Developing a capital investment and finance decision tree for alternative energy resources at a vegetable farm

HL Bester

orcid.org/0000-0003-2865-0526

Mini-dissertation submitted in partial fulfilment of the requirements for the degree Master of Commerce in Management Accountancy at the North-West University

Supervisor: Prof M Oberholzer

Graduation: July 2019

Student number: 11935537

ACKNOWLEDGEMENTS

Firstly, my Heavenly Father for giving me the ability to do this study, and giving me the strength to carry on when I wanted to give up.

To my husband Martin, my biggest supporter, without you this would not have been possible. Thank you for your patience, love and support. To my children, Maré and Annebe, for always understanding when mommy had to work on her studies.

Thank you to my parents for believing in me and constantly motivating me and to my siblings, you inspire me!

To my friends, thanks for always being there and lending an ear.

Finally, to Prof Oberholzer for his patience and guidance.

ABSTRACT

Keywords: Alternative energy, electricity, energy resources, financing decisions, capital investment decisions, farm, decision tree

Background: Electricity is a day to day necessity. When looking at Eskom as the only electricity supplier in South Africa, with the constant increase in coal prices and thus electricity prices it is clear that if a business is looking at sustainable energy resources, they will have to start investigating alternative energy methods to supply energy to the business. This study gave businesses the insight into the much unknown field of decision making in regards to alternative energy resources.

Objectives: The objective of this study was to investigate whether alternative energy can be purchased for the vegetable farm and how it will be financed. This was done by doing a capital investment decision to consider whether to continue with Eskom electricity or switch over to alternative energy resources. After the capital investment decision, a finance decision was made to determine whether such investment will be financed or bought with the company's own funds.

Design and method: The study comprised a literature review and an empirical study. A literature review was undertaken to determine what different energy resources are available; what the capital investment decision entails and what financial analysis can be done to determine the options that are available for implementing alternative energy resources. The empirical study was in the form of a case study. Through the case study an interview was conducted and document analysis was done on the financial statements and monthly management reports. The capital investment decision was made by using the following capital budgeting techniques: net present value (NPV), internal rate of return (IRR) and discounted payback period. For the financing decision the following ratios were taken into consideration; times interest earned and debt-equity ratio, to determine whether there is scope for additional financing. The current ratio was done, to determine the liquidity of the company and whether there is cash available to purchase the alternative energy resource from the company's own funds.

Findings and conclusion: The capital investment decision-making techniques were executed and it was determined that implementing solar energy on the farm will be a good capital investment due to the fact that the result of the NPV calculation was positive. The finance decision was also investigated and it was concluded that no additional debt must be acquired. The liquidity of the company indicated that the company will have trouble servicing its current short-term debt and therefore it can be determined that it is not viable to acquire solar power. A decision tree was then created to be an aid for various businesses when they experience similar research questions.

Practical implication: The decision tree could form the basis to be used in future by similar entities in the decision-making process in regards to alternative energy resources. As alternative energy is still a relatively new and unexplored field for businesses, this new knowledge will be of great value when working with capital investment and financing decisions regarding alternative energy resources.

Value of the research: This study focused on the financial aspect of alternative energy and assistance is given to a farmer when they want to investigate the alternatives to Eskom electricity. With the decision tree the steps are defined; in the process from choosing an alternative energy option until the implementation of such an option.

Research limitations: Alternative energy is still a relatively new field and the effect of the implementation of alternative energy on the environment are not yet known, this will only be known in the future after years of implementation. Fossil fuels however are being depleted from the earth and that is why when a decision regarding alternative energy had to be taken, only renewable resources were considered.

Areas for future research: The same study can be performed, but with the focus on other farming activities or businesses. A study can also be performed with the focus on a hybrid solar system.

