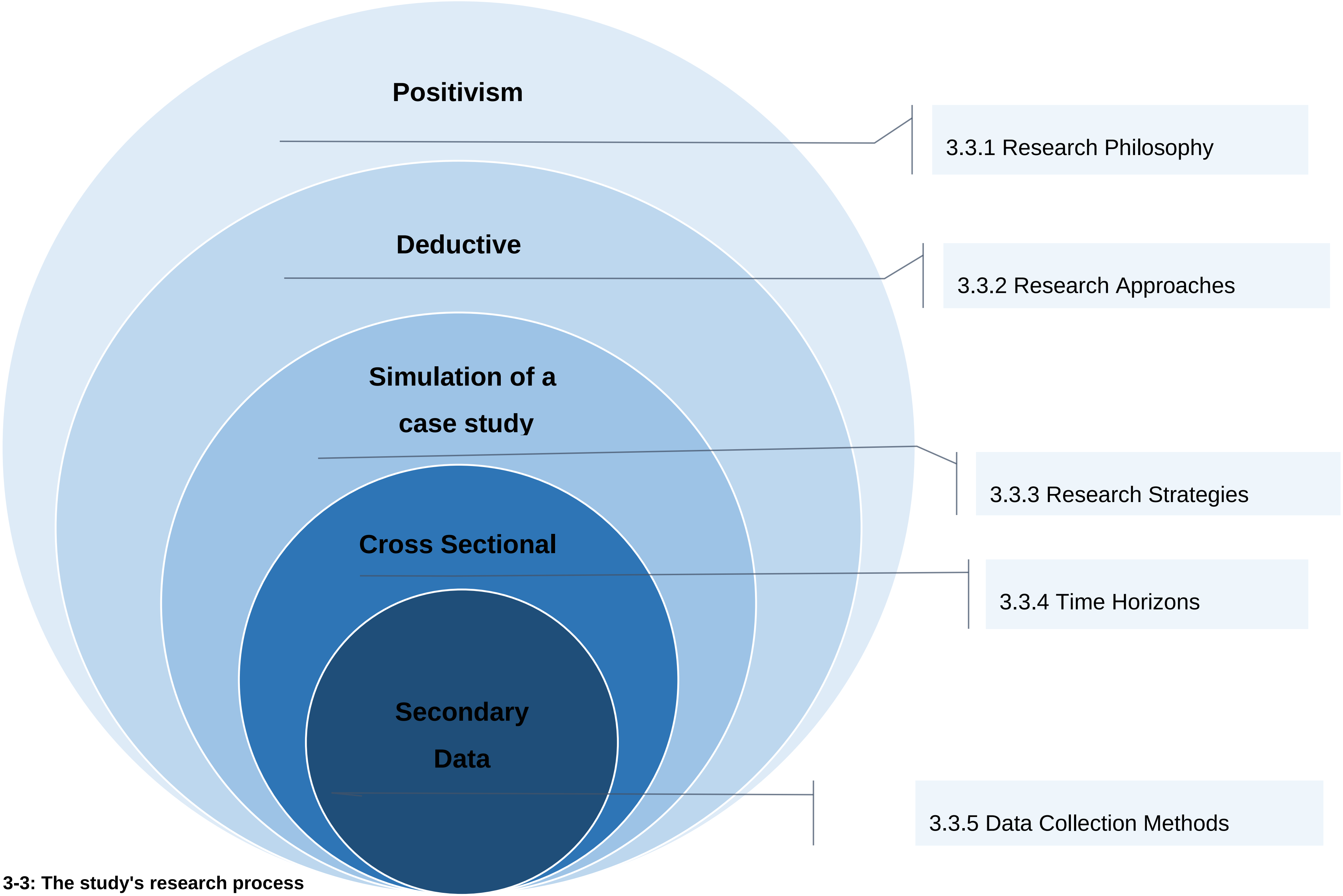


Figure 3-3: The study's research process

Source: Own construction which is adapted from Saunders, Lewis and Thornhill's (2019) research onion process

3.4.1 Research philosophy

All research is founded on a set of philosophical assumptions that define what constitutes "legitimate" research methodologies for the advancement of knowledge in a certain discipline. The various sorts of research philosophies and techniques enable the researcher to determine the most effective method of research (Saunders, Lewis and Thornhill 2019). Critical realism, interpretivism and positivism are the most common examples of research paradigms adopted.

3.4.1.1 Critical realism

Critical realism is a belief in an external reality or an objective truth combined with a rejection of the claim that this external reality can be objectively measured. As a result, the critical realist questions our ability to grasp the world with confidence. Whilst, a positivist believes that the purpose of research is to discover the truth, the critical realist argues that the goal is to progress towards it, even if it is impossible to achieve. Measures of phenomena such as emotions, feelings, and attitudes, according to the critical realism approach, are often subjective in nature, and data collecting is, in general, inaccurate and defective (Sekaran and Bougie 2019).

Critical realism is frequently regarded as a midway between positivism and interpretivism on the other. It can be adopted in both qualitative as well as quantitative research. The methodological aspects have made remarkable advancements during the past years (Zachariadis, Scott and Barrett 2013; Mingers and Standing 2017).

However, this philosophy did not suit this study as there is a risk associated with this investment which required a certain level of confidence.

3.4.1.2 Interpretivism

According to the interpretivism philosophy, human beings and their social surroundings cannot be investigated in the same way that physical science can, and hence social science study must be distinct from physical science research. Interpretivist research aims to develop new, more refined understandings by gathering information that is meaningful to the participants. They would perceive that in an organisation such as a company, everyone working would see the company in various ways comparing the eyes of the CEO to the one of a clerk (Saunders, Lewis and Thornhill 2019).

The interpretivism design was born from the critics of the positivism design. This design advocates that the positivism paradigm has disregarded related hidden parts based on observations and that these hidden parts should also be considered part of the related research and has meaningful impact in business research (Chowdhury 2014; Wang 2020).

The interpretivism paradigm approach is similar to that of the critical realism and thus is not suitable to the study's research.

3.4.1.3 Positivism

In a positivist worldview, scientific inquiry minds are considered as the way to discover the truth, obtain a thorough understanding of the universe so that we can predict and govern it. The experiment is a key method used by positivist researchers to test cause-and-effect relationships through manipulation and observation (Saunders, Lewis and Thornhill 2019). Some positivists argue that research should only describe experiences that can be observed and measured objectively. Positivists believe to see organisations and social entities as real in the same was as physical objects and anything beyond that such as emotions, sensations, and thoughts are impossible for them to comprehend (Sekaran and Bougie 2019).

The approach has to be determined by three factors: philosophical assumptions regarding the topic's knowledge, the investigation's goal, and a well-crafted data collecting, analysis, and writing process (Creswell and Creswell 2017). Thus, this study adopted the positivism paradigm as it sees the simulation performed as a real-world experience. The researcher is also detached, neutral and independent of what is researched in this study.

3.4.2 Research approach

There are namely two sorts of research approaches; deductive which is fixed and collects quantitative data and inductive on the other hand which is unfixed and gathers qualitative data. These are two opposing approaches of thinking and are based on two philosophical and research approaches that are fundamentally distinct. The deductive approach is a method of research that is usually linked with employing a scientific and positivist approach to the research problem. As a result, the deductive approach is more commonly applied with the positivism research philosophy stated above. The inductive technique is a theory-building process that begins with direct observations of individual cases and moves toward generalisations about the phenomenon being studied. It's better suited to the realism research philosophy (Saunders, Lewis and Thornhill 2019; Sekaran and Bougie 2019).

One of the fundamental contrasts between deductive and inductive approaches is how current literature and theory are used to guide the investigation (Creswell and Creswell 2017). The deductive method is used to put a theory to the test. Before collecting data, the literature is used to identify questions, themes, and interrelationships. The inductive technique, on the other side, develops a hypothesis as the investigation advances (Creswell and Creswell 2017; Saunders, Lewis and Thornhill 2019).

Hence this study adopted a deductive approach as it is associated with the positivism philosophy and is more suited to the study as compared to the inductive technique.

3.4.3 Research strategy

A strategy, in general, is a plan of action for achieving an objective. As a result, a research strategy can be characterised as a plan for researchers to solve research objectives. It's the methodological relationship between the philosophy, the data collection and methodologies that one uses. There are many strategies namely, experiments, survey, case study, grounded theory, action research and ethnography (Creswell and Creswell 2017; Saunders, Lewis and Thornhill 2019) .

This study’s strategy is a case study of McDonalds South Africa. Case studies are referred to as a methodical inquiry into a topic within its real-life setting (Saunders, Lewis and Thornhill 2019). This strategy has been used by positivists over the past years. This study had to evaluate a case to see whether this investment is worthwhile or not. A case study approach seemed a more fit-in as it has the capacity to generate more in-depth insights in a real-life context (Creswell and Creswell 2017; Saunders, Lewis and Thornhill 2019).

3.4.3.1 Research methods

The three most common classification of research methods namely are quantitative, qualitative and mixed methods (Creswell and Creswell 2017).

The quantitative method is based on numeric data. In this sense, the term “quantitative” is frequently used to refer to any data gathering or analysis procedure (such as questionnaires and analysis) that produces numerical data. Quantitative research is based on the positivist school of thought (Creswell and Creswell 2017; Sekaran and Bougie 2019).

The qualitative method is based on non-numeric data for instance, words, images and videos. In contrast to quantitative, the term "qualitative" is commonly used as a synonym for any non-numerical data collecting approach, for example interviews. The qualitative method seeks to answer questions related to the study with ‘how,’ ‘what,’ or ‘why,’ rather than ‘how many’ and ‘how much’ to which quantitative methods pursue to answer (Creswell and Creswell 2017; Sekaran and Bougie 2019).

Mixed methods are a mixture of both quantitative and qualitative methods. When a single approach is insufficient to handle a specific research study, a combination of both quantitative and qualitative is recommended, resulting in the usage of mixed methodologies (Creswell and Creswell 2017).

This study adopted a quantitative approach to compare and evaluate distinct variables on measurement. This method was suitable for the study since the research objectives was measured using evaluations. It made use of simulations of solar PV systems discussed in the literature review which is used to analyse the viability of the investment through capital budgeting techniques such as the Payback Period, Net Present Value and Internal Rate of Return (IRR) on investing in solar panels.

3.4.3.2 Simulation

A simulation is the replication of a real-world operation (Sekaran and Bougie 2019). It is used to analyse the behaviour of a system which can be modelled using both existing and conceptual systems. The number of businesses using simulations are growing as the advantages outweigh the disadvantages (Sekaran and Bougie 2019).

One of the advantages is that simulations let one test a model without obliging resources. It also explores more possibilities and analyses problems. A critical path can also be identified to be more time efficient. It also identifies bottlenecks and helps to prepare for the ever-evolving modern age (Banks 1998; Scheidegger, Pereira, de Oliveira, Banerjee and Montevechi 2018).

The disadvantages however still exist. Simulations can be expensive and time consuming. It can be difficult to understand and be used incorrectly. It may require special training to build a model (Banks 1998; Scheidegger *et al.* 2018).

The study's solar energy financial simulations were performed to evaluate solar systems and their electrical energy generation at various McDonalds Drive-Thru across South Africa. Two resources, comprising the National Renewable Energy Laboratory PV Watts calculator and Treetops were employed for the simulation. This calculator provides reliable estimations of how much electrical energy solar panels can generate at different conditions. The energy simulation's outcome was then used on the Treetops (2021) website to calculate the cost of the required solar system. Treetops (2021) is a nationwide solar system installation firm that offers online commercial quotations.

Simulations are becoming an important decision-making tool hence it was a fit-in to this study as it gave it a real-life procedure value. The study can add value to business organisations and to the environmental welfare.

3.4.4 Time horizon

Time horizons relate to how a research study wants to be carried out. Does it need to be just at a certain period of time or does it need to be over a long period of time?

A research done at a certain period of time is termed as “cross-sectional study” whilst for over a period of time is termed as “longitudinal study. Cross-sectional studies more likely take a snap of the ongoing research problem whilst longitudinal tries to research the dynamics (Saunders, Lewis and Thornhill 2019).

This study does not analyse data from long periods of time but rather at a certain period of time hence this research is cross-sectional. The data obtained from the NREL PV watts calculator (2021) and the Treetops (2021) will be subject to change over a certain period of time as factors such as global warming will affect the solar energy generation and also inflation will impact on the solar system cost (Roy and Kabir 2012; Solaun and Cerdá 2019).

3.4.5 Data collection method

3.4.5.1 Primary data

Primary data is information that is collected specifically for the research problem at hand, employing processes from a data source without going through any other sources that are tailored to the study problem. The data obtained adds on to the existing store of data. The most common methods are namely, interviews, surveys, questionnaires, observations and experiments (Saunders, Lewis and Thornhill 2019; Sekaran and Bougie 2019).

3.4.5.2 Secondary data

Secondary data is when the solution to obtain data to answer the research question lies in exploring and conducting additional analyses on existing data. It includes both raw data and published which are then analysed to provide more information (Sekaran and Bougie 2019).

The study’s research objectives were addressed using solar panel financial simulation from secondary data which was derived from the NREL PV watts calculator (2021) as it analysed numerical data. All the data gathered were available on the public domain (NREL 2021; Treetops 2021). The simulator was broken down into two parts: firstly, gathering estimates of how much energy solar panels can produce on the NREL PV

Watts calculator (2021) which was thereafter used to calculate the cost of the solar system which was obtained from Treetops Renewable Energy System CC a solar system company based in Cape Town. Lastly, these figures were used and adapted to the study's investment appraisal simulation which is further shown in detail through an illustrative example in sections 3.6 and 3.7.

3.5 Population and sample

3.5.1 Population

A research population is usually a large group of individuals or objects that is the primary focus of a scientific inquiry (Saunders, Lewis and Thornhill 2019). This study was more suitable to a case study on McDonalds as it analysed a single targeted organisation. McDonalds includes a total population of 225 outlets in South Africa (WorldAtlas 2019). The census, which were available on public domain, were derived through GoogleEarth (2021) and GoogleMap (2021). The target population was the South African McDonalds drive-thru restaurants as described in chapter two across the nine provinces.

3.5.2 Census

A census can offer detailed information on most aspects of a population. The approach to use an entire population as a sample is impossible for large populations but is more attractive for small populations which is known as a census (Israel 1992; Mahmoud, Zayed and Fahmy 2019). In this study, the census adopted are the 125 McDonalds Drive-Thru across South Africa's nine provinces which are shown in the table below:

Table 3-1: Census of the Study

McDonalds South Africa	
Province	**Drive-Thru**
Eastern Cape	14
Free State	3
Gauteng	27
KwaZulu-Natal	19
Limpopo	7
Mpumalanga	11
Northern Cape	5
North West	11
Western Cape	28
Census	**125**

Source: (WorldAtlas 2019; GoogleEarth 2021; GoogleMap 2021)

3.6 The research instruments and the simulation process

Research instruments refers to a variety of procedures used to collect data from the required sample or the census in this study. Questionnaires, interviews, observations, experiments and simulations are examples of research tools used to obtain reliable data (Sekaran and Bougie 2019).

Various research instruments can be used to achieve project feasibility. However, this study focused on the following hybrid of a financial simulation process and an investment appraisal.

Firstly, the financial simulation process is explained which forms part of the technical input as shown in the development of the financial simulation and thereafter the capital budgeting aspect is explained and how it is integrated which forms part of the appraisal input.

A solar panel simulation was utilised to obtain data and information. The PV watts calculator on the NREL (2021) (National Renewable Energy Laboratory) website was used as the simulator. This is a website where one may learn about solar energy and is also user-friendly. NREL (2021) calculates how much of electrical energy solar panels can generate under various scenarios. The PV watts calculator calculates performance using data from over 30 years of solar irradiance. The PV watts calculator was chosen for the simulation aspects of this study because of NREL's knowledge of solar energy. The PV watts calculator is very easy to use and comprehend, making the simulation process for this study much easier (Welsh 2017; NREL 2021).

The calculator's first step is to locate resource data and is accomplished by determining the place where the solar panels will be installed. The locations of the McDonalds Drive-Thru were obtained from Google Maps and Google Earth which also forms part of the study’s census. The illustrative example below of the McDonalds uMhlanga Drive-Thru demonstrates the study’s simulation process and the investment appraisal. Figure 3.4 illustrates how the PV watts calculator on the NREL works.

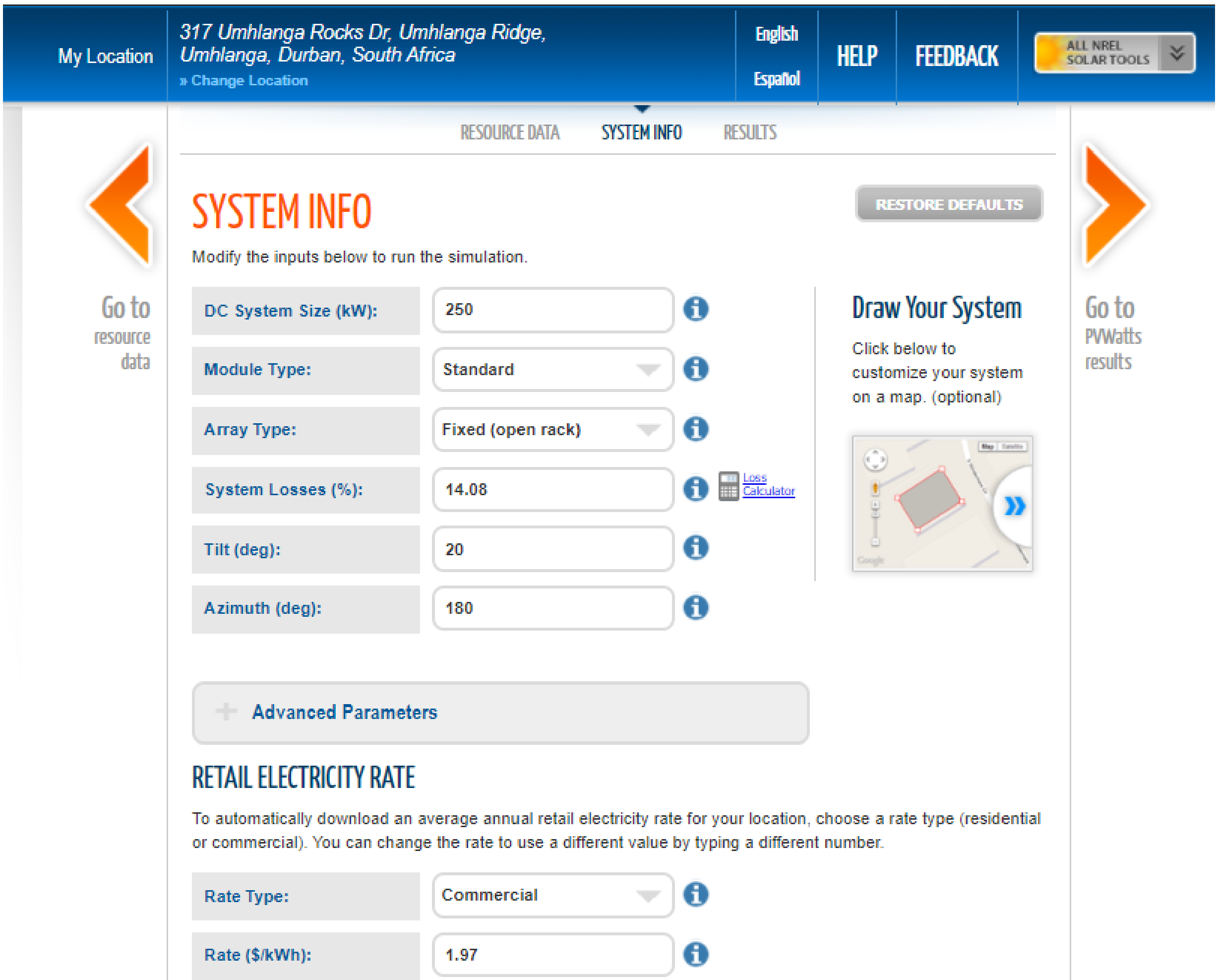


Figure 3-4:NREL PVWatts calculator extract (i)

Source: NREL (2021)

The requested location in Figure 3.4 is the address of the uMhlanga Drive-Thru in Durban, KwaZulu-Natal. Once the address is inserted, the weather data is automatically presented. Thereafter the system size, in this example is 250kW and the commercial option was chosen. The standard fixed solar panel was used throughout the study. The array tilt (angle which the panel is tilted), array azimuth (the angle of the sunlight), system losses, inverter efficiency and the DC to AC size ratio were constant numbers throughout the study as these are the average numbers used and assumed to be constant (Welsh 2017). The dollars ($) were overlooked and was considered as Rands (R). The electricity rate of R1.97 was of Eskom's tariff (Eskom 2020).