OPSOMMING

Sleutelwoorde: Alternatiewe energie, elektrisiteit, energiehulpbronne, finansieringsbesluite, beleggingsbesluite, plaas, besluitnemingsboom

Agtergrond: Elektrisiteit is 'n daaglikse noodsaaklikheid. Wanneer ons Eskom as die enigste elektrisiteitsverskaffer in Suid-Afrika beskou, met die konstante styging in steenkoolpryse en dus elektrisiteitspryse, is dit duidelik dat as 'n besigheid na volhoubare energiebronne kyk, hulle moet begin om alternatiewe energiemetodes te ondersoek om energie te verskaf aan die besigheid. Hierdie studie het ondernemings die insig gegee in die baie onbekende veld van besluitneming met betrekking tot alternatiewe energiebronne.

Doelwitte: Die doel van hierdie studie was om te ondersoek of alternatiewe energie vir die groenteplaas gekoop kan word en hoe dit gefinansier sal word. Dit is gedoen deur 'n kapitaalbeleggingsbesluit te ondersoek sodat oorweeg kan word of die maatkappy met Eskom-elektrisiteit sal voortgaan of oorskakel na alternatiewe energiebronne. Ná die kapitale beleggingsbesluit is 'n finansierings besluit geneem om vas te stel of sodanige belegging gefinansier moet word of gekoop sal word met die maatskappy se eie fondse.

Ontwerp en metode: Die studie het bestaan uit 'n literatuuroorsig en 'n empiriese studie. 'n Literatuuroorsig is onderneem om te bepaal watter verskillende energiebronne beskikbaar is; wat die kapitaalinvesteringsbesluit behels en watter finansiële analise gedoen kan word om die opsies wat beskikbaar is vir die implementering van alternatiewe energiebronne te bepaal. Die empiriese studie was in die vorm van 'n gevallestudie. Deur die gevallestudie is 'n onderhoud gevoer en dokumentanalise is gedoen op die finansiële state en maandelikse bestuursverslae. Die kapitaalbeleggingsbesluit is gemaak deur die volgende kapitaalbegrotingstegnieke te gebruik: netto huidige waarde, interne opbrengskoers en verdiskonteerde terugbetalingsperiode. Vir die finansieringsbesluit is die volgende verhoudings in ag geneem; rentedekking en skuld-ekwiteit verhouding, om vas te stel of daar ruimte is vir addisionele finansiering. Die bedryfskapitaalverhouding is gedoen om die likiditeit van die maatskappy te bepaal en of daar kontant beskikbaar is om die alternatiewe energiebron uit die maatskappy se eie fondse te koop.

Bevindings en gevolgtrekkings: Die besluitnemingstegnieke vir kapitaalinvesterings is uitgevoer en daar is vasgestel dat die implementering van sonkrag op die plaas 'n goeie kapitaalbelegging sal wees as gevolg van die feit dat die uitslag van die NHW-berekening positief was. Die finansieringsbesluit is ook ondersoek en daar is bevind dat geen bykomende skuld verkry moet word nie. Die likiditeit van die maatskappy het aangedui dat die maatskappy sal sukkel om sy

huidige korttermynskuld te betaal en daarom kan bepaal word dat dit nie lewensvatbaar is om sonkrag te verkry nie. 'n Besluitnemingsboom is geskep om 'n hulpmiddel vir verskeie besighede te wees wanneer hulle soortgelyke navorsingsvrae ervaar.

Praktiese implikasie: Die besluitnemingsboom kan die basis vorm wat in die toekoms deur soortgelyke entiteite gebruik word in die besluitnemingsproses ten opsigte van alternatiewe energiebronne. Aangesien alternatiewe energie steeds 'n relatief nuwe en onontginde veld vir besighede is, sal hierdie nuwe kennis van groot waarde wees wanneer hulle met kapitaalbeleggingsbesluite en finansieringsbesluite rakende alternatiewe energiebronne werk.

Waarde van die navorsing: Hierdie studie het gefokus op die finansiële aspek van alternatiewe energie en hulp word aan 'n boer gegee wanneer hulle die alternatiewe vir Eskom elektrisiteit wil ondersoek. Met die besluitnemingsboom word die stappe in die proses gedefinieer; van die keuse van 'n alternatiewe energie opsie tot die implementering van so 'n opsie.

Navorsingsbeperkings: Alternatiewe energie is nogsteeds 'n relatief nuwe veld en die effek van die implementering van alternatiewe energie op die omgewing is nog nie bekend nie. Dit sal eers in die toekoms bekend wees na jare van implementering. Fossiele brandstowwe word egter uit die aarde uitgeput en daarom is slegs hernubare hulpbronne oorweeg wanneer 'n besluit oor alternatiewe energie geneem moes word.

Areas vir toekomstige navorsing: Dieselfde studie kan uitgevoer word, maar met die fokus op ander boerderyaktiwiteite of sakeondernemings. 'n Studie kan ook uitgevoer word met die fokus op 'n hibriede sonkrag stelsel.

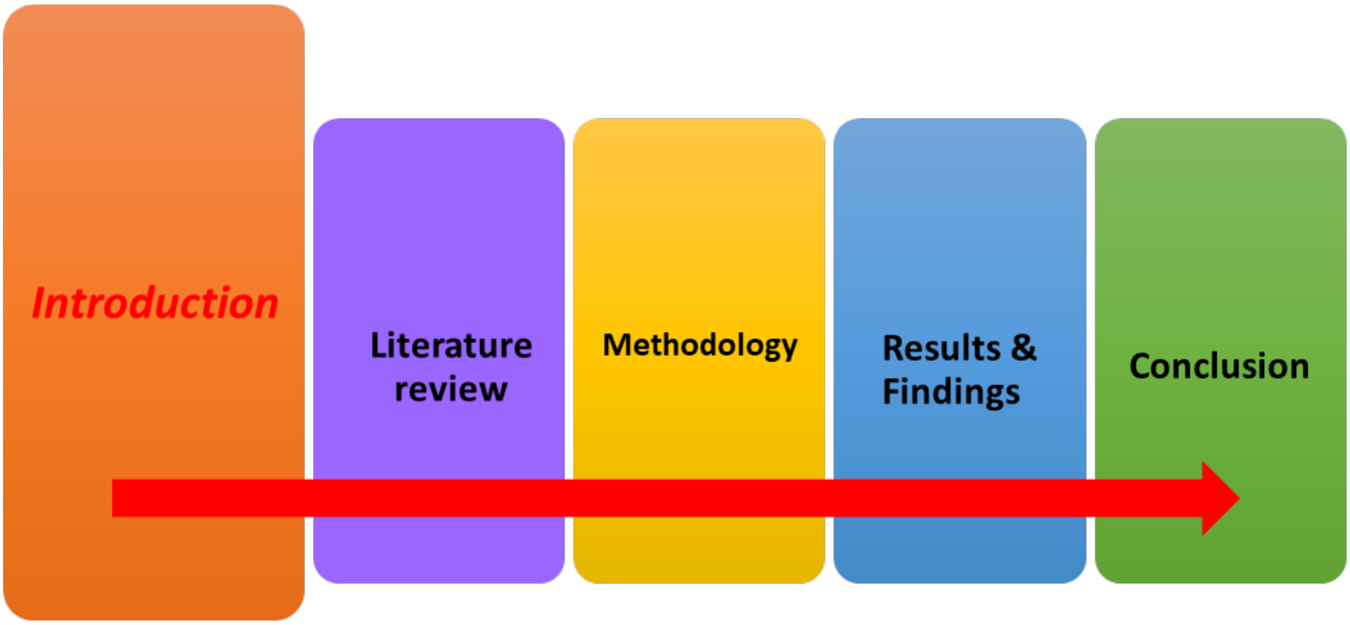
TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PICTURES

LIST OF GRAPHS



CHAPTER 1 INTRODUCTION

One of the key elements of any successful business is the sustainability of energy resources (Wallington, 2016). With the ever-rising energy consumption, resource scarcity is causing major obstacles in the sustainability of energy resources (Brutschin & Fleig, 2016). According to Alberts (2005), 77% of all the energy needs on a global level are satisfied by coal, while various alternative energy resources have been identified and developed to replace the use of coal in generating energy.