An example of the output from the simulation is presented in Figure 3.5.

NREL

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at https://sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

https://pvwatts.nrel.gov/pvwatts.php

RESULTS

310,655 kWh/Year*

Month	Solar Radiation (kWh / m² / day)	AC Energy (kWh)	Value ($)
January	6.26	36,667	72,234
February	5.58	30,014	59,128
March	4.88	28,746	56,629
April	3.67	21,203	41,770
May	2.71	15,324	30,188
June	2.21	11,932	23,506
July	2.47	13,976	27,534
August	3.39	19,984	39,368
September	4.45	25,798	50,821
October	5.43	32,942	64,896
November	5.94	34,801	68,558
December	6.55	39,268	77,357
Annual	4.46	310,655	$ 611,989

Location and Station Identification

Requested Location	317 Umhlanga Rocks Dr, Umhlanga Ridge, Umhlanga, Durban, South Africa
Weather Data Source	(INTL) JOHANNESBURG, SOUTH AFRICA 303 mi
Latitude	26.13° S

Figure 3-5: NREL PVWatts calculator extract (ii)

Source: NREL (2021)

From the extract of the simulation in Figure 3.5, the total annual electricity cost is R 611 989 (310 655 kWh X R1.97). The monthly electrical costs amount to R 50 999 (611 989/12). All data collected and obtained are available on public domains (NREL 2021).

Once the solar energy annual kWh was derived, thereafter it was used to obtain an estimated cost of the required Solar PV system from Treetops Renewable Energy Systems CC (Treetops 2021) as shown in Figures 3.6, 3.7 and 3.8 below.

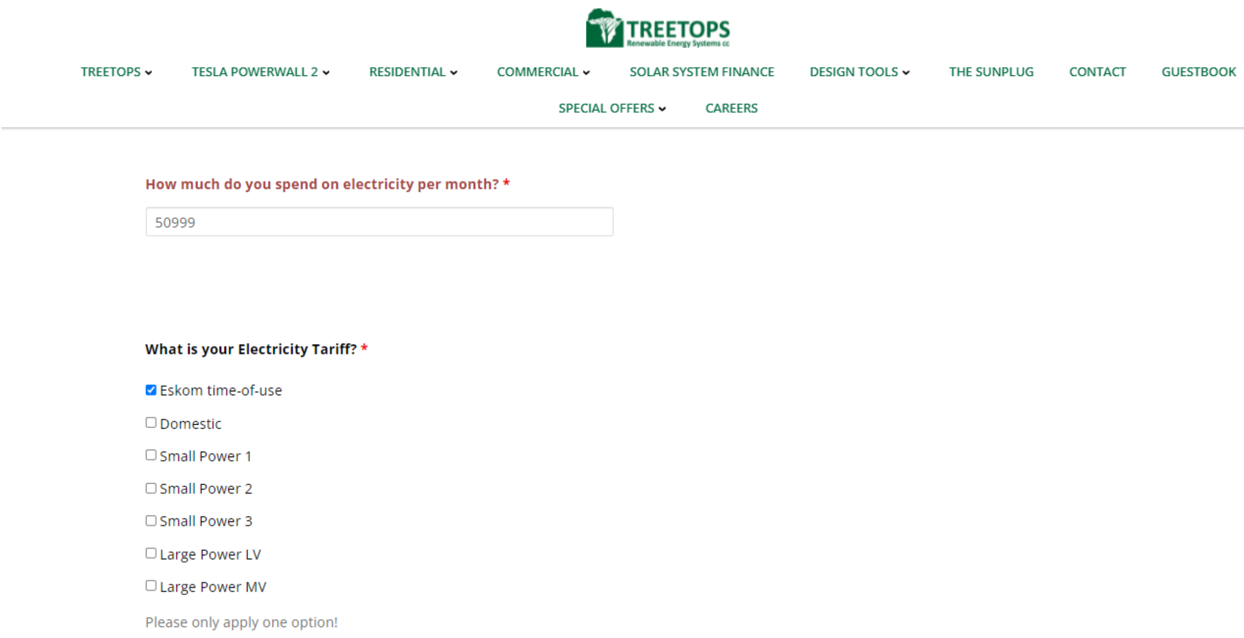


Figure 3-6: Treetops Renewable Energy Systems CC quote extract (i)

Source: Treetops (2021)

For this study, the commercial quote was selected and thereafter R50 999 was inserted which was derived from the NREL calculator.

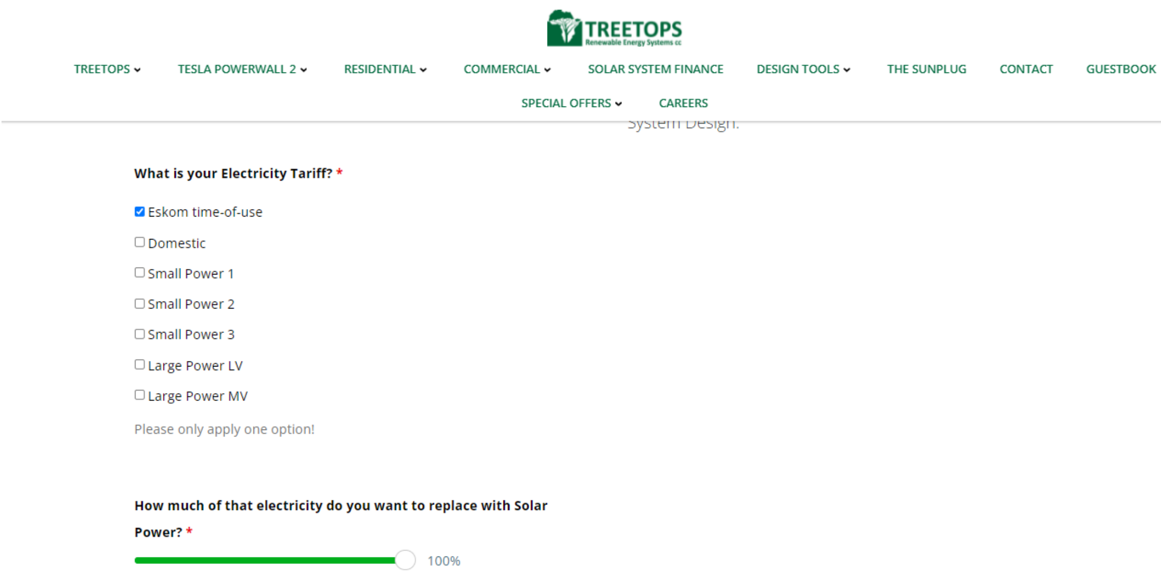


Figure 3-7: Treetops Renewable Energy Systems CC quote extract (ii)

Source: Treetops (2021)

The Eskom tariff and the option to replace the traditional way with solar panels at 100% were chosen.

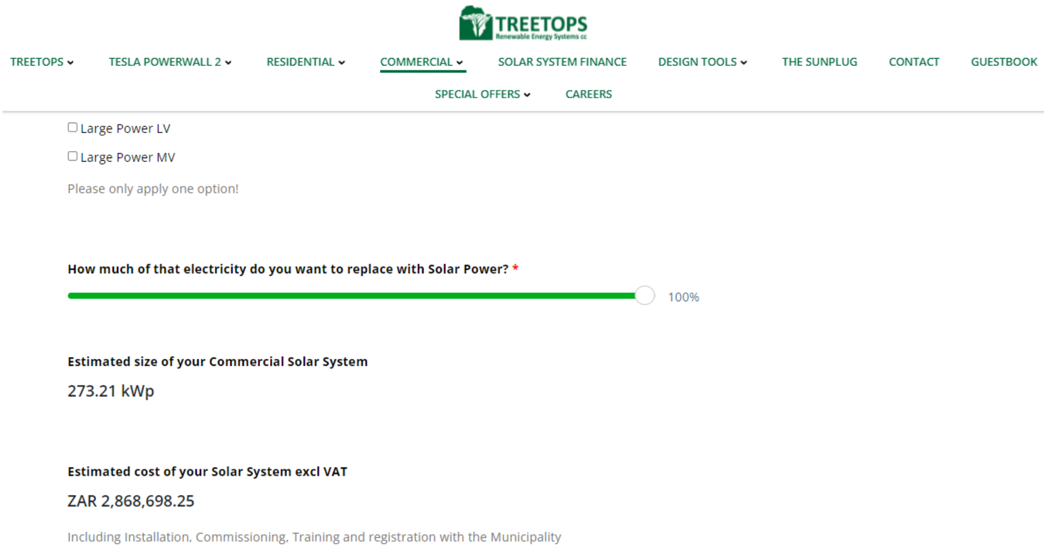


Figure 3-8: Treetops Renewable Energy Systems CC quote extract (iii)

Source: Treetops (2021)

Finally, the estimated cost of the solar system was derived which was used in the investment appraisal. Therefore, the cost of the solar system is R 2 868 698 as shown in Figure 3-8 and the annual electrical savings which is also the annual cash flow of the solar investment sums up to R 611 989 as shown in Figure 3-5. The illustrative example of the uMhlanga Drive-Thru continues in section 3.7 through the appraisal techniques.

The national level data comprised of the average of all the nine provinces numbers. It is, in other words, the results for each individual Drive-Thru, added up for its particular province and divided by the respective number of Drive-Thru outlets in that province. Thereafter, all the nine provinces numbers added up and divided by nine resulted in the national average data.

3.7 The appraisal techniques

The capital budgeting methods as defined in the previous chapter were used to appraise the solar energy investment and thereafter compared to recommend the most profitable solar energy system. Brief explanations of the various appraisal methods adopted in the study are provided below.

<u>Payback Period:</u> The Payback Period is the length of time it takes to pay off the solar investment through electricity savings. To perform the calculation, the study took the cost price of the solar system and divided it by the restaurant's simulated/estimated annual electricity bill savings (Marimuthu and Du Toit 2017; EduPristine 2018).
This was obtained using the following formula:

$$\frac{\text{Net Solar System Cost}}{\text{McDonalds Annual Utility Savings from Solar}} = \text{Payback period in years}$$

Therefore, the result of the example which is McDonalds uMhlanga would be as follows:

$$\frac{R\ 2\ 868\ 698}{R\ 611\ 989} = 4.69\ years$$

This means that it would take McDonalds uMhlanga 4 years, 8 months and 9 days (4.69 years) to recoup their initial outlay of R 2 868 698.

<u>The Return on Investment (ROI):</u> The Return on Investment (ROI) is also a viable capital budgeting technique which can directly reflect the savings from a given investment. ROI estimates on the amount of savings anticipated throughout the duration of the lifespan of solar panels. The ROI formula included components such as:

- McDonalds present kilowatt-hour (kWh) utility rate (Load-curve);
- McDonalds annual electricity bill without any solar consideration; and
- The lifetime costs of the solar system.

The following formula was used to estimate the ROI:

$$\text{ROI} = \frac{\text{McDonalds South Africa electrical energy savings}}{\text{Solar system cost}} \text{ X } 100$$

(Davidove and Schroeder 1992; Phillips 1996; Devarakonda 2019)

The ROI of McDonalds uMhlanga would be as follows:

$$\frac{R\ 611\ 989}{R\ 2\ 868\ 698} X\ 100 = \ 21.33\%$$

In other words, McDonalds uMhlanga would get an annual return of investment of 21.33% if they had to undertake the solar energy investment. Once the ROI was calculated, the restaurant would not only see the number of payback years, but also the total amount saved by capitalizing on solar (Marimuthu and Du Toit 2017; EduPristine 2018).

While ROI takes into account all the financial benefits and costs of going solar power, it does not consider the future value of the money being invested. That is, it does not reflect inflation, risk or the lost opportunity to invest in another form of investment, such as shares or debentures. This is frequently referred to as the ‘time value of money’.

<u>Net Present Value (NPV):</u> To resolve the limitations associated with the ROI, the Net Present Value (NPV) capital budgeting instrument was used. To calculate the NPV on McDonald's solar project, the future value (FV) for each year (which includes all the installation upfront costs plus McDonalds projected net annual utility savings and income from any incentives based on production) was divided by a discount rate (Marimuthu and Du Toit 2017; EduPristine 2018).

Table 3-2 displays the example of McDonalds uMhlanga NPV.

Table 3-2: McDonalds uMhlanga NPV table

Net Present Value							
Discount Rate	**7,0%**						
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Discount Factor	1,00	0,93	0,87	0,82	0,76	0,71	0,67
Undiscounted Cash Flow	(2 868 698)	611 989	611 989	611 989	611 989	611 989	611 989
Present Value	(2 868 698)	571 952	534 535	499 565	466 883	436 340	407 794
Net Present Value	**45 207**						
Discounted Value	-	40 037	77 454	112 424	145 106	175 649	204 195

Source: Own construction

At a discounting rate of 7%, McDonalds uMhlanga, will start to benefit from electrical energy savings from the sixth year, as by then the solar panels cost would have been recouped.

Internal Rate of Return (IRR): The last measuring instrument that the study considered was the Internal Rate of Return (IRR). The IRR is a metric used to estimate the profitability of future potential investments. The IRR is a discount rate that makes the NPV of all cash flows equal to zero in a discounted cash flow analysis. The study considers the rate of return from NPV cash flows received from a solar investment. (Marimuthu and Du Toit 2017; EduPristine 2018).

The IRR was obtained using the following formula:

$$NPV = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n}$$

NPV – Net Present Value

N – Number of years of the solar energy investment

n – Each period/year

C_n – Electrical energy savings (Cash flow)

r – Internal rate of return (IRR)

(Moten Jr and Thron 2013; Marimuthu and Du Toit 2017; Fernando 2021a)

The IRR was calculated using excel spreadsheets for the various McDonalds Drive-Thru across South Africa. Nevertheless, the calculation of the McDonalds uMhlanga Drive-Thru example would be as follows:

$$0 = \sum_{0}^{6} \frac{(R2\ 868\ 698)_0}{(1+r)^0} + \sum_{1}^{6} \frac{R611\ 989_1}{(1+r)^1} + \sum_{2}^{6} \frac{R611\ 989_2}{(1+r)^2} + \sum_{3}^{6} \frac{R611\ 989_3}{(1+r)^3} + \sum_{4}^{6} \frac{R611\ 989_4}{(1+r)^4} + \sum_{5}^{6} \frac{R611\ 989_5}{(1+r)^5} + \sum_{6}^{6} \frac{R611\ 989_6}{(1+r)^6}$$

NPV - 0

N – 6

C_n – R 611 989

r - IRR

Initial cost – R 2 868 698

The IRR on the short-run of this example, on a six year cash flow, is at 7.54%. At the aforementioned rate, the NPV of the solar energy investment will equate to zero.

3.8 Data analysis and interpretation

This study adopts the Monte Carlo method as stated in the literature review. The Monte Carlo simulation, based on the assumption that it is meaningless to have a closed solution to solve complex problems, allows for a numerical solution for the underlying problem. The use of numerical approaches gives a more comprehensive and detailed view of the investment (Gianmarco 2018).

Data gathered from the simulation process, which is the technical input of the financial simulation, starting from the solar PV watts calculator to the results which forms of the financial input of the investment appraisal were presented in a typical tabular spreadsheet manner and in graphs using Microsoft Excel. All the information from the simulations process were disclosed on the spreadsheet meeting the study’s objectives. The results from the payback period, NPV, ROI and IRR techniques indicated if this capital investment is viable in the long run.

Simulation results will be displayed firstly. The explanation of the simulation process has been provided in the earlier illustrative example. The results were presented, first, for the McDonalds South Africa as a whole and second, based on provincial dynamics, meeting the study’s aim. The variables that are expected to be constant have been discussed in the previous chapter.

3.9 Reliability of the study

Research reliability is the degree to which the research method delivers steady and consistent outcomes. A specific measure is reliable if its procedure on the same sample provides the same results on multiple attempts (Kudanga 2018; Saunders, Lewis and Thornhill 2019). To ensure reality, the researcher did not tamper with the study's findings.

The study’s financial simulation and investment appraisal has documented key business realistic and appropriate assumptions. The study’s simulation and appraisal are flexible and easy to follow. Complexity might be fun, but simplicity wins in the long run. Thus, the simplicity of this study indicates the credibility of the data obtained and simulated results. This method has been adopted and corroborated by earlier researchers such as Olivier (2015), Welsh (2017), Gianmarco (2018) and Al Garni (2018) to be reliable.

3.10 Validation of the study

The validity is described as the influence on which a study contributes to the body of knowledge to reach meaningful conclusions from the data. Validity also relates to the accuracy of the researcher’s observation (Kudanga 2018; Saunders, Lewis and Thornhill 2019).

To test the validity of the financial simulation and investment appraisal in this study, it is applied to a case study of McDonalds South Africa. According to the project's feasibility assessment, the equity internal rate of return is around 21 percent, and the payback period is around five years. The financial indicators derived from the investment appraisal was found to be consistent with the solar project's current modern value as discussed earlier.

3.11 Summary

This chapter discussed the methodology adopted by this study to achieve the research objectives and questions. It also spelt out the research design, census, data collection and analysis and development of this study. The chapter further explained the reliability and validity of the study. The positivism philosophy was adopted to guide the research study. The following chapter presents, interprets and discusses this study’s financial simulation and investment appraisal results.

CHAPTER FOUR
EMPIRICAL RESULTS

4.1 Introduction

This chapter is conducive towards analysing the financial simulations and the investment appraisal of the study. It also presents the various methods that were conducted to gather the data; it begins with how the study was developed, which progresses to McDonalds South Africa on a national level, thereafter to the provincial analysis and finally the discussion of the profitability of the solar energy investment and also the conclusion of the chapter. The solar energy investment viability and latent variables efficacy are amongst the results discussed.

4.2 Data collection

There are 125 McDonalds Drive-Thru across the nine provinces that have been simulated in this study as shown in Table 3.1 in the preceding chapter.

Solar panel simulations were used to appraise solar systems at various McDonalds Drive-Thru and their electrical energy generation. The simulator used was the PVwatts calculator from NREL. This calculator provides accurate information and estimates of how much electrical energy solar panels can produce at different conditions. The result from the energy simulation was thereafter used on the Treetops website. Treetops are a solar system installation company based nationally which provides online commercial quotes. The cost of the required solar system was thereafter derived from the Treetops website.

The information from the energy simulation was thereafter downloaded into an excel spreadsheet. The worksheet accounted for the amount of energy used at a minimum energy consumption level of 250kWh, most likely energy consumption level of 325kWh and a maximum energy consumption level of 400 kWh. The data results for both national and provincial with regards to the cost of the solar system and the electrical energy savings are attached in the appendices. The selected solar system produce used different factors such as the size, location and infrastructure which determined how much the solar system budgeted at the various Drive-Thru. The energy generated also established the amount of savings that McDonalds would recoup at the various drive-thru. Utilising the cost of the solar systems and the savings, financial information was then derived for the appraisal such as the cash flow of the investment. The study's objectives and its results are displayed as follows:

- To simulate a financial appraisal for solar energy investments at McDonalds Drive-Thru restaurants on a national level.

The first objective results are displayed in section 4.3.

- To examine the provincial dynamics of solar energy investments at McDonalds Drive-Thru restaurants.

The second objective results are displayed in section 4.4.

- To recommend a profitable solar energy investment for McDonalds Drive-Thru restaurants on a national and provincial basis.

The third objective results are displayed in section 4.5.

4.3 The simulation of financial appraisal for solar energy investments at McDonalds Drive-Thru restaurants on a national level

The descriptive statistics were used to present a summary and information in the form of percentages and graphs to analyse the feasibility of the solar investment at McDonalds.

The first objective related to the simulation of a financial appraisal for solar energy investments at McDonalds Drive-Thru restaurants on a national level. The need to provide a separate analysis for the national level is to develop a complete perspective of the solar energy investment. The study although takes into account the finer details but it also considers the ultimate outcome of the solar energy investment project (Dundjerovic 2017). Will it feasible on the larger scale in the long-run as well?

The national data was derived by the average of the numbers from all nine provinces. For instance, the results for each individual Drive-Thru, totalled for each province, then divided by the number of Drive-Thru outlets in that province. As a result, the national average data was calculated by adding all nine provinces' values and dividing them by nine.

Hence, this section displays the nationalised appraised numbers of the simulated McDonalds Drive-Thru solar energy investment.

The results begin from McDonalds South Africa thereafter moving to a provincial analysis. These are presented below:

4.3.1 Payback period

The payback period as discussed in the previous chapters indicates how long will it take for McDonalds to recoup its investment.

The normal payback period was calculated as shown below in Table 4-1 and Figure 4-1 by forecasting the average cost and savings of the solar system of McDonalds South Africa on a broader picture.

The average parameter of the solar system of McDonalds South Africa at the minimum parameter of 250 kWh costs R 2 873 126, most likely parameter at 325 kWh expenditures at R 3 734 796 and the maximum parameter at 400 kWh expenses at R 4 597 010. The average cost of the investment amounts to R 3 734 977.

The total average cash flow of R 792 368 which relates to the electrical savings is derived from the average of all nine provinces. The minimum parameter of savings amounts to R 609 527, most likely savings sums up to R 792 332 and the maximum adds up to R 975 245.

Table 4-1: McDonalds South Africa payback period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Annual utility savings	-R3 734 977	R792 368	R792 368	R792 368	R792 368	R792 368
Cumulative Cash Flow	-R3 734 977	-R2 942 609	-R2 150 241	-R1 357 873	-R565 505	R226 863

Source: Own construction

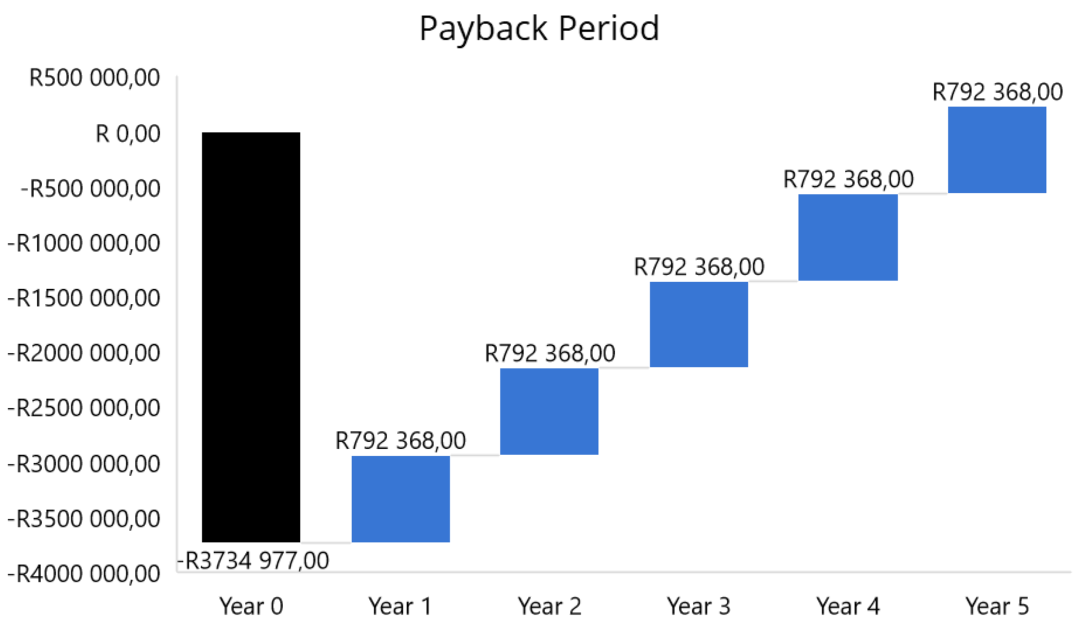


Figure 4-1: McDonalds South Africa payback period

Source: Own construction

The average normal payback period is 4.71 years which equates to 4 years 8 months 16 days for McDonalds South Africa to recoup the initial outlay.

The solar system is paid within its useful life. Therefore, greater profits can be realised with a shorter payback period which also makes it an attractive investment. With Eskom showing no signs presently to improve its service delivery, approximately a five year payback seems to be lucrative for McDonalds South Africa.

4.3.2 Average return on investment (ROI)

The ROI analysis gives an indication of the profitability percentage of an expenditure as mentioned in prior chapters. The formula is adapted and is as follows:

$$\text{ROI} = \frac{\text{McDonalds South Africa electrical energy savings}}{\text{Solar system cost}} \text{ X } 100$$

(Davidove and Schroeder 1992; Phillips 1996; Devarakonda 2019)

Hence, the average return on the solar panel's investment is at 21.21%.

$$\text{ROI} = \frac{\text{R } 792\ 368}{\text{R } 3\ 734\ 977} \text{ X } 100$$

$$= 21.21\%$$

Sunbadger, a solar company have been installing solar panels for both residential and commercial use, indicated that in the practical world that the ROI of a typical solar PV system is around 20% (Sunbadger 2021). Thus, the ROI of 21.21% is considered a worthwhile investment. The finding of a 21% return relates to not only McDonalds South Africa but to the majority of provinces as well. The ROI of 21% can be qualified as a good 'ROI' (Birken 2021). Normally, risk-averse investors would not opt for this investment but in the case of McDonalds, the return might be even greater as the scale of the investment is as such.

As discussed in chapter three, ROI has its limitations as it does not consider factors such as time value of money, inflation and to overcome this, the Net Present Value is discussed in the next section.

4.3.3 Net present value (NPV)

The NPV was used to analyse the present value of cash inflows against cash outflows over the projected timeline of the investment as mentioned earlier.

The average NPV was calculated as shown in Table 4.2 below. The average cost and savings of the solar panels estimated figures have been discussed in the previous payback period section and the figures have been used accordingly.

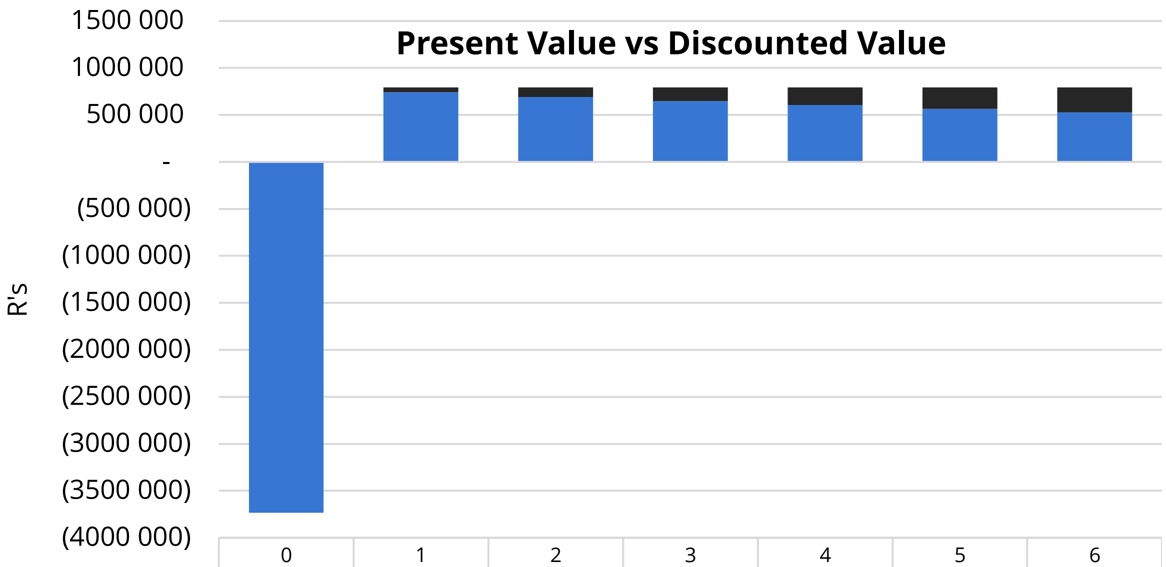
The discounting rate is constant throughout the simulations at 7% which is the prescribed interest rate (SARS 2020) as mentioned in the assumptions of the financial appraisal.

Table 4-2 shows the calculation of the average Net Present Value of the solar system for McDonalds South Africa which is thereafter portrayed in a graphical manner in figure 4-2.

Table 4-2: Net Present Value Calculation

Net Present Value							
Discount Rate	**7,0%**						
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Discount Factor	1,00	0,93	0,87	0,82	0,76	0,71	0,67
Undiscounted Cash Flow	(3 734 977)	792 368	792 368	792 368	792 368	792 368	792 368
Present Value	(3 734 977)	740 531	692 085	646 808	604 494	564 947	527 988
Net Present Value	**39 137**						
Discounted Value	-	51 837	100 283	145 560	187 874	227 421	264 380

Source: Own construction



	0	1	2	3	4	5	6
Discounted Value	-	51 837	100 283	145 560	187 874	227 421	264 380
Present Value	(3734 977)	740 531	692 085	646 808	604 494	564 947	527 988

Figure 4-2: Present Value vs Discounted value

Source: Own construction

The analysis reflects that after the 5th year of savings on electrical bills, the investment starts yielding a positive return. In other words, the discounted payback period can be said to be in between five to six years. All the positive Net Present Values are of the sixth year of the investment. Having a positive NPV indicates that the investment makes financial sense. Considering the longevity of solar panels is more than 20 years as discussed in chapter two, McDonalds will gain a great return on this investment as of the sixth year.

4.3.4 Internal rate of return (IRR)

The internal rate of return is a discount rate where the NPV of cash flows break-even as indicated in chapter three.

The average IRR of McDonalds South Africa has been calculated using the NPV at the most likely parameter as discussed in the above sections. The two scenarios considered was one where the cash flow has been discounted for six years and the other for 20 years.

The IRR has been presented in a graphical manner in figure 4-3 below:

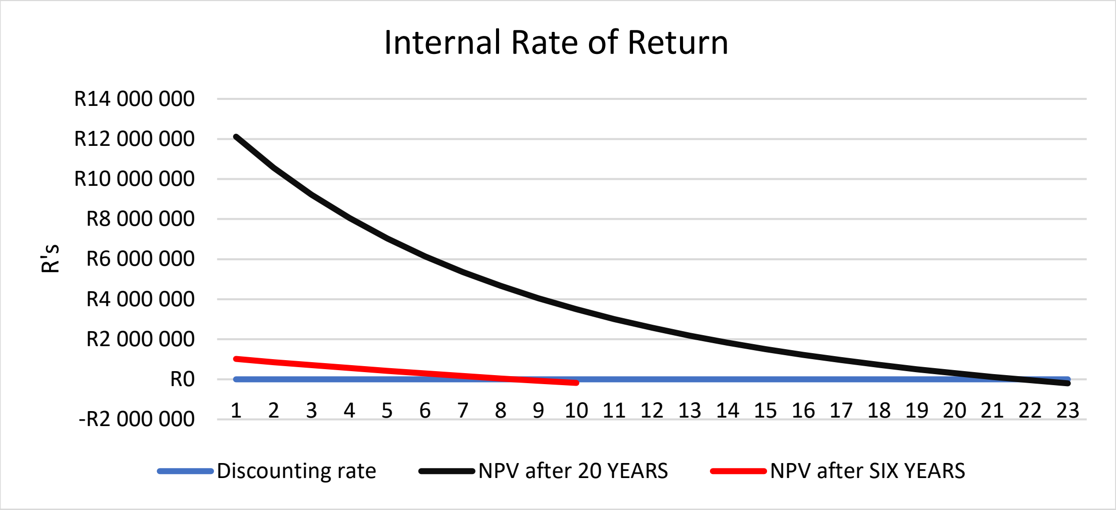


Figure 4-3: McDonalds South Africa Internal Rate of Return

Source: Own construction

The average IRR for the short run is at approximately 7.36% and the long run is 20.72%. These values are similar to all the provinces. This means that on the shorter-run, the savings returns will be slow and steady due to the recoupment of the initial investment cost and will increase in the longer-run of the project.

The national average appraisal results are feasible. With an average payback period of 4.71 years, a ROI of 21.21, a positive NPV as from the sixth year and favourable IRRs both on the long and short-term indicates that McDonalds South Africa will recoup and save on electrical energy on both the longer-run and the bigger picture.

4.4 The provincial dynamics of solar energy investments at McDonalds Drive-Thru restaurants

This section displays the second objective's results. The need for a provincial analysis was because each individual McDonalds Drive-Thru were financially simulated and appraised which were grouped under each province across South Africa. The analysis of the nine provinces are discussed below in an alphabetical provincial order commencing with McDonalds Eastern Cape and concluding with McDonalds Western Cape.

4.4.1 McDonalds Eastern Cape

Eastern Cape has 14 McDonalds Drive-Thru outlets. The average cost of the solar system in the province with a minimum parameter of R 2 974 169 at 250 kWh usage, most likely at R 3 864 083 at a 325 kWh and a maximum of R 4 758 675 at a 400 kWh usage. The province's average savings at 250 kWh is R 634 489, at 325 kWh is R 824 338 and 400 kWh is R 1 015 184.

The province's average cost of the solar investments is at R 3 865 643 compared to the national average of R 3 734 977 is above by R 130 666 but also comes with a greater average utility savings of R 824 670 compared to the national average of R 792 368 per annum. This indicates that the province is one of the coldest regions in South Africa as the solar systems costs are higher than the national average. The results of the Eastern Cape are displayed below starting with the payback period, ROI, NPV and lastly the IRR.

4.4.1.1 Average payback period

Table 4-3: McDonalds Eastern Cape average payback period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Annual utility savings	-R3 865 643	R824 670	R824 670	R824 670	R824 670	R824 670
Cumulative Cash Flow	-R3 865 643	-R3 040 973	-R2 216 303	-R1 391 633	-R566 963	R257 707

Source: Own construction

Table 4-4 displays the average payback period for the province. It resulted in an average payback period of 4.69 years for Eastern Cape. The result is similar to that of the national payback period of 4.71 years.

4.4.1.2 Average return on investment

The average return for the province on the solar panel's investment is at 21.33%.

$$\text{ROI} = \frac{\text{R } 824\ 670}{\text{R } 3\ 865\ 643} \text{ X } 100$$

$$= 21.33\%$$

The ROI of 21.33% is slightly higher to the national average ROI of 21.21%. It means that the solar investment in McDonalds Eastern Cape will yield a slightly greater return compared to the national return hence making the investment in this province look prosperous.

4.4.1.3 Net present value

Figure 4.4 displays the province's McDonalds NPV after their sixth year at a seven percent discounting rate.

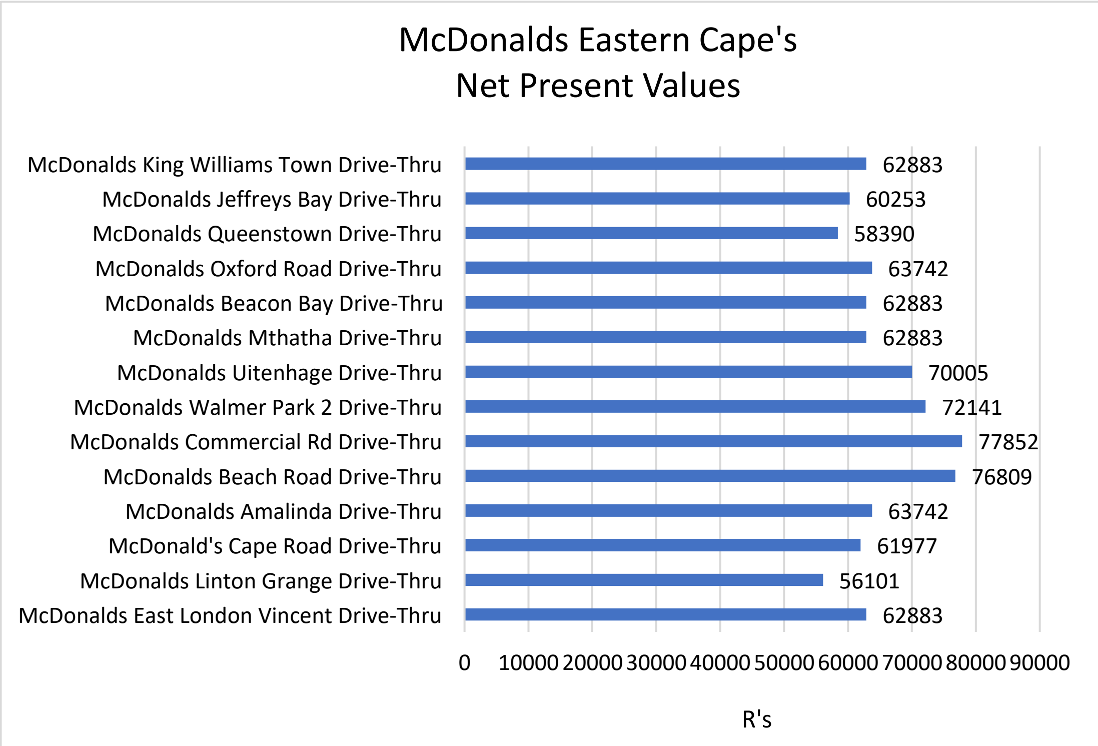


Figure 4-4: McDonalds Eastern Cape's Net Present Values

Source: Own construction

With greater average cost and savings, all 14 outlets' NPV are higher than the national average of R39 137. The average NPV of the province is R65 182, the lowest NPV of R 56 101 at McDonald's Linton Grange in Eastern Cape to the highest of R 77 852 at the Commercial Road Drive-Thru in Eastern Cape, thus making this solar investment lucrative for the province.