Company X, a vegetable farm in the Free State, is a business facing these exact obstacles, and that is why Company X was used in the form of a case study for this research. In the case study, a capital investment decision was evaluated to determine whether the company could move from Eskom energy to alternative energy. A finance decision was also investigated, because to finance an investment, two routes are available: to either use the company's own money or to acquire external funding.

1.1. Background to the research area

In South Africa, the availability of electricity was always a certainty, and therefore other business issues were viewed as priority (Hough *et al.*, 2011) and understandably so. However, in the next few years the focus of management will have to shift to incorporate the following questions: What will happen when the electricity goes down? What will happen if electricity is not available for a few days? What will happen if there is such a big increase in the electricity tariff that electricity is no longer affordable?

When looking at Eskom as the only electricity supplier in South Africa (Wallington, 2016), it is clear that if businesses are considering sustainable energy resources, they will have to start investigating alternative energy-generating methods (Van Rooyen, 2016). With all the alternative energy resources available (Alberts, 2005), the question remains if it is advisable to still make use of Eskom as the main energy resource.

Company X is a 2,512-hectare crop farm, of which 125 hectares are specifically for potatoes. They are highly dependent on electricity as they make use of automated centre pivots and linear irrigators. In addition, the facility used for the processing of the potatoes is extremely dependent on electricity. In light of the unreliability of Eskom and continual increases in coal prices and therefore electricity prices, Company X was the ideal candidate to use as a case study, as this enterprise needs to be sustainable and make a profit. However, with electricity being a large expense, their goals are becoming more difficult to reach.

1.2 Literature review of the topic

Considerable research has been done in recent years with regard to alternative energy resources. Azadeh *et al.* (2013) investigated the consumption potential of renewable energy in specific sectors. This study determined that the utilisation of renewable energy plays an important part in the sustainable development of a country/business. In a study carried out by Walwyn and Brent (2015), renewable energy was explored as an option for South Africa. In this study, it was apparent that the high capital investment characteristics of renewable energy projects mean that these projects compete primarily on a cost of capital basis. The role of fossil fuels with regard to alternative energy resources in developing countries was studied by Brutschin and Fleig (2016). They noted that additional incentives might be necessary to influence resource-abundant countries to join the efforts in developing alternative energy resources.

Kaley (2016) and Cilliers (2017) studied nuclear power. In their respective studies, Kaley considered nuclear power as an alternative green fuel, while Cilliers compared the cost of nuclear power to other energy sources. The impact of fossil fuels on future endeavours was evident in studies carried out by both Oludaisi *et al.* (2017) and Daraei *et al.* (2017).

In their study, Ellabban *et al.* (2014) focused on available renewable energy resources: The current status of these resources; future prospects; and the enabling technology that each resource brings. Other researchers focused more on specific renewable energy resources:

- Solar power (Powell *et al.*, 2014; Alberts, 2005).
- Wind power (Hartman, 2017).
- Hydropower (Miller, 2018; Hartman, 2015).
- Biomass (Uysal *et al.*, 2017).
- Geothermal energy (Constant, 2018).

Huttes (2017) focused on farming with the aid of renewable energy, while Bhutta (2018) studied the role of renewable energy in sustainable agriculture. Herbert *et al.* (2014) investigated how renewable energy can be produced on farms.

Even though alternative energy resources were studied, the focus was mainly on what alternative energy resources were and how these resources worked. When alternative energy resources are discussed, financing is of the utmost importance. Mazzucato and Semieniuk (2017) considered different ways to finance the generation of energy and why most financing is still going to fossil fuels instead of renewable energy. According to these authors, the main factor with regard to financing is whether there is an appetite for technology or not. Ng and Tao (2016) contemplated the options of bond financing for renewable energy. They concluded that the financial gap is mainly due to financial diversity and immature capital markets. Tyl and Lizarralde (2017) conducted a study about the effectiveness of citizen funding for renewable energy projects where it was evident that citizen funding is a strong asset for any territorial project insofar as it adds confidence while a link between energy policies of local communities is created. Cheung *et al.* (2016) researched the challenges involved and opportunities for the local government in the financing of alternative energy projects. They identified that there might be a need for a financial instrument that can be used to determine the best use of restricted funding.