4.4.1.4 Internal rate of return

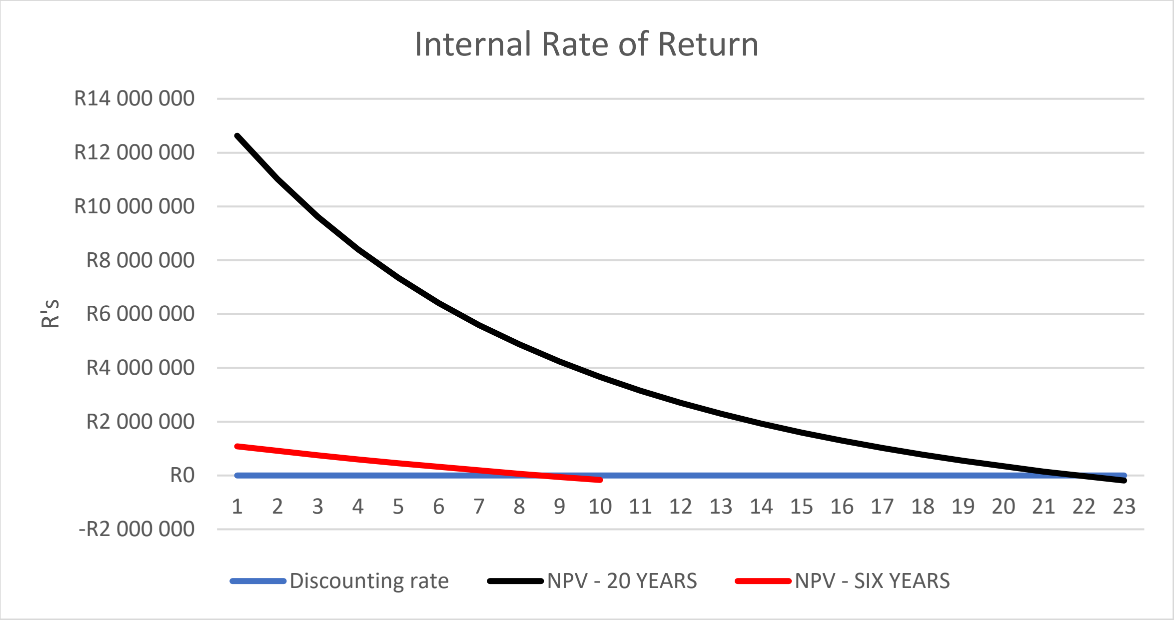


Figure 4-5: McDonalds Eastern Cape IRR

Source: Own construction

Figure 4-5 shows McDonalds electrical energy savings after the initial outlay at multiple discounting rates. The IRR discounts at 7.54% with a six year cash flow considered and on the longer-term with 20 year cash flow considered, it discounts at 20.85%. The short-run IRR of 7.54% is slightly higher than the national IRR of 7.36% and the longer-run IRR of 20.85% is also higher than the national IRR of 20.72%. This indicates that the solar investment in the province is viable.

With a payback period, ROI, average NPV and both short and long-term IRR, all the four appraisal techniques are higher than that of the national results, Eastern Cape should accept and make the solar energy investment as the above indicators proved the investment to be viable.

4.4.2 McDonalds Free State

McDonalds Free State has only three Drive Thru in the province and within close proximity which resulted in similar results as shown in the sections below.

The minimum parameter cost of the panels are R 2 868 698, most likely R 3 729 323 and maximum of R 4 589 930. The average cost of the system is R 3 729 317. The savings on the other hand amount to a minimum parameter of R 611 989, most likely of R 795 589 and a maximum of R 979 185. The average savings summed up to R 795 588. The provincial average cost is slightly lower than that of the national average of R 3 734 977 and vice-versa for the savings as mentioned as R 795 588 compared to the national of R 792 368. Having more or less the same average cost compared to the national average shows that the weather in the Free State province is more likely a typical South African climate.

4.4.2.1 Average payback period

Table 4-4: McDonalds Free State average payback period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Annual utility savings	-R3 729 317	R795 588	R795 588	R795 588	R795 588	R795 588
Cumulative Cash Flow	-R3 729 317	-R2 933 729	-R2 138 141	-R1 342 553	-R546 965	R248 623

Source: Own construction

Table 4-5 displays the province's average payback period resulting in a less than five year period. Free State's average payback period equates to 4.68 years. It is more or less on par with that of the national average payback of 4.71 years. With only three McDonalds in the province and simulated the same results show that the investment is still feasible despite the number of restaurants.

4.4.2.2 Average return on investment

The average return for the province on the solar panel's investment is at 21.3%.

$$\text{ROI} = \frac{\text{R } 795\ 588}{\text{R } 3\ 729\ 317} \text{ X } 100$$

$$= 21.3\%$$

Free State's average ROI is slightly more than half percent higher than that of the national average ROI of 20.72%. The province results indicate that the investment will yield a great return for the Drive-Thru during its useful life.

4.4.2.3 Net present value

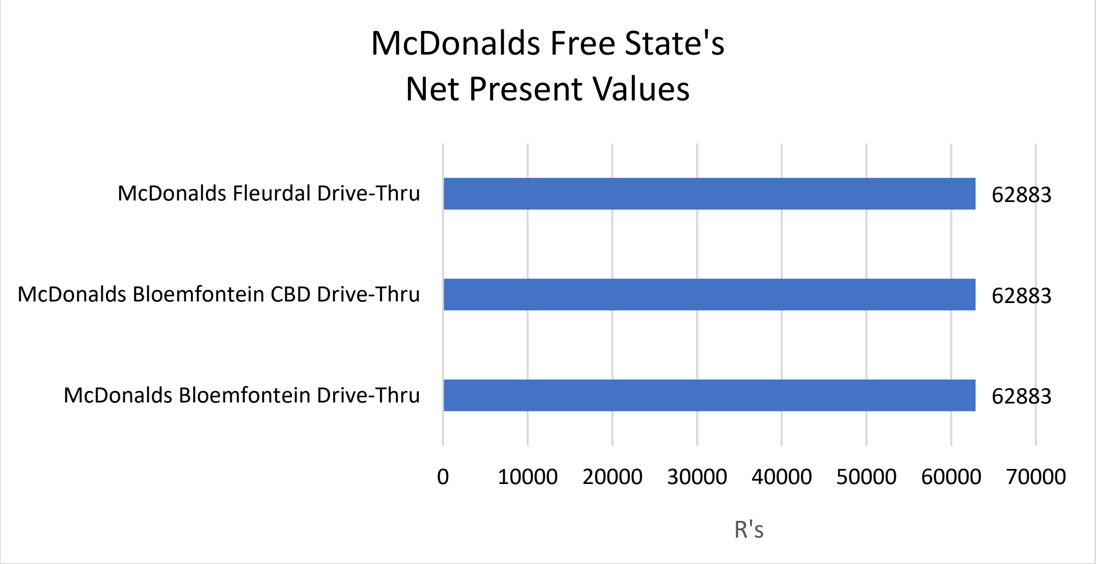


Figure 4-6: McDonalds Free State's Net Present Values

Source: Own construction

Figure 4-6 shows the province's individual outlets' NPV in their sixth year after a seven percent discounting factor. All three being within a close proximity is more likely the reason for the same results. All three Drive-Thru outlets are showing a positive NPV after the sixth year, which indicates that it is a profitable investment on the longer run considering the average lifespan of the panels.

4.4.2.4 Internal rate of return

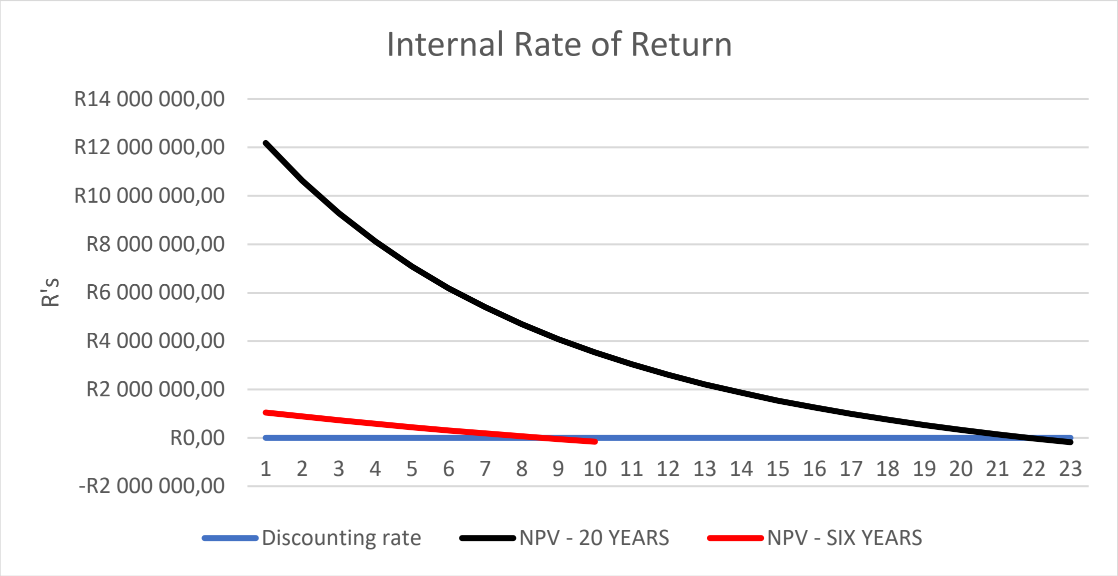


Figure 4-7: McDonalds Free State IRR

Source: Own construction

Figure 4-7 demonstrates Free State's internal rate of return on a six year cash flow and on a 20 year cash flow after taking into account the cost of the solar system. The IRR on the shorter term equates to a discounting rate of more or less 7.5% compared to the national of 7.36% and the longer term equates to 20.8% as compared to the national of 20.72%. Both the province's short and long-run's IRR are slightly higher than the national average. This indicates the solar investment will recoup a great return both in the short and longer term.

The results of Free State have been more likely on par with the national results. The payback period and ROI is similar to the national whilst the NPV and the IRR both short and long-term are slightly higher than the national. This indicates that Free State should accept and consider the solar energy investment for the McDonalds Drive-Thru in the province.

4.4.3 McDonalds Gauteng

Gauteng is the capital province of South Africa. The province has 27 McDonalds Drive-Thru. It is the smallest province of the country. Due to its small radius, the results are similar due to many being within the same vicinity.

The capital's average parameter cost ranges from R 2 953 453, most likely of R 3 839 502 to a maximum of R 4 725 535. The savings range from R 630 070, most likely of R 819 094 to R 1 008 114. The average cost approximates around R 3 839 497 and the average savings sums up to R 819 093. The cost and savings direct that the capital province is likely to be one of South Africa's coldest regions.

4.4.3.1 Average payback period

Table 4-5: McDonalds Gauteng average payback period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Annual utility savings	-R3 839 497	R819 093	R819 093	R819 093	R819 093	R819 093
Cumulative Cash Flow	-R3 839 497	-R3 020 404	-R2 201 311	-R1 382 218	-R563 125	R255 968

Source: Own construction

Table 4-6 displays McDonalds Gauteng's payback period. The payback period is 4.69 years which is relatively the same as of the national average payback period of 4.71 years. Gauteng has the second greatest number of McDonalds Drive Thru in South Africa hence this investment on a larger scale in this province will be much more fruitful.

4.4.3.2 Average return on investment

The average return for Gauteng on the solar panel's investment is calculated at 21.33%.

$$\text{ROI} = \frac{\text{R } 819\ 093}{\text{R } 3\ 839\ 497} \text{ X } 100$$

$$= 21.33\%$$

Gauteng’s ROI is a fraction higher than the national ROI average of 21.21% which indicates that the solar investment as well as taking into account the environment’s welfare is also proving out to be profitable.

4.4.3.3 Net present value

Figure 4-8 below shows the NPV values after six years with a discounting factor of seven percent.

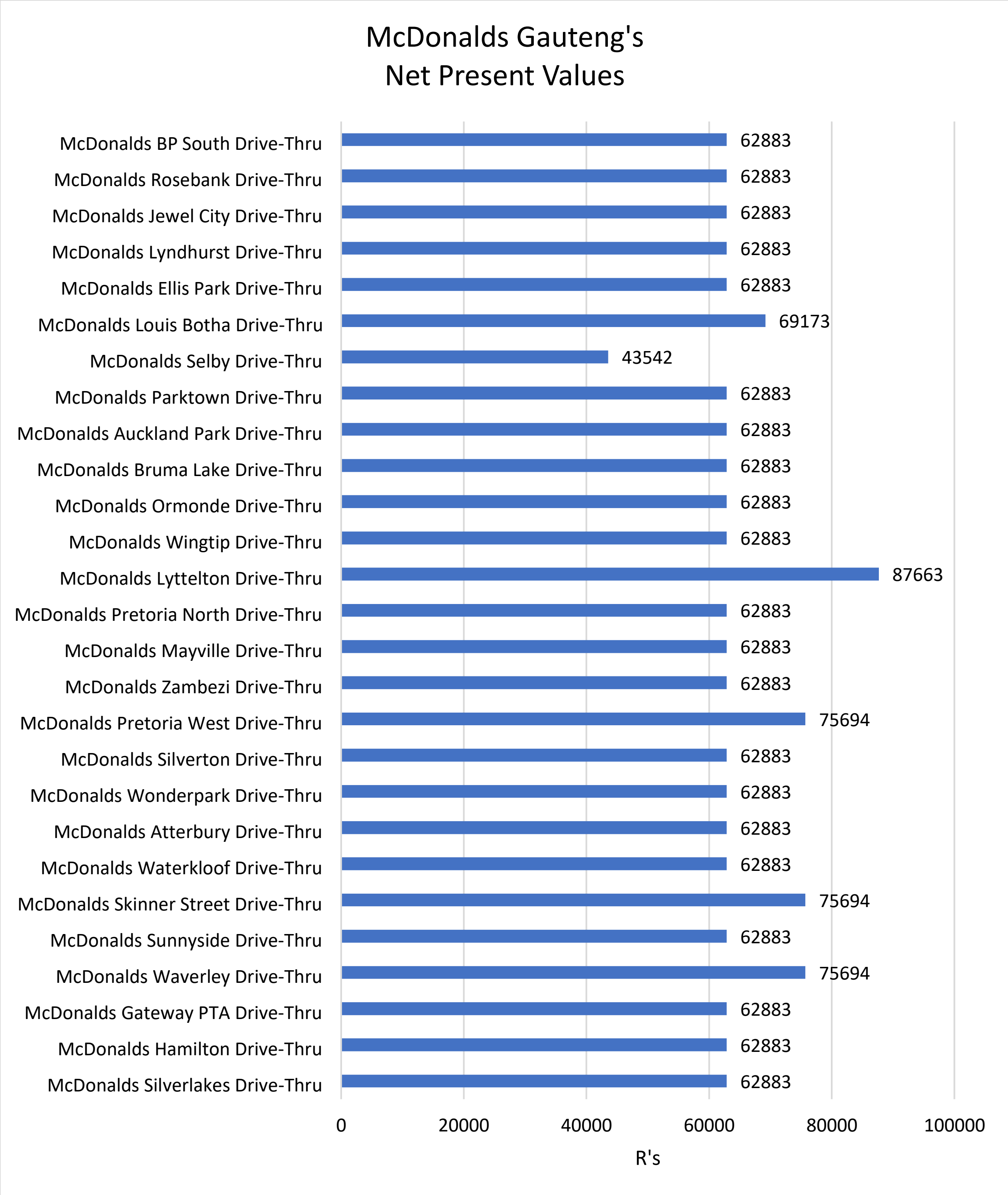


Figure 4-8: McDonalds Gauteng's Net Present Values

Source: Own construction

The results presented in Figure 4.8 shows that the province's cost and savings exceed that of the national average. All the 27 Drive-Thru outlets have a positive NPV after a six year cash flow. The lowest NPV value for Gauteng is R 43 542 which comes from the McDonalds Selby Drive-Thru whilst the highest NPV comes from McDonalds Lytteleton Drive-Thru with a figure of R 87 663. With relatively an average of R 64 741 positive NPV, the investment is still highly practical for Gauteng.

4.4.3.4 Internal rate of return

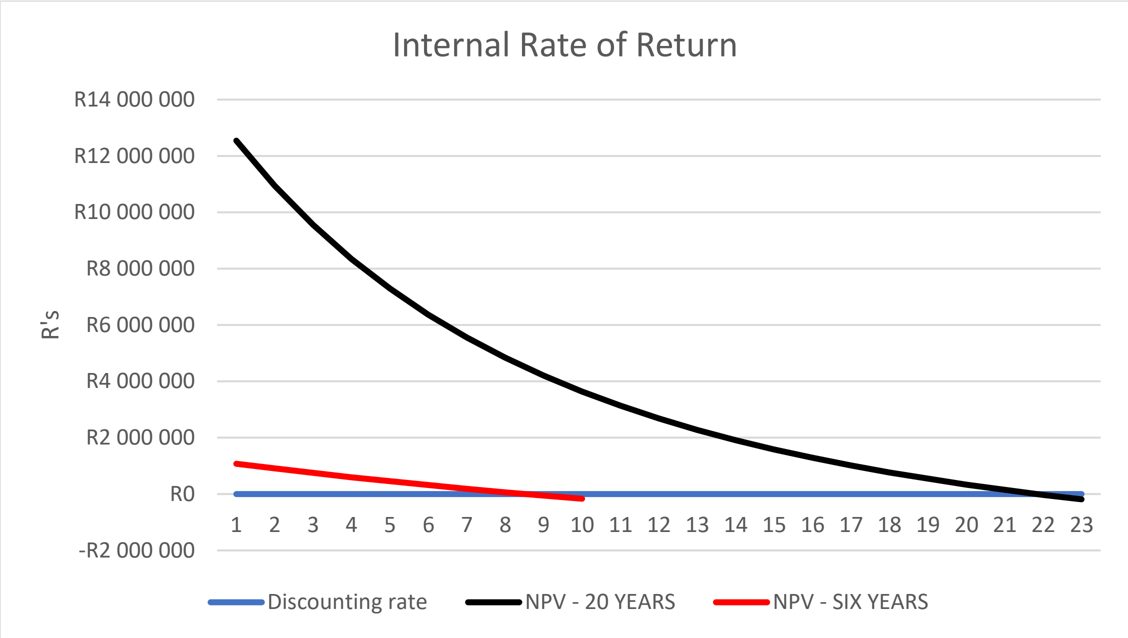


Figure 4-9: McDonalds Gauteng IRR

Source: Own construction

Figure 4-9 displays Gauteng's IRR for a six year cash and a 20 year cash flow. The red line representing the six year cash flow touches the x-axis at a discounting rate of 7.54% compared to the national average of 7.36% whilst the black line which is the 20 year cash flow dashes the x-axis at a rate of 20.85% compared to the national of 20.72%. These results demonstrate that the province's IRR both short and long term is higher than that of the national IRR indicating an advisable opportunity to invest in solar energy.

Gauteng has the second highest McDonalds Drive-Thru outlets across South Africa. With such a number, and positive indicators and results mentioned above, the solar investment should be accepted as it will turn out to be beneficial.

4.4.4 McDonalds KwaZulu-Natal

KwaZulu-Natal (KZN) is one of the largest economic hub in the country (Moodley, Mahlangeni and Reddy 2021). It has 19 McDonald's Drive Thru outlets. KZN's average minimum cost parameter is R 2 872 347, most likely is R 3 733 904 and maximum parameter at R 4 595 765. The average savings of the province at 250 kWh is R 582 107, at 325 kWh is R 756 742 and at 400 kWh is 931 374. Both the average cost of R 3 734 005 compared to the national of R 3 734 977 and savings of R 756 741 compared to the national of R 792 368 are slightly under the national average. This indicates that KZN is likely to be a representative of South Africa's typical humid temperature.

4.4.4.1 Average payback period

Table 4-6: McDonalds KZN average payback period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Annual utility savings	-R3 734 005	R756 741	R756 741	R756 741	R756 741	R756 741
Cumulative Cash Flow	-R3 734 005	-R2 977 264	-R2 220 523	-R1 463 782	-R707 041	R49 700

Source: Own construction

Table 4-7 illustrates KZN's average payback period. The average payback period is 4.93 years which is longer than the national average of 4.71 years. However, it is still under five years and considering the longevity of the solar panels, it is still a beneficial investment to McDonalds KZN.

4.4.4.2 Average return on investment

The average return for KZN on the solar panel's investment is calculated at 20.27%.

$$\text{ROI} = \frac{\text{R 756 741}}{\text{R 3 734 005}} \text{ X } 100$$

$$= 20.27\%$$

KZN's average ROI is a percent lower (compared) to the country's ROI of 21.21%. However, a 20% ROI is still a rewarding investment as the electrical energy savings over the future years will exceed the initial outlay.

4.4.4.3 Net present value

Figure 4-10 shows KZN McDonalds NPV's after 6 years of utility savings at seven percent discounting rate.

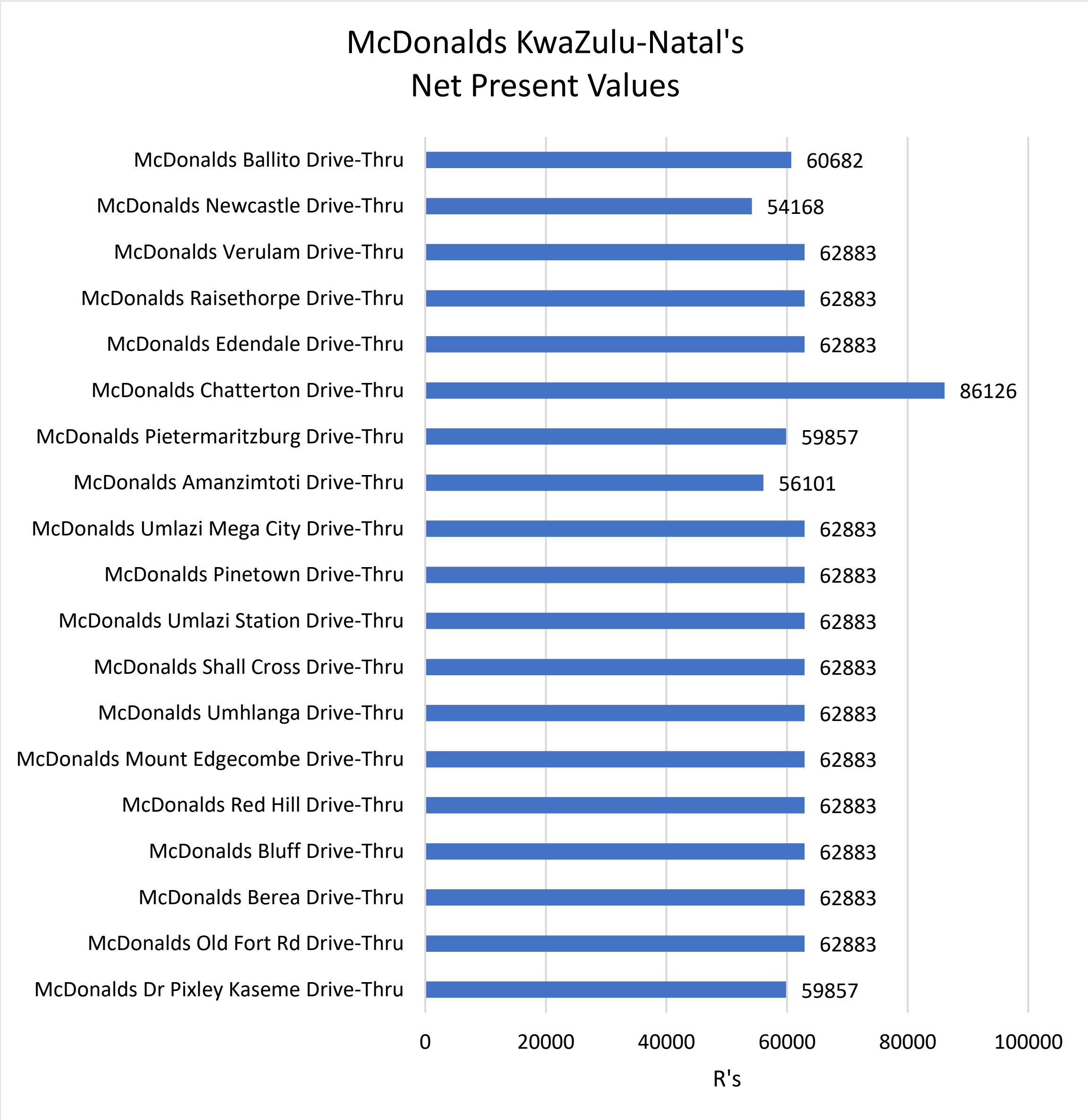


Figure 4-10: McDonalds KZN's Net Present Values

Source: Own construction

KwaZulu-Natal's NPVs are all positive which indicates that the solar energy investment for the Drive-Thru will be advisable to take on the investment. There are many Drive-Thru outlets within the same radius and temperature which resulted in similar outcomes.

4.4.4.4 Internal rate of return

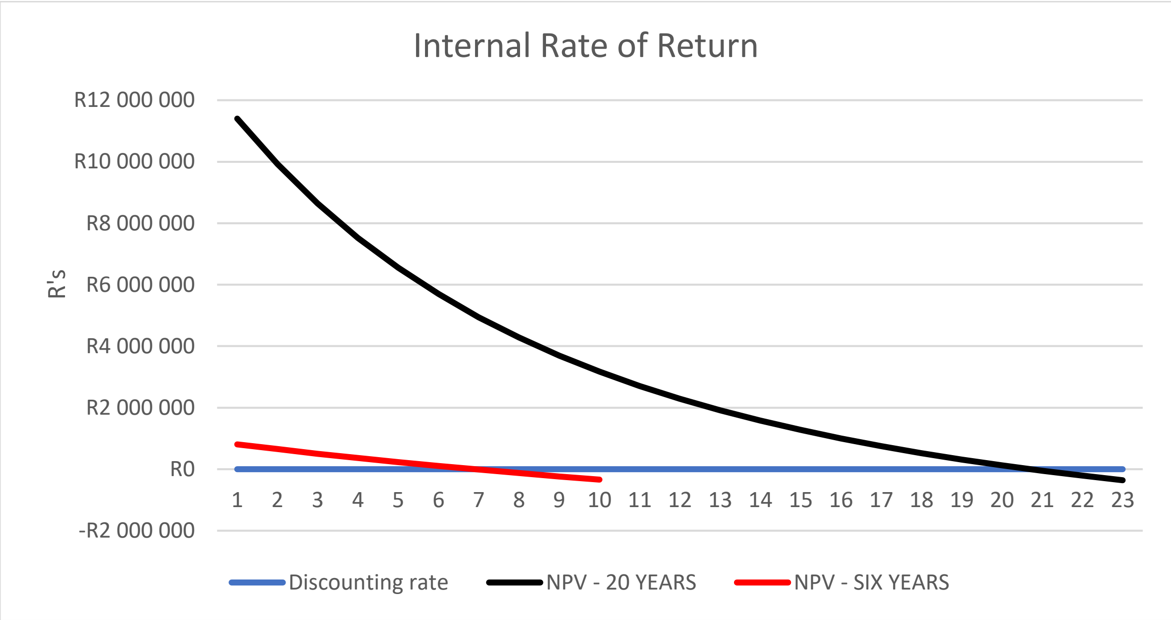


Figure 4-11: McDonalds KZN IRR

Source: Own construction

Figure 4-11 displays KZN's IRR on the short-term and the long-term. The IRR discounts at 5.89% on the short-term compared to the national of 7.36% and 19.71% on the long-term compared to the national of 20.72%. McDonalds KZN's IRR is below the national average IRR but is still an attractive savings as the return rates are still favourable both on the short and long-term.

Despite having a longer payback period, lower ROI and IRR compared to the national average, the investment is still feasible for the province. All the Drive-Thru NPV's are positive hence the decision is to accept the solar energy investment at McDonalds KZN.

4.4.5 McDonalds Limpopo

McDonalds Limpopo has seven Drive Thru outlets in the province. The results demonstrate that Limpopo's cost of the solar system is at a minimum of R 2 944 548, most likely at R 3 827 922 and a maximum of R 4 711 248. The utility savings ranges from a minimal of R 628 170, most likely of R 816 623 to a maximum of R 1 005 074. Limpopo's average cost of R 3 827 918 as compared to the national average of R 3 734 977 and savings of R 816 623 as compared to the national average of R 792 368 just exceeds the national average which indicates that the province turns out to be a warm province.

4.4.5.1 Average Payback period

Table 4-7: McDonalds Limpopo average payback period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Annual utility savings	-R3 827 918	R816 623	R816 623	R816 623	R816 623	R816 623
Cumulative Cash Flow	-R3 827 918	-R3 011 295	-R2 194 672	-R1 378 049	-R561 426	R255 197

Source: Own construction

Table 4-8 demonstrates Limpopo's average payback period which results in 4.69 years which is a mirror image to the national average payback period of 4.71 years, therefore this is a favourable indication for the province.

4.4.5.2 Average return on investment

The average return for Limpopo on the solar energy investment is calculated at 21.33%.

$$\text{ROI} = \frac{\text{R } 816\ 623}{\text{R } 3\ 827\ 918} \text{ X } 100$$

$$= 21.33\%$$

The province’s average ROI is slightly higher than McDonalds South Africa’s ROI average of 21.21%. The reason being due to higher electrical energy savings over the estimated financial life of the solar panels.

4.4.5.3 Net present value

Figure 4-12 shows Limpopo’s NPV figures for the individual McDonalds after six years of cash flow and the investment at a discounting rate of seven percent.

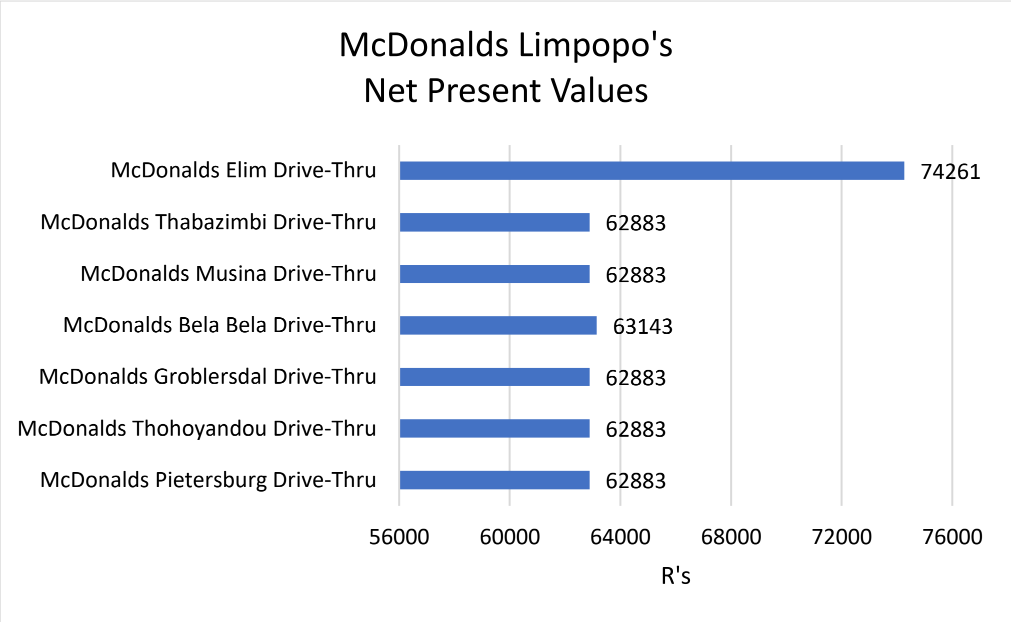


Figure 4-12: McDonalds Limpopo's Net Present Values

Source: Own construction

Figure 4-12 illustrates McDonalds Limpopo’s NPVs. The results are similar as the majority of the Drive-Thru are within the same radius. All seven Drive-Thru NPVs are positive hence the investment should be considered.

4.4.5.4 Internal rate of return

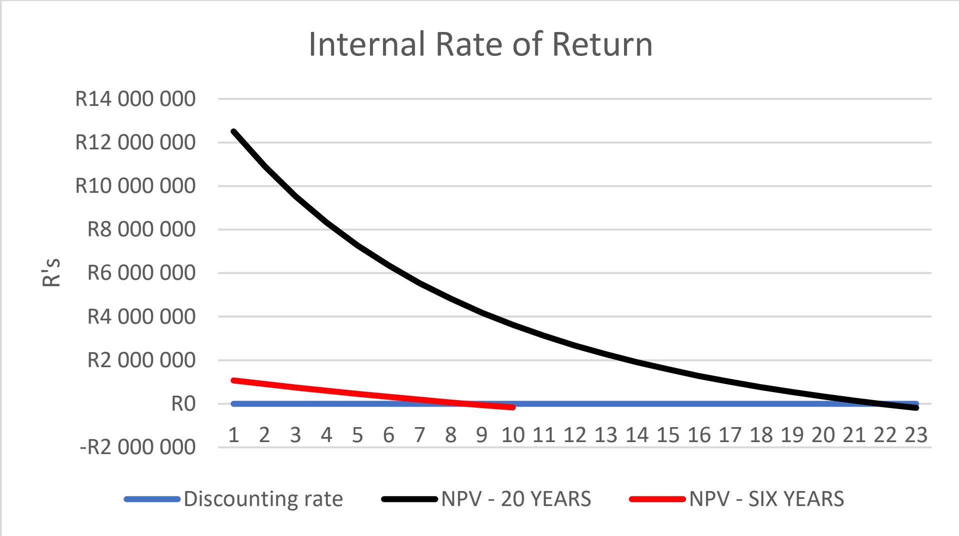


Figure 4-13: McDonalds Limpopo IRR

Source: Own construction

Figure 4-13 represents McDonalds Limpopo's IRR on the short-term and the long-term. The IRR discounts at a rate of 7.54% compared to the national of 7.36% on the short-run and 20.85% compared to the national average of 20.72% on the long-run. It exceeds the McDonalds South Africa IRR on both timelines hence showing to be of a worthy investment.

The above indications speaks for itself when compared to the national average. The solar energy investment at McDonalds Limpopo should be considered and accepted as it is highly beneficial to the province as it results in a good payback period, ROI and IRR. To add on, the NPV's of the Drive-Thru are all positive as of the sixth year.

4.4.6 McDonalds Mpumalanga

The province has 11 McDonalds Drive Thru outlets. The average cost of the province at 250kWh is R 2 918 921, most likely at R 3 794 610 and at 400kWh is R 4 670 284. The minimum cash flow of the investment is R 622 703, most likely R 809 517 and maximum is R 996 327. Both the provincial cost of R 3 794 605 compared to the national average cost of R 3 734 977 and savings of R 809 516 compared to the national savings of R 792 368 are just above the national average. With similar kind of climate, which is notably humid, 90% of the results are analogous.

4.4.6.1 Average Payback period

Table 4-8: McDonalds Mpumalanga average payback period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Annual utility savings	-R3 794 605	R809 516	R809 516	R809 516	R809 516	R809 516
Cumulative Cash Flow	-R3 794 605	-R2 985 089	-R2 175 573	-R1 366 057	-R556 541	R252 975

Source: Own construction

Table 4-9 illustrates Mpumalanga's average payback period. The average payback period is 4.69 years. It is on par with the national average payback period of 4.71 years. Time is considered as a risk factor and the province's 4.69 years shows to be low-risk.

4.4.6.2 Average return on investment

The average ROI for the province on the solar panel's investment is calculated at 21.33%.

$$\text{ROI} = \frac{\text{R } 809\ 516}{\text{R } 3\ 794\ 605} \text{ X } 100$$

$$= 21.33\%$$

Mpumalanga's ROI is to some extent higher than the national ROI average of 21.21% which shows that the solar investment and factoring green energy is also proving to be a pleasant venture.

4.4.6.3 Net present value

Figure 4-14 below displays Mpumalanga's 11 McDonalds Drive Thru NPV's after 6 years of cash flow from the investment at a discounting factor of seven percent.