In this study, the above-mentioned research was expanded by exploring what alternative energy resource would have been the most effective for a business − a vegetable farm − and by designing a decision tree to be used as an example by other entities. This decision tree can assist role-players when they need to determine whether the acquisition of alternative energy must be done and how this venture can be financed.

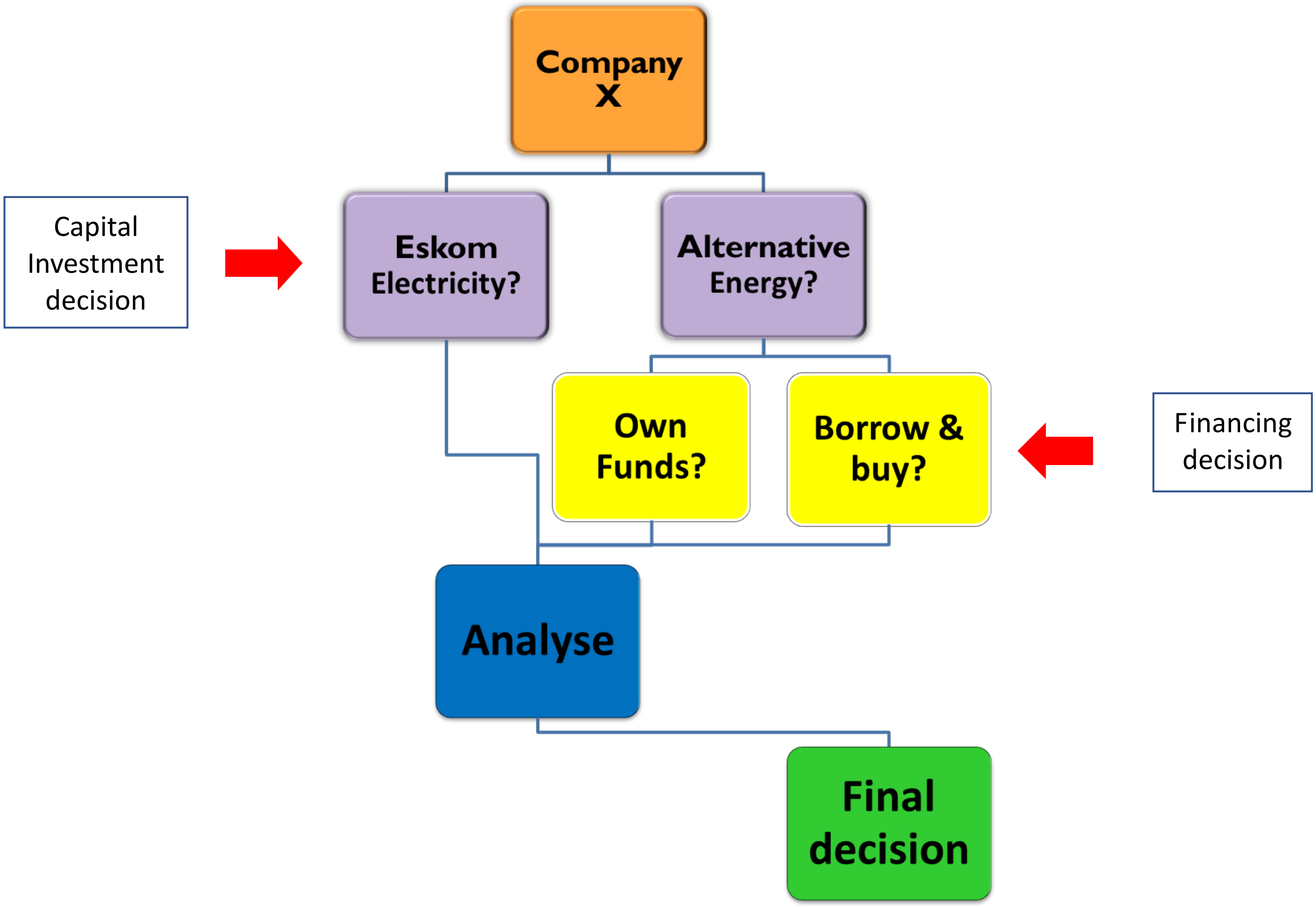
1.3. Motivation of the actuality of the topic