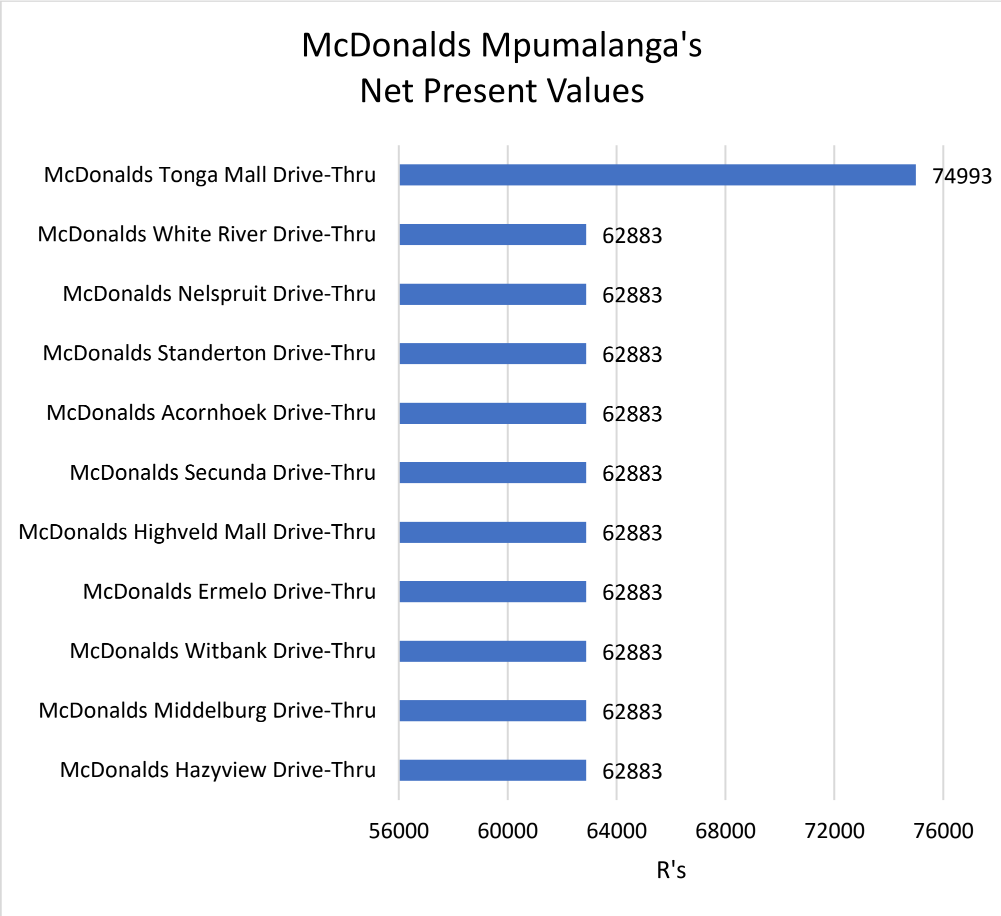


Figure 4-14: McDonalds Mpumalanga's Net Present Values

Source: Own construction

Figure 4-14 illustrates the NPV values after six years with a discounting factor of seven percent. The province's NPVs are all positive which indicates that the solar energy investment for the Drive-Thru is feasible. There are many Drive-Thru within similar distances which resulted in parallel conclusions.

4.4.6.4 Internal rate of return

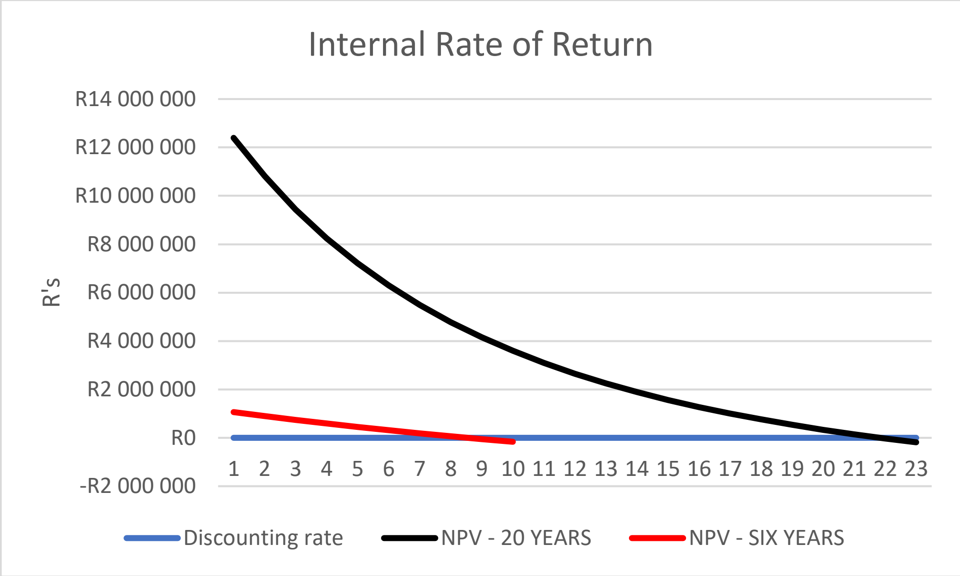


Figure 4-15: McDonalds Mpumalanga IRR

Source: Own construction

Figure 4-15 displays Mpumalanga's IRR for a six year cash and a 20 year cash flow. The six year cash flow intercepts the x-axis at a discounting rate of 7.54% whilst the 20 year cash flow cuts the x-axis at a rate of 20.85%. The province's short-term IRR of 7.54% compared to the national average of 7.36% and long term IRR of 20.85% compared to the national average of 20.72%. Thus, the results are higher than that of the national IRR indicating a suitable opening to invest in solar energy.

With a risk averse payback period, favourable ROI, positive NPV's and good IRR's, all four indicators are either on par or slightly above the national average, the solar energy investment should be accepted at all Drive-Thru in Mpumalanga.

4.4.7 McDonalds Northern Cape

McDonalds Northern Cape has only five Drive Thru outlets. The province's minimum solar cost is R 2 705 712, most likely R 3 517 434 and maximum is R 4 329 146. The minimum utility savings on the other hand adds up to R 577 219, most likely R 750 386 and maximum of R 923 551. Both the average cost of R 3 517 431 compared to the national cost of R 3734 977 and savings of R 750 385 compared to the national average savings of R 792 368 are marginally lower than that of the average which indicates that Northern Cape is more likely a warm and dry region.

4.4.7.1 Average payback period

Table 4-9: McDonalds Northern Cape average payback period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Annual utility savings	-R3 517 431	R750 385	R750 385	R750 385	R750 385	R750 385
Cumulative Cash Flow	-R3 517 431	-R2 767 046	-R2 016 661	-R1 266 276	-R515 891	R234 494

Source: Own construction

Table 4-10 shows Northern Cape's average payback period. It results in a payback period of 4.69 years which is similar to that of the national average payback period of 4.71 years. Although it has only five McDonalds Drive-Thru, it yields a great crop of the investments.

4.4.7.2 Average return on investment

The average return for the Northern Cape on the solar panel's investment is at 21.33%.

$$\text{ROI} = \frac{\text{R 750 385}}{\text{R 3 517 431}} \text{ X } 100$$

$$= 21.33\%$$

The results show that the ROI is 21.33%, which just peaks above the national average ROI of 21.21%. It means that the solar energy investment will result in a slightly better return compared to the national return hence making the investment in this province look convincing.

4.4.7.3 Net present value

Figure 4-16 shows the province's Drive Thru NPV's after six years of utility savings at a discounting rate of seven percent.

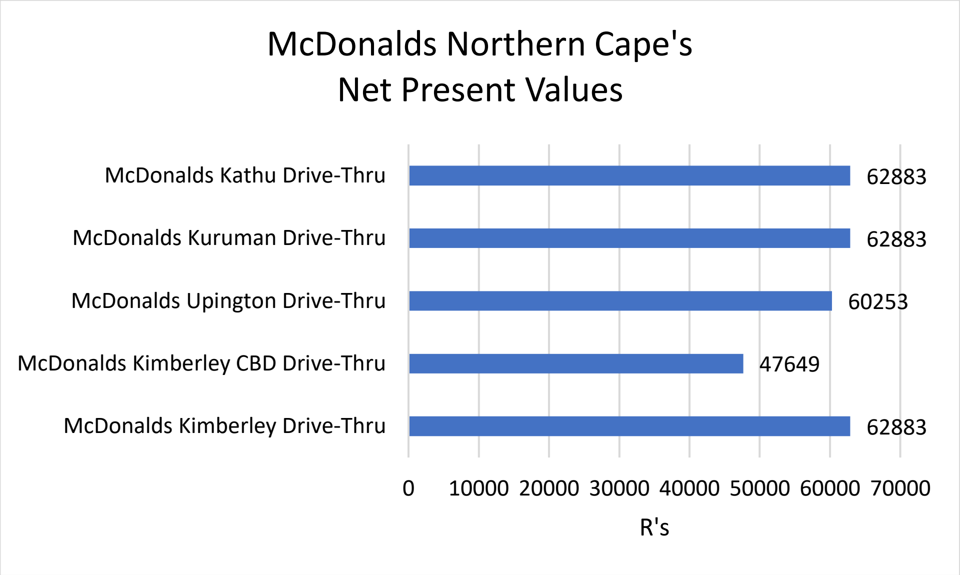


Figure 4-16: McDonalds Northern Cape's Net Present Values

Source: Own construction

With lower average cost and savings, all the five NPV's are close to the national average of R39 137. The lowest NPV of R 47 649 at McDonald's Kimberly CBD in Northern Cape to the highest of R 62 883 at three out of five Drive-Thru in Northern Cape, consequently making this solar energy a sound investment for the province.

4.4.7.4 Internal rate of return

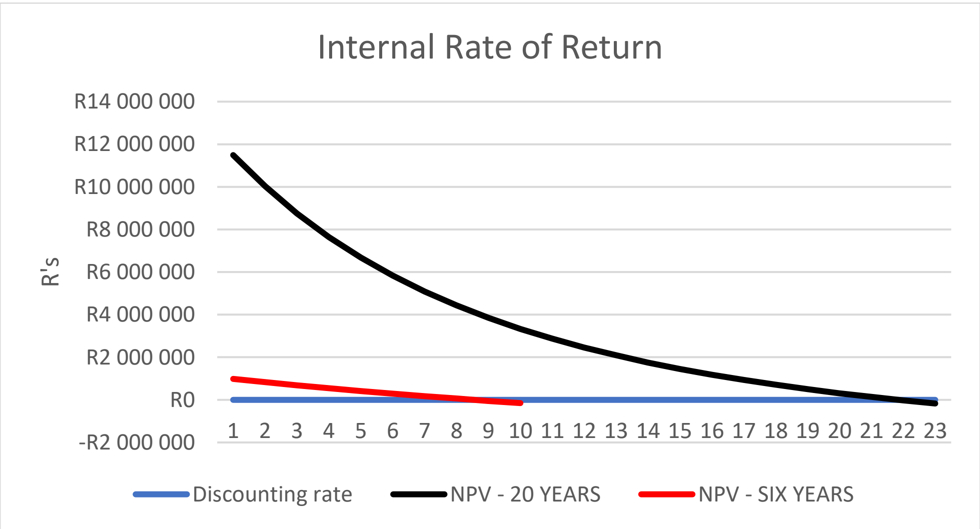


Figure 4-17: McDonalds Northern Cape IRR

Source: Own construction

Figure 4-17 illustrates the internal rate of return on a six year cash flow and on a 20 year cash flow after taking into account the solar investment cost. The IRR on the shorter-run equates to a discounting rate of more or less 7.5% compared to the national average of 7.36% and the longer-run equates to 20.8% compared to the national average of 20.72%. Both Northern Cape's short and long-term's IRR are similar to that of the national average.

The results as mentioned above are similar to that of the national average. All indicators of the investment appraisal are showing that solar energy investment in Northern Cape is worthwhile and should be accepted.

4.4.8 McDonalds North West

The province has 11 McDonalds Drive Thru outlets. The minimum cost of the solar system is R 2 811 467, most likely is R 3 654 917 and maximum is R 4 498 355. The minimum utility savings is R 599 780, most likely is R 799 716 and maximum is R 959 649. The average local cost of R 3 654 913 compared to the national average cost of R 3 734 977 and savings of R 779 715 compared to the national average savings of R 792 368 is less than the national average thus indicating that North West seems to be of a hot temperature.

4.4.8.1 Average payback period

Table 4-10: McDonalds North West average payback period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Annual utility savings	-R3 654 913	R779 715	R779 715	R779 715	R779 715	R779 715
Cumulative Cash Flow	-R3 654 913	-R2 875 198	-R2 095 483	-R1 315 768	-R536 053	R243 662

Source: Own construction

Table 4-11 illustrates North West's average payback period. The average payback period is 4.6 years which is similar to the national average of 4.71 years. However, the payback period of the outlets in the province is still under five years, proving to be a valuable investment to North West.

4.4.8.2 Average return on investment

The average return for North West on the solar panel energy investment is estimated at 21.33%.

$$\text{ROI} = \frac{\text{R } 779\ 715}{\text{R } 3\ 654\ 913} \text{ X } 100$$

$$= 21.33\%$$

North West’s average ROI is higher compared to that of McDonalds South Africa’s average ROI of 21.21%. Nevertheless, a 20% ROI is still a fulfilling investment as the electrical energy savings over the future years will exceed the initial cost.

4.4.8.3 Net present value

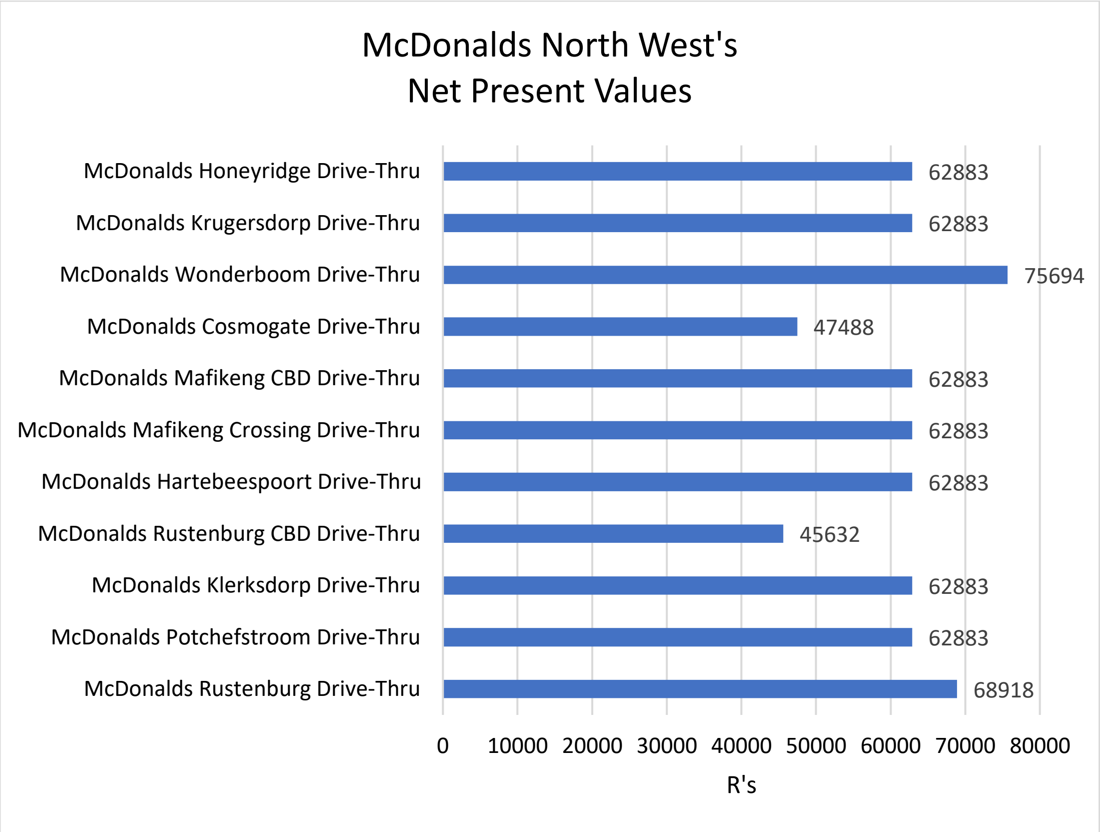


Figure 4-18: McDonalds North West's Net Present Values

Source: Own construction

The results varied from NPV's of R 45 632 to R 75 964 after six years at a discounting rate of seven percent as shown in Figure 4-18. The NPV of all the 11 Drive-Thru outlets are positive hence the investment should be considered and accepted.

4.4.8.4 Internal rate of return

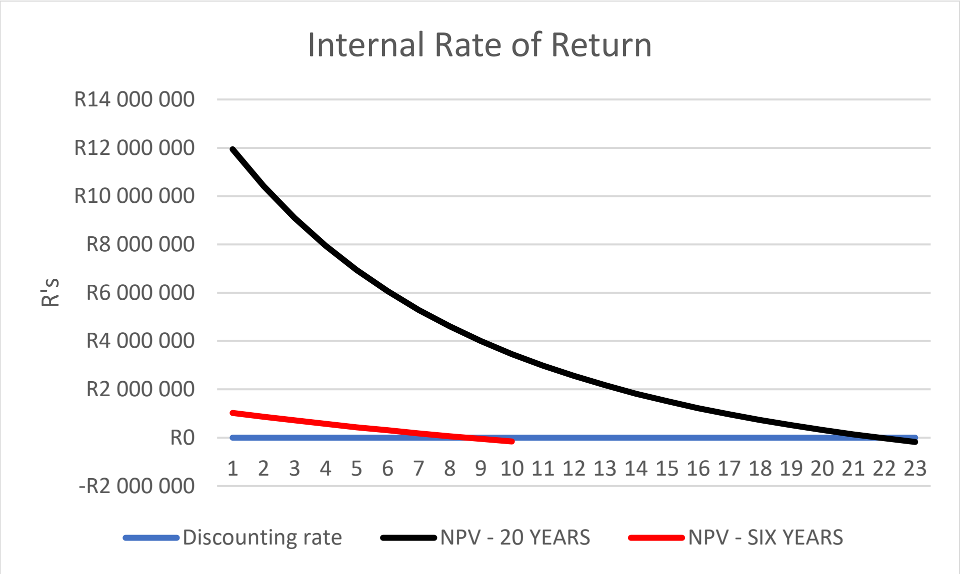


Figure 4-19: McDonalds North West IRR

Source: Own construction

Figure 4-19 represents McDonalds North West's IRR on the short-term and the long-term. The IRR discounts at a rate of 7.54% compared to the national average of 7.36% on the short-run and 20.85% compared to the national average of 20.72% on the long-run. It exceeds the McDonalds South Africa IRR for both short and long-run.

The results demonstrate that McDonalds North West should accept the solar energy investment as the numbers above does show that the investment can increase all the Drive-Thru electrical energy savings and cash flows. Most of the results are parallel to the results of the national average.

4.4.9 McDonalds Western Cape

The Western Cape has the highest number of McDonald's Drive Thru outlets with 28 throughout the province. The minimum cost at 250 kWh is R 2 808 821, at 325 kWh is R 3 651 468 and at 400 kWh is R 4 494 115. The minimum savings adds up to R 599 215, most likely to R 778 980 and maximum to R 958 745. The province's average cost is R 3 651 468 compared to the national cost of R 3 734 977 and the average savings sums up to R 778 980 compared to the national average savings of R 792 368 which is just under par compared to the national average showing that climate of the province is typical South African.

4.4.9.1 Average payback period

Table 4-11: McDonalds Western Cape average payback period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Annual utility savings	-R3 651 468	R778 980	R778 980	R778 980	R778 980	R778 980
Cumulative Cash Flow	-R3 651 468	-R2 872 488	-R2 080 120	-R1 287 752	-R495 384	R296 984

Source: Own construction

Table 4-12 displays the province's average payback period resulting in a less than five year period. Western Cape's average payback period estimates to 4.69 years. It is more or less the same as that of the national average payback of 4.71 years.

4.4.9.2 Average return on investment

The average ROI for Western Cape on the solar panel's investment is calculated at 21.33% as follows:

$$\text{ROI} = \frac{\text{R 778 980}}{\text{R 3 651 468}} \text{ X 100}$$

$$= 21.33\%$$

Western Cape's ROI is a fraction higher than the national ROI average of 21.21%, which indicates that the solar investment is worthwhile which can also help to contribute to decrease its share of carbon emissions.

4.4.9.3 Net present value

Figure 4-20 below shows the 28 Drive Thru NPV's after the sixth year of investment with a discounting of seven percent. The results demonstrate that Western Cape's NPVs are all positive which indicates that the solar energy investment for the Drive-Thru will be advisable to take on the investment. There are many Drive-Thru within close proximity.

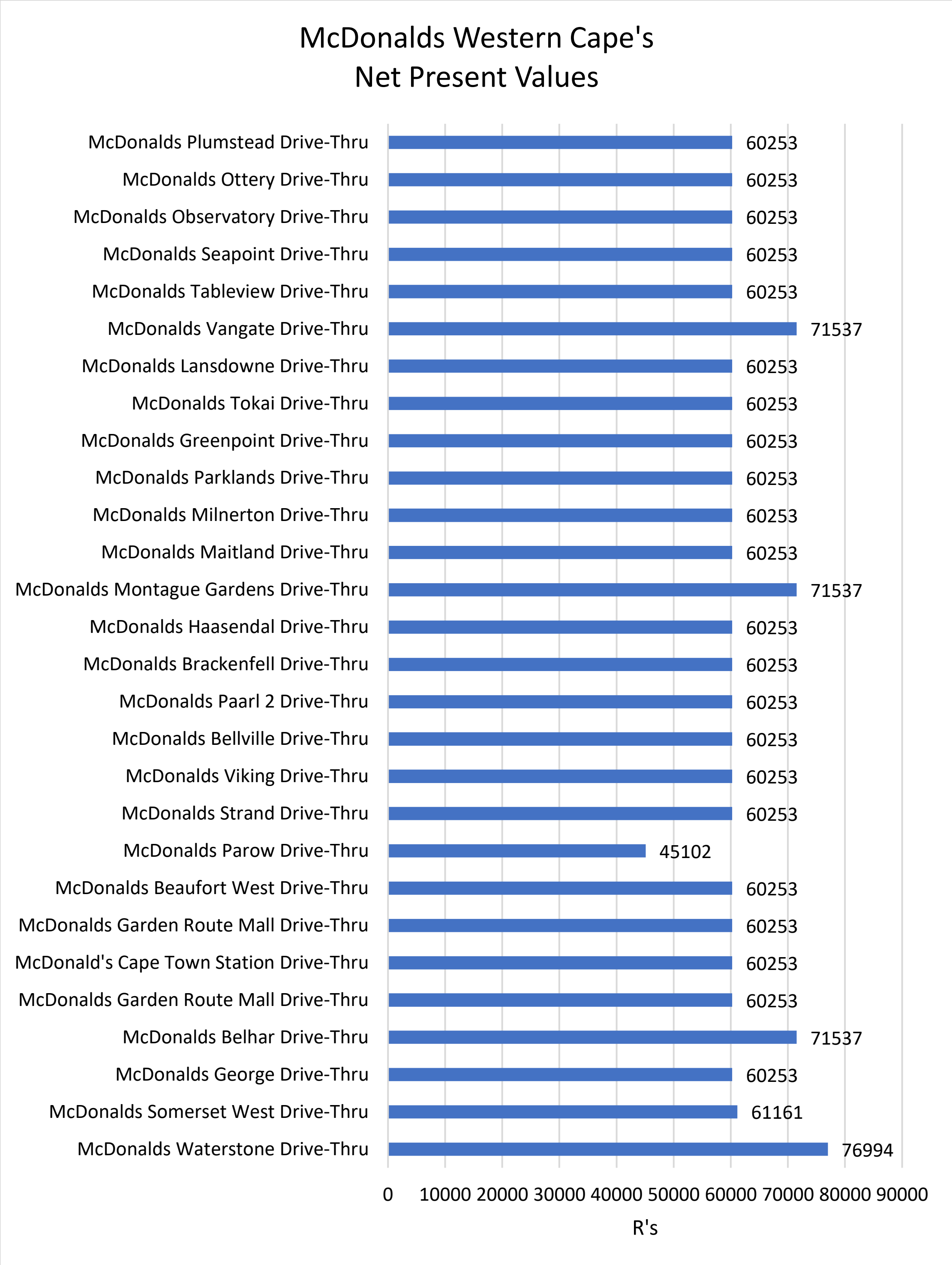


Figure 4-20: McDonalds Western Cape's Net Present Values

Source: Own construction

4.4.9.4 Internal rate of return

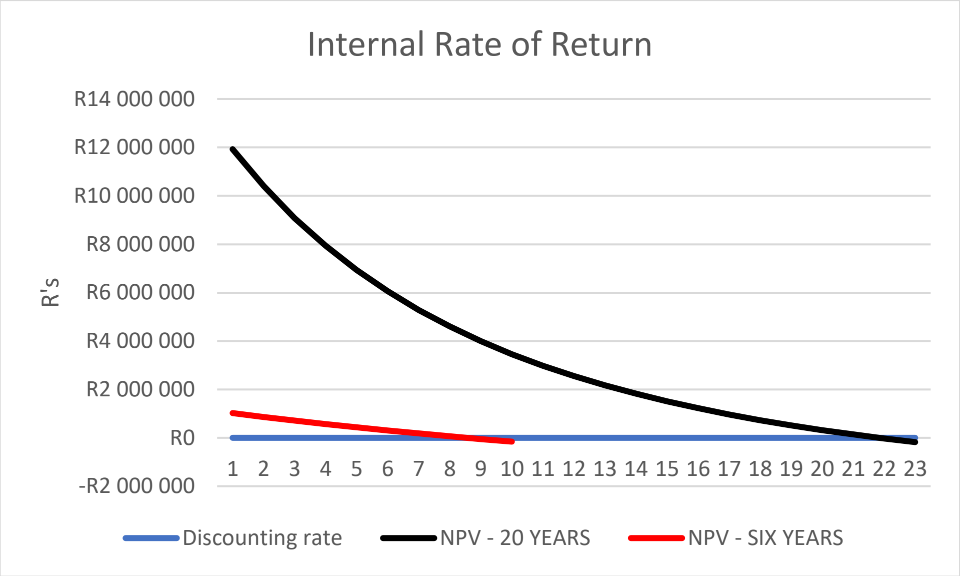


Figure 4-21: McDonalds Western Cape IRR

Source: Own construction

Figure 4-21 illustrates McDonalds Western Cape's IRR on the short-term and the long-run. The IRR discounts at a rate of 7.5% compared to the national average of 7.36% on the short-term and 20.8% compared to the national average of 20.72% on the longer-term. It exceeds the McDonalds South Africa IRR on both occasions hence proving to be of a fruitful investment.

The results show that McDonalds Western Cape has the highest number of Drive-Thru across South Africa. The solar energy investment should be accepted as the above indicators show how viable the investment is in the province despite having such a large number of Drive-Thru restaurants.

4.5 Profitable solar energy investment for McDonalds Drive-Thru restaurants on a national and provincial basis

This section covers the third objective which is to recommend a profitable solar energy investment for McDonalds Drive-Thru restaurants on a national and provincial basis.

Table 4-12: Capital investment decision

McDonalds	Payback period	ROI	AVERAGE NPV	IRR (Short-term)	IRR (Long-term)	Decision
South Africa (National)	4,71 Years	21,21%	R39 137	7,36%	20,72%	Accept
Eastern Cape	4,69 Years	21,33%	R65 182	7,54%	20,85%	Accept
Free State	4,68 Years	21,3%	R62 883	7,5%	20,8%	Accept
Gauteng	4,69 Years	21,33%	R64 741	7,54%	20,85%	Accept
KZN	4,93 Years	20,27%	R62 856	5,89%	19,71%	Accept
Limpopo	4,69 Years	21,33%	R64 546	7,54%	20,85%	Accept
Mpumalanga	4,69 Years	21,33%	R63 984	7,54%	20,85%	Accept
Northern Cape	4,69 Years	21,33%	R59 310	7,5%	20,8%	Accept
North West	4,6 Years	21,33%	R61 628	7,54%	20,85%	Accept
Western Cape	4,69 Years	21,33%	R61 551	7,5%	20,8%	Accept

Source: Own construction

Table 4-3 illustrates the appraised results on a national and provincial basis. The quickest payback period on a provincial level is the North West with 4.6 years and the longest is KZN with 4.93 years. The national payback period is 4.71 years. It can also be said that the investment will take close to five years to break-even. With similar and good payback periods, approximately just under five years, throughout the nine provinces and nationally indicates that the solar energy investment is not much of a risk.

The ROI on a national basis sum up to 21.21%, whilst on a provincial basis, the lowest is at KZN with 20.27% and the highest is practically at seven of the nine provinces at 21.33%. The ROIs of the national average and the provinces are all above 20% proving to be a fruitful return on the solar energy investment.

Since all the NPVs are positive as of their sixth year, at a discounting factor of seven percent accounting for time value of money, McDonalds South Africa and all the provinces should go ahead with solar energy investment considering the 20 year life span. Despite the fact that, the national NPV is the lowest compared to all the provinces, it is still positive and will turn out to be profitable in the longer-run.

Lastly the IRR both on the short-term and long-term indicates that greater savings and cash flow will increase as the time goes by. Despite KZN having the lowest IRR, it is still a risk adverse and profitable investment both on a small and big scale.

The financial simulation and the investment appraisal in this study contributes to the current knowledge base of the South African fast-food industry and it can be used as a tool to financially evaluate solar power. The other financial benefits of this appraisal are explained below:

Electrical energy is a semi-variable cost to McDonalds South Africa. A semi-variable cost contains both a fixed and variable cost. The cost varies during different periods of production and demand (Marimuthu and Du Toit 2017). This will lead to cost savings on electrical energy consumption and increased profitability.

This appraisal can lead to a business expansion. Such expansion of an organisation occurs when it has reached a point of growth and is looking for new ways to make more profit (Arensberg 2018). The study's investment appraisal can contribute to McDonalds South Africa's business plan, expansion and financial analysis as the investment can bring in another stream of cash flow.

Benchmarking is the process of determining essential business practices and areas of improvement which are compared to that of relative market competitors (Torun, Peconick, Sobreiro, Kimura and Pique 2018). This financial appraisal can benefit McDonalds South Africa to lead ahead of its industry peers.

The net amount of cash being moved in and out of an organisation is referred to as cash flow. A cash inflow relates to monies received whilst monies spent are referred as outflows (Hayes 2021). The investment shows an initial huge amount of cash outflow, referring to the results in the following chapter, however the study's appraisement displays that the cash flows saved which is the electrical energy spending exceeds that cash outflow. It is actually an additional source of cash flow for McDonalds other than its main operating activity.

One of the options McDonalds can explore is to approach the Sustainable Energy Fund for Africa (SEFA) which is managed by the African Development Bank (2021) to access funds. SEFA provides financial support to private sector investments in green energy. The investment appraisal also forecasts as to what quantum may be required by McDonalds South Africa to undertake this investment hence it can help to establish a funding strategy.

An added advantage of this study's simulations and appraisal is its accessibility and simplicity, which allows any researcher to assess the profitability of any solar energy project and then optimise it to achieve a profitable project configuration. The correctness of any appraisal is determined by whether the data utilised is current and accurate, just as the profitability of any project is determined by time. Another advantage is that this simulation and appraisal gives McDonalds a futuristic financial performance view of installing solar panels.

However, the drawback of this appraisal is that it is based on a variety of assumptions which indicates that the financial simulation and investment appraisal is vulnerable to manipulation. At the end of the day, it is meaningless to have a closed solution to solve complex problems, hence the Monte Carlo adopted allows for a numerical solution for the underlying problem and try to budget and get the numbers as accurate as possible (Gianmarco 2018).

This study recommends that McDonalds South Africa and all provinces should accept the solar energy investment as it proves out to be a profitable investment based on the financial simulation and appraised results.

4.6 Summary

The chapter introduced the study, developed the study's financial simulation process and displayed the various results of the investment appraisal. This study would contribute to the body of knowledge as it has not been done before in the context of the South African fast food industry.

With equal and favourable payback periods across the nine provinces, it appears that investing in solar energy is not a risky proposition. The national average and the provinces' ROIs are all above 20%, indicating a profitable return on investment. At a discounting factor of 7% to account for time value of money, all of the NPVs are positive as of the sixth year. Finally, both the short-term and long-term IRRs imply that as time passes, more savings and cash flow will be generated. McDonald's South Africa and all provinces should approve the solar energy investment because the appraised results show that it is likely to be a lucrative investment.

The next chapter provides the summary of the major results and the conclusions to the entire research, based on the aims and objectives of the research. It also provides recommendations by the researcher.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

The great Archbishop Desmond Tutu once said; *"Do your little bit of good where you are; it's those little bits of good put together that overwhelm the world."*
It all starts with a small step in the right direction, lead the scene and keep it green!

5.1 Introduction

This chapter brings the study to a close by presenting a summary of previous chapters. Thereafter the appraised results are highlighted to address the research objectives. The chapter concludes with recommendations, limitations of the study and suggestions for future research.

5.2 Summary of study

The introductory chapter set the tone for the rest of the thesis. It provided an introduction and background to the study describing the problem statement, the research objectives and questions, the study's significance and the organisation of the thesis.

The second chapter started with a review of renewable energy sources and solar panels from different geographical perspectives. The discussion then followed reviews on the fast-food sector alongside McDonalds fast-food restaurants. It also discussed the different factors that influence electrical energy usage and a financial perspective. It then concluded by underlining the study's adopted theories.

The third chapter discussed the methodology aspect used by the researcher to meet the objectives of the study. The chapter examined the various methods adopted and as to why. The investment appraisal and the financial simulation process was also conversed. The study was an explorative quantitative study in nature.

The fourth chapter presented and discussed the study's appraised results. The study simulated a census of 125 McDonalds Drive-Thru across the nine provinces in South Africa. It started off discussing McDonalds South Africa then moving on to a provincial basis. The results were presented in several ways such as in numerical tables and bar graphs.

5.3 Conclusions

This study contributes to the knowledge base on solar energy and its financial appraisal in the South African fast-food sector. The hybrid of the financial simulation and investment appraisal can be used as a tool to evaluate solar energy and influence business decisions.

South Africa experiences long periods of sunshine, receives many more hours of sunlight during the year than most countries due to its tropical climate. The investment in solar panels will therefore be beneficial to McDonalds because of the availability of abundant solar energy in South Africa.

In the study's case of the profitability on the solar energy investment, the Monte Carlo method allowed a reasonable estimation on the selected simulated outputs. This study's financial appraisal was based on methods such as the Payback period, Return on investment, Net Present Value and the Internal Rate of Return. The Monte Carlo simulation, based on the assumption that it is meaningless to have a closed solution to solve complex problems. This allows for a numerical solution for the underlying problem. The theory in this sense helps the study's appraisal to produce realistic outputs and determines the investment's feasibility on a varied range.

The summary of the results of the study's objectives are explained below:

- **Objective one:** To simulate a financial appraisal for solar energy investments at McDonalds Drive-Thru restaurants on a national level

  The simplicity of the financial simulation process and the investment appraisal have been discussed in both chapter two and three. It simulated solar energy investments at 125 McDonalds Drive-Thru across South Africa. The results on a national level are displayed in chapter four.

  The national average cost of the solar energy panels varied from a minimum consumption of 250 kWh at R 2 873 216, most likely of 325 kWh at R 3 734 796 and maximum consumption of 400 kWh at R 4 597 010. The national average energy savings on the other side varied from a minimum consumption of R 609 527, mostly likely consumption of R 792 332 and a maximum consumption of R 975 245.

The study's displayed the analysis in to two sections notably the national and provincial analysis. The national analysis was to bring a much broader view as to how feasible the solar energy investment is and narrowing it to down to the provincial's McDonalds Drive-Thru which forms part of the study's second objective.

- **Objective two:** Examine the provincial dynamics of solar energy investments at McDonalds Drive-Thru restaurants

The results indicated that the solar energy is feasible for all 125 McDonalds Drive-Thru in the nine provinces as the payback period was reasonable throughout, an optimistic average ROI, all NPV's were positive as of the sixth year and the short and long-term IRRs imply that savings and cash flow will increase with time.

The findings further showed that the solar energy initial outlay and electrical energy savings varied with the different parameters used in the study. The provinces average solar energy cost varied from a minimum average consumption at R 2 705 712 from Northern Cape to a maximum consumption cost at R 4 578 675 from Eastern Cape. The provinces average electrical savings at a minimum consumption level sums up to R 577 219 from Northern Cape to a maximum consumption level of R 1 015 184.

Eskom's commercial tariff was used making the estimated numbers of the electrical energy savings and the cost of the solar system more realistic and accurate. The tariff remained constant throughout the appraisal.

The different geographical areas numbers also differed from one another due to different weather in different areas. For instance, at a minimum consumption level of 250kWh, whilst the Eskom tariff remained constant, the cost of the solar system at Gauteng is R 2 953 454 whilst at Western Cape, the cost is R 2 808 821. The cost varies irrespective of being at the same consumption level, but due to the weather conditions and the availability of sunlight in that particular area.

- **Objective three: Recommend a profitable solar energy investment for McDonalds Drive-Thru restaurants on a national and provincial basis**

  The results revealed that solar energy appears to be a risk-free investment, with equal and favourable payback periods nationwide. The national average, as well as the ROIs of the provinces, are all above 20%, indicating a healthy return on investment. As of the sixth year, all of the NPVs are positive when discounting factor of 7% was applied to account for time value of money. The IRR displayed those greater long-term profits can be realised as compared to the short-term. The financial study's results suggest that the solar energy investment is a worthy investment, McDonalds South Africa and all provinces should accept and undertake the investment in solar energy.

5.4 Recommendations

Based on the findings of the study, the following recommendations are provided:

The financial simulation and investment appraisal in this study, as presented namely in chapters three and four, can be useful to McDonalds, other fast-food restaurants, other business, governmental sectors and by other researchers.

It is recommended, as presented and discussed in section 4.5, that McDonalds place emphasis on energy management which uses electrical energy-efficient measures and its own generation. It is evident that McDonalds is a huge consumer and has the ability of turning all its buildings into Net-Zero Energy buildings.

It is further recommended based on the study's findings that South Africa needs a much more capable and innovative electrical energy supplier. Eskom needs to switch from coal to other renewable sources as the energy crisis in South Africa is not improving alongside with the challenges brought about by COVID-19.

5.5 Contribution to knowledge

This study's primary contribution is to add new knowledge to the limited literature on the financial aspect of solar energy in South Africa's fast-food industry.

Solar energy and its feasibility have not been investigated in South Africa's fast-food industry. Thus, this study's financial simulation and investment appraisal will contribute to the knowledge in this field.

Given the study's results, the solar energy seems to be a sound investment for McDonalds. This type of investigation and the study's financial simulation and investment appraisal can be adapted accordingly. This could assist the private and commercial sector in determining the worthiness of solar energy investments.

5.6 Limitations of the study

It is vital to highlight the study's numerous limitations in order to improve future research in the field. Whilst this study covers a wide range of scenarios and attributes, some McDonalds locations may have had weather, shade, roof slopes, and orientations that were inconsistent with a simulated situation. Another limitation of this study is that it is solely based on PV systems that are mounted on the roof and does not apply to PV systems that are installed on the ground. The study was also limited to South Africa's McDonalds Corporation.