Electricity is a day to day necessity. In a study carried out by De Vos (2016), the Eskom situation was assessed and it became apparent that businesses depending on electricity would have to investigate alternative resources (Wallington, 2016). This study provided businesses with much needed insights into the unknown field of decision-making concerning alternative energy resources.

In Figure 1-1, the outline of the decision tree is provided. When a capital investment decision is made, the main consideration should be either to continue with Eskom electricity or to switch over to alternative energy resources. What alternative energy resources are, therefore, available? How should role-players determine what energy resources will be the most effective in the business field they operate in?

After a capital investment decision was made, a finance decision is next. How will financing take place? Does the business have the ability to purchase alternative energy resources as a capital expense or do they have to finance the acquisition?

Figure 1-1: Decision-making process



Source: Own research

1.4. Problem statement

In light of the above-mentioned discussion of Figure 1-1, the problem that remained is the availability and the uncertainty of electrical supply for a business. Guidance is needed when decision-making is addressed regarding (i) whether to invest/not to invest in alternative energy resources, and (ii) when alternative energy resources are chosen, how these resources should be financed. The following research question was, therefore, formulated:

- Can alternative energy be purchased for the vegetable farm and how will it be financed?

This research study focused on the problem faced by South African businesses when they need to make a decision with regard to alternative energy resources, and was addressed by the designing of a decision tree. A decision tree is a decision support tool that uses a tree-like model of decisions and their possible consequences, including chance event outcomes, resource costs and utility. This decision tree can assist businesses in a similar dilemma with their decision-making regarding capital investments and financing choices.

1.5. Objectives of the study

1.5.1 Primary objective

The following primary objective was formulated for the study:

- To design a decision tree as an aid when capital investments or financing decisions are considered during the implementation of alternative energy resources by Company X.

1.5.2 Secondary objectives

The following secondary objectives were formulated for the study:

i. To investigate available alternative energy resources applicable to Company X.
ii. To identify and explain the appropriate methodology for the study.
iii. To analyse the viability of alternative energy resources by applying selected capital investment decision-making techniques.
iv. To analyse the finance decision.
v. To solve the problem for Company X (Can alternative energy be purchased and how will it be financed?).
vi. To design a decision tree serving as an aid for various businesses when they experience similar business questions.

1.6. Research design and methodology

The study comprised a literature review and an empirical study. The empirical study would be in the form of a case study. The case study is viewed as a way of investigating an empirical topic by following a set of pre-specified procedures (Yin, 2009).

The research philosophy of this study was an epistemological approach within an interpretive paradigm. The research approach followed inductive reasoning – the study investigated from the particular (the vegetable farm) and concluded to the general (various other entities). In this process, a holistic decision tree was designed, which could be used by other entities. The research strategy was qualitative in nature. The researcher acted as an instrument in the gathering of data by interacting with the research subject by way of the case study. The case study was viewed as the research design, while the data collection methods were a semi-structured interview and document analysis. After the data collection, an analysis of the data was done by examining the capital investment decision and the financing decision. The decision tree designed by this study is unique and could not be compared to other decision trees used in research studies. The study attempted to explain the phenomena of various business decisions associated with alternative energy to the world by designing a decision tree (Mouton, 2015).

The following steps were used to design a decision tree (see Figure 1-1):

1. Consider the alternative energy resources that are available.
2. Investigate the capital investment decision.
3. Consider viable finance options.
4. Complete an analysis on the results found in steps two and three.
5. Design a decision tree for use by other entities.

1.6.1 Literature review

A comprehensive literature review was undertaken to determine the following:

- The various available energy resources.
- What capital investment decisions entail.
- What financial analyses can be done to determine available options for implementing alternative energy resources.