The emphasis of this study has been mainly on the investment of solar energy at McDonalds South Africa. However, it is worth noting that hidden costs associated with this solar investment must be acknowledged, even if they are not accounted for in the methods used.

Another limitation to mention in terms of the financial analysis is the approach. A fixed discounting rate was considered and implemented for the solar system's useful life, according to the methodology and assumptions of the study. This implies that the capital structure remained unchanged. This setup prevents one from profiting from transitory fluctuations such as interest rates, market returns, inflation and deflation. After the initial estimate, there is no room for lowering the cost of capital, which can raise the level of future discounted cash flows. This is critical, particularly owing to the fact that the capital structure should be viewed as a variable that affects the external interest rate environment.

Capital budget viability is when the techniques is able to work successfully in the real financial world and not just theoretically. As this study makes use of simulations, it assumes that the financial simulation and investment appraisal can be modified and adapted according to the real world.

Finally, no thought was given to the ecological issues. This means that the environmental costs and benefits of investing in solar energy were not taken into account by the study.

5.7 Suggestions for further research

The study has financially simulated and appraised solar energy investment for McDonalds South Africa and established the groundwork for future research on the subject of financial appraisal of solar energy. Research could be conducted in the following areas:

- Financially appraise other renewable energies in a South African context.

- Investigate how electrical energy is used by different appliances in fast-foods and how it can be managed in order to increase energy efficiency.

- Financial analysis of Eskom switching from coal-based energy to renewable energy.

- Investigation on the impact that the energy crisis has had on the South African economy.

- Investigate the impact that load-shedding has on businesses and how it affects its productivity.

- It would be interesting to financially integrate solar PV into an energy-mix, the demand pattern and market prices to determine feasibility of the investment.

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APPENDICES

APPENDIX ONE: National data results

Table 0 - 1: National Cost data results

McDonalds South Africa	Average Cost (parameter)			Average Cost
	250 kWh	325 kWh	400 kWh	
Eastern Cape	R2 974 169,49	R3 864 082,99	R4 758 675,35	R3 865 642,61
Free State	R2 868 698,25	R3 729 323,25	R4 589 929,69	R3 729 317,06
Gauteng	R2 953 453,50	R3 839 501,54	R4 725 535,42	R3 839 496,95
KZN	R2 872 347,39	R3 733 903,73	R4 595 764,64	R3 734 005,25
Limpopo	R2 944 548,08	R3 827 922,19	R4 711 284,38	R3 827 918,21
Mpumalanga	R2 918 920,57	R3 794 610,34	R4 670 284,09	R3 794 605,00
Northern Cape	R2 705 712,08	R3 517 434,26	R4 329 146,25	R3 517 430,86
North West	R2 811 466,50	R3 654 916,93	R4 498 354,69	R3 654 912,71
Western Cape	R2 808 821,15	R3 651 468,25	R4 494 115,35	R3 651 468,25
	R2 873 126	R3 734 796	R4 597 010	R3 734 977

Source: Own Construction

Table 0 - 2: National Energy savings data results

McDonalds South Africa	Average savings (parameter)			Average savings
	250 kWh	325 kWh	400 kWh	
Eastern Cape	R634 489,50	R824 337,71	R1 015 184,07	R824 670,43
Free State	R611 989,00	R795 589,00	R979 185,00	R795 587,67
Gauteng	R630 070,11	R819 093,78	R1 008 114,22	R819 092,70
KZN	R582 107,26	R756 741,63	R931 373,47	R756 740,79
Limpopo	R628 170,29	R816 623,43	R1 005 074,00	R816 622,57
Mpumalanga	R622 703,09	R809 516,91	R996 327,27	R809 515,76
Northern Cape	R577 218,60	R750 386,00	R923 551,20	R750 385,27
North West	R599 779,55	R779 715,64	R959 649,00	R779 714,73
Western Cape	R599 215,18	R778 979,89	R958 744,61	R778 979,89
	R609 527	R792 332	R975 245	R792 368

Source: Own Construction

APPENDIX TWO: Provincial data results

Table 0 - 3: Eastern Cape's Cost data results

McDonalds Eastern Cape

	Solar system cost			Average cost
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds East London Vincent Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Linton Grange Drive-Thru	R2 559 295	R3 327 080	R4 094 873	R3 327 083
McDonalds Cape Road Drive-Thru	R2 827 374	R3 675 586	R4 523 789	R3 675 583
McDonalds Amalinda Drive-Thru	R2 907 872	R3 780 235	R4 652 597	R3 780 234
McDonalds Beach Road Drive-Thru	R3 504 009	R4 555 209	R5 606 423	R4 555 214
McDonalds Commercial Rd Drive-Thru	R3 551 573	R4 617 047	R5 682 516	R4 617 045
McDonalds Walmer Park 2 Drive-Thru	R3 291 071	R4 278 399	R5 265 713	R4 278 394
McDonalds Uitenhage Drive-Thru	R3 202 027	R4 129 833	R5 123 240	R4 151 700
McDonalds Mthatha Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Beacon Bay Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Oxford Road Drive-Thru	R2 907 872	R3 780 235	R4 652 597	R3 780 234
McDonalds Queenstown Drive-Thru	R2 663 756	R3 462 895	R4 262 016	R3 462 889
McDonalds Jeffreys Bay Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds King Williams Town Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
	R2 974 169	R3 864 083	R4 758 675	R3 865 643

Source: Own Construction

Table 0 - 4: Eastern Cape's Energy savings data results

McDonalds Eastern Cape

	Electrical energy savings			Average Savings
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds East London Vincent Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Linton Grange Drive-Thru	R545 983	R709 777	R873 573	R709 778
McDonalds Cape Road Drive-Thru	R603 173	R784 125	R965 075	R784 124
McDonalds Amalinda Drive-Thru	R620 346	R806 450	R992 554	R806 450
McDonalds Beach Road Drive-Thru	R747 522	R971 778	R1 196 037	R971 779
McDonalds Commercial Rd Drive-Thru	R757 669	R984 970	R1 212 270	R984 970
McDonalds Walmer Park 2 Drive-Thru	R702 095	R912 725	R1 123 352	R912 724
McDonalds Uitenhage Drive-Thru	R683 099	R881 031	R1 092 958	R885 696
McDonalds Mthatha Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Beacon Bay Drive-Thru	R611 989	R795 589	R979 185	R795 588

McDonalds Oxford Road Drive-Thru	R620 346	R806 450	R992 554	R806 450
McDonalds Queenstown Drive-Thru	R568 268	R738 751	R909 230	R738 750
McDonalds Jeffreys Bay Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds King Williams Town Drive-Thru	R611 989	R795 589	R979 185	R795 588
	R634 490	R824 338	R1 015 184	R824 670

Source: Own Construction

Table 0 - 5: Free State's Cost data results

McDonalds Free State				
	Solar system cost			**Average cost**
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Bloemfontein Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Bloemfontein CBD Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Fleurdal Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
	R2 868 698	R3 729 323	R4 589 930	R3 729 317

Source: Own Construction

Table 0 - 6: Free State's Energy savings data results

McDonalds Free State				
	Electrical energy savings			**Average Savings**
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Bloemfontein Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Bloemfontein CBD Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Fleurdal Drive-Thru	R611 989	R795 589	R979 185	R795 588
	R611 989	R795 589	R979 185	R795 588

Source: Own Construction

Table 0 - 7: Gauteng's Cost data results

McDonalds Gauteng

	Solar system cost			Average cost
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Silverlakes Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Hamilton Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Gateway PTA Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Waverley Drive-Thru	R3 453 136	R4 489 078	R5 525 016	R4 489 077
McDonalds Sunnyside Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Skinner Street Drive-Thru	R3 453 136	R4 489 078	R5 525 016	R4 489 077
McDonalds Waterkloof Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Atterbury Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Wonderpark Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Silverton Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Pretoria West Drive-Thru	R3 453 136	R4 489 078	R5 525 016	R4 489 077
McDonalds Zambezi Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Mayville Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Pretoria North Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Lyttelton Drive-Thru	R3 999 145	R5 198 897	R6 398 634	R5 198 892
McDonalds Wingtip Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Ormonde Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Bruma Lake Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Auckland Park Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Parktown Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Selby Drive-Thru	R1 986 370	R2 582 283	R3 178 200	R2 582 284
McDonalds Louis Botha Drive-Thru	R3 155 658	R4 102 350	R5 049 052	R4 102 353
McDonalds Ellis Park Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Lyndhurst Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Jewel City Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Rosebank Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds BP South Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
	R2 953 454	R3 839 502	R4 725 535	R3 839 497

Source: Own Construction

Table 0 - 8: Gauteng's Energy savings data results

McDonalds Gauteng	Electrical energy savings			Average Savings
	250 kWh	325 kWh	400 kWh	
McDonalds Silverlakes Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Hamilton Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Gateway PTA Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Waverley Drive-Thru	R736 669	R957 670	R1 178 670	R957 670
McDonalds Sunnyside Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Skinner Street Drive-Thru	R736 669	R957 670	R1 178 670	R957 670
McDonalds Waterkloof Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Atterbury Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Wonderpark Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Silverton Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Pretoria West Drive-Thru	R736 669	R957 670	R1 178 670	R957 670
McDonalds Zambezi Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Mayville Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Pretoria North Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Lyttelton Drive-Thru	R853 151	R1 109 098	R1 365 042	R1 109 097
McDonalds Wingtip Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Ormonde Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Bruma Lake Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Auckland Park Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Parktown Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Selby Drive-Thru	R423 759	R550 887	R678 016	R550 887
McDonalds Louis Botha Drive-Thru	R673 207	R875 168	R1 077 131	R875 169
McDonalds Ellis Park Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Lyndhurst Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Jewel City Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Rosebank Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds BP South Drive-Thru	R611 989	R795 589	R979 185	R795 588
	R630 070	R819 094	R1 008 114	R819 093

Source: Own Construction

Table 0 - 9: KZN's Cost data results

McDonalds KZN

	Solar system cost			Average cost
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Dr Pixley Kaseme Drive-Thru	R2 730 675	R3 549 872	R4 369 078	R3 549 875
McDonalds Old Fort Rd Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Berea Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Bluff Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Red Hill Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Mount Edgecombe Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Umhlanga Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Shall Cross Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Umlazi Station Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Pinetown Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Umlazi Mega City Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Amanzimtoti Drive-Thru	R2 559 295	R3 327 080	R4 094 873	R3 327 083
McDonalds Pietermaritzburg Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Chatterton Drive-Thru	R3 883 439	R5 045 456	R6 213 502	R5 047 466
McDonalds Edendale Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Raisethorpe Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Verulam Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Newcastle Drive-Thru	R2 471 133	R3 212 470	R3 953 817	R3 212 473
McDonalds Ballito Drive-Thru	R2 768 283	R3 598 767	R4 429 242	R3 598 764
	R2 872 347	R3 733 904	R4 595 765	R3 734 005

Source: Own Construction

Table 0 - 10: KZN's Energy savings data results

McDonalds KZN

	Electrical energy savings			Average Savings
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Dr Pixley Kaseme Drive-Thru	R582 544	R757 306	R932 070	R757 307
McDonalds Old Fort Rd Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Berea Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Bluff Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Red Hill Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Mount Edgecombe Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Umhlanga Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Shall Cross Drive-Thru	R611 989	R795 589	R979 185	R795 588

McDonalds Umlazi Station Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Pinetown Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Umlazi Mega City Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Amanzimtoti Drive-Thru	R545 983	R709 777	R873 573	R709 778
McDonalds Pietermaritzburg Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Chatterton Drive-Thru	R828 467	R1 077 004	R1 325 547	R1 077 006
McDonalds Edendale Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Raisethorpe Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Verulam Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Newcastle Drive-Thru	R527 175	R685 327	R843 481	R685 328
McDonalds Ballito Drive-Thru	R590 567	R767 737	R944 905	R767 736
	R582 107	R756 742	R931 373	R756 741

Source: Own Construction

Table 0 - 11: Limpopo's Cost data results

McDonalds Limpopo				
		Solar system cost		**Average cost**
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Pietersburg Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Thohoyandou Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Groblersdal Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Bela Bela Drive-Thru	R2 880 581	R3 744 745	R4 608 923	R3 744 750
McDonalds Musina Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Thabazimbi Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Elim Drive-Thru	R3 387 764	R4 404 094	R5 420 419	R4 404 092
	R2 944 548	R3 827 922	R4 711 284	R3 827 918

Source: Own Construction

Table 0 - 12: Limpopo's Energy savings results

McDonalds Limpopo				
		Electrical energy savings		**Average Savings**
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Pietersburg Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Thohoyandou Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Groblersdal Drive-Thru	R611 989	R795 589	R979 185	R795 588

McDonalds Bela Bela Drive-Thru	R614 524	R798 879	R983 237	R798 880
McDonalds Musina Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Thabazimbi Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Elim Drive-Thru	R722 723	R939 540	R1 156 356	R939 540
	R628 170	R816 623	R1 005 074	R816 623

Source: Own Construction

Table 0 - 13: Mpumalanga's Cost data results

McDonalds Mpumalanga				
		Solar system cost		**Average cost**
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Hazyview Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Middelburg Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Witbank Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Ermelo Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Highveld Mall Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Secunda Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Acornhoek Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Standerton Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Nelspruit Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds White River Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Tonga Mall Drive-Thru	R3 421 144	R4 447 481	R5 473 828	R4 447 484
	R2 918 921	R3 794 610	R4 670 284	R3 794 605

Source: Own Construction

Table 0 - 14: Mpumalanga's Energy savings results

McDonalds Mpumalanga				
		Electrical energy savings		**Average Savings**
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Hazyview Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Middelburg Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Witbank Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Ermelo Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Highveld Mall Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Secunda Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Acornhoek Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Standerton Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Nelspruit Drive-Thru	R611 989	R795 589	R979 185	R795 588

McDonalds White River Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Tonga Mall Drive-Thru	R729 844	R948 796	R1 167 750	R948 797
	R622 703	R809 517	R996 327	R809 516

Source: Own Construction

Table 0 - 15: Northern Cape's Cost data results

McDonalds Northern Cape				
	Solar system cost			**Average cost**
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Kimberley Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Kimberley CBD Drive-Thru	R2 173 734	R2 825 850	R3 477 970	R2 825 852
McDonalds Upington Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Kuruman Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Kathu Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
	R2 705 712	R3 517 434	R4 329 146	R3 517 431

Source: Own Construction

Table 0 - 16: Northern Cape's Energy savings data results

McDonalds Northern Cape				
	Electrical energy savings			**Average Savings**
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Kimberley Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Kimberley CBD Drive-Thru	R463 730	R602 848	R741 967	R602 848
McDonalds Upington Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Kuruman Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Kathu Drive-Thru	R611 989	R795 589	R979 185	R795 588
	R577 219	R750 386	R923 551	R750 385

Source: Own Construction

Table 0 - 17: North West's Cost data results

McDonalds North West				
	Solar system cost			**Average cost**
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Rustenburg Drive-Thru	R3 144 023	R4 087 233	R5 030 438	R4 087 231
McDonalds Potchefstroom Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Klerksdorp Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317

McDonalds Rustenburg CBD Drive-Thru	R2 081 709	R2 706 230	R3 330 741	R2 706 227
McDonalds Hartebeespoort Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Mafikeng Crossing Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Mafikeng CBD Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Cosmogate Drive-Thru	R2 166 375	R2 816 283	R3 466 200	R2 816 286
McDonalds Wonderboom Drive-Thru	R3 453 136	R4 489 078	R5 525 016	R4 489 077
McDonalds Krugersdorp Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
McDonalds Honeyridge Drive-Thru	R2 868 698	R3 729 323	R4 589 930	R3 729 317
	R2 811 467	R3 654 917	R4 498 355	R3 654 913

Source: Own Construction

Table 0 - 18: North West's Energy savings data results

McDonalds North West				
	Electrical energy savings			**Average Savings**
	250 kWh	**325 kWh**	**400 kWh**	
McDonalds Rustenburg Drive-Thru	R670 725	R871 943	R1 073 160	R871 943
McDonalds Potchefstroom Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Klerksdorp Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Rustenburg CBD Drive-Thru	R444 098	R577 329	R710 558	R577 328
McDonalds Hartebeespoort Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Mafikeng Crossing Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Mafikeng CBD Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Cosmogate Drive-Thru	R462 160	R600 807	R739 456	R600 808
McDonalds Wonderboom Drive-Thru	R736 669	R957 670	R1 178 670	R957 670
McDonalds Krugersdorp Drive-Thru	R611 989	R795 589	R979 185	R795 588
McDonalds Honeyridge Drive-Thru	R611 989	R795 589	R979 185	R795 588
	R599 780	R779 716	R959 649	R779 715

Source: Own Construction

Table 0 - 19: Western Cape's Cost data results

McDonalds Western Cape				
	Solar system cost			Average cost
	250 kWh	325 kWh	400 kWh	
McDonalds Waterstone Drive-Thru	R3 512 466	R4 566 206	R5 619 942	R4 566 205
McDonalds Somerset West Drive-Thru	R2 790 155	R3 627 206	R4 464 248	R3 627 203
McDonalds George Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Belhar Drive-Thru	R3 263 513	R4 242 563	R5 221 617	R4 242 564
McDonalds Garden Route Mall Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Cape Town Station Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Garden Route Mall Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Beaufort West Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Parow Drive-Thru	R2 057 550	R2 674 814	R3 292 088	R2 674 817
McDonalds Strand Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Viking Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Bellville Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Paarl 2 Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Brackenfell Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Haasendal Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Montague Gardens Drive-Thru	R3 263 513	R4 242 563	R5 221 617	R4 242 564
McDonalds Maitland Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Milnerton Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Parklands Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Greenpoint Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Tokai Drive-Thru	R2 772 928	R3 604 814	R4 436 691	R3 604 811
McDonalds Lansdowne Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Vangate Drive-Thru	R3 263 513	R4 242 563	R5 221 617	R4 242 564
McDonalds Tableview Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Seapoint Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Observatory Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Ottery Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
McDonalds Plumstead Drive-Thru	R2 748 731	R3 573 352	R4 397 972	R3 573 352
	R2 808 821	R3 651 468	R4 494 115	R3 651 468

Source: Own Construction

Table 0 - 20: Western Cape's Energy savings data results

McDonalds Western Cape	Electrical energy savings			Average Savings
	250 kWh	325 kWh	400 kWh	
McDonalds Waterstone Drive-Thru	R749 326	R974 124	R1 198 921	R974 124
McDonalds Somerset West Drive-Thru	R595 233	R773 804	R952 373	R773 803
McDonalds George Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Belhar Drive-Thru	R696 216	R905 080	R1 113 945	R905 080
McDonalds Garden Route Mall Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Cape Town Station Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Garden Route Mall Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Beaufort West Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Parow Drive-Thru	R438 944	R570 627	R702 312	R570 628
McDonalds Strand Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Viking Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Bellville Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Paarl 2 Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Brackenfell Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Haasendal Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Montague Gardens Drive-Thru	R696 216	R905 080	R1 113 945	R905 080
McDonalds Maitland Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Milnerton Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Parklands Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Greenpoint Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Tokai Drive-Thru	R591 558	R769 027	R946 494	R769 026
McDonalds Lansdowne Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Vangate Drive-Thru	R696 216	R905 080	R1 113 945	R905 080
McDonalds Tableview Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Seapoint Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Observatory Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Ottery Drive-Thru	R586 396	R762 315	R938 234	R762 315
McDonalds Plumstead Drive-Thru	R586 396	R762 315	R938 234	R762 315
	R599 215	R778 980	R958 745	R778 980

Source: Own Construction