Secondary data sources were mostly used, such as relevant text books; case studies; and articles found on different databases and search engines. EBSCOhost, Google Scholar and Google were used. Catch phrases used in the searches included the following:

Alternative energy; electricity; energy resources; financing decisions; capital investment decisions; farm; decision tree.

1.6.2 Empirical research

The empirical research was conducted in the form of a case study of Company X.

The case study method was used to understand a real-life phenomenon (Yin, 2009). Company X was, therefore, researched in the form of a case study, and the need for electricity and its workings were understood more clearly.

In the case study, a document analysis was done on the concrete financial details of Company X, specifically the financial statements and monthly management reports in order to obtain a clear view of the company's current financial position.

A semi-structured interview with the farm manager/owner provided the financial data.

The semi-structured interview consisted of questions pertaining to the following:

- Day to day running of the vegetable farm.
- What the electricity requirements were.
- The current situation regarding the availability of electricity from Eskom.
- Perceived future electrical needs of the company.

This interview was of an informative nature due to the fact that the farm and its operations were visited and explained. By interpreting this semi-structured interview, a clear understanding was obtained after the semi-structured interview was interpreted: The situation, needs and requirements of Company X were highlighted.

The data and results were analysed by management accounting techniques and formulas.

Firstly, an analysis was done to assist in making the capital investment decision (see Figure 1-1, step 1), and to determine whether or not it would have been viable to implement an alternative energy resource. The decision regarding capital investment was made by using the following capital budgeting methods: net present value (NPV); internal rate of return (IRR); and discounted payback period. NPV and IRR are discounted cash flow methods and an understanding of the concepts of the time value of money are essential when making use of these methods (Correia *et al.*, 2015).

Secondly, an analysis was done to determine the best financing alternative (see Figure 1-1, step 2). To make this financing decision, the following ratios were taken into consideration: times interest earned; and debt-equity ratio. These ratios were used to determine whether there was scope for additional financing in Company X. The current ratio was used to determine the liquidity of Company X and whether there was cash available to purchase an alternative energy resource from the company's own funds.

After the examination of the financing decision was completed (Figure 1-1, step 2), it became apparent what financing option was the most viable for the company.

After data collection took place and the analyses were completed, a decision tree was designed. A decision tree was created by making use of an inductive strategy and this model was constructed to fit this particular set of empirical data (Mouton, 2015). The decision tree was then refined to be conceptual in nature to serve as a holistic (generic) decision tree for similar business questions from other companies.

This decision tree could be used in future by similar entities in their decision-making process with regard to alternative energy resources. Alternative energy resources are still a relatively new and unexplored field for businesses, and can be of great value when working with capital investment decisions and financing decisions regarding the knowledge of and choosing alternative energy resources.

In Figure 1-1, the basic concept is displayed. In this study, each step was defined, developed and refined until the decision tree was completed and ready to be used in future by various kinds of businesses.

1.7. Ethical considerations

No data were used without the prior consent of the management of Company X. The company and individuals were aware that this was a voluntary study and that the data were used for academic purposes. This study's proposal was viewed by the Faculty of Economic and Management Sciences. Clearance was given and the ethics number NWU-00746-18-S4 HL Bester was allocated to this study. This study was classified as a low-risk study.

1.8. Overview

The following chapters are included in this study:

Chapter 1: Introduction

This chapter outlines where the interest in the study originated from and what the methodology was − to design a decision tree that can be useful to various businesses. This chapter includes the following: the introduction, background, problem statement, and objectives of the study.

Chapter 2: Literature review

Chapter 2 focuses on the literature review − recent and related studies that enabled an investigation of the different types of alternative energy resources available. How easily alternative energy is obtainable and what the requirements are for implementing alternative energy resources.

In this chapter, applicable measuring tools were investigated to assist in capital investment decisions and financing decisions relating to alternative energy resources.

Chapter 3: Methodology

The focal point of this chapter is how the case study was executed. Through the research design, a logical sequence was visible that connected the empirical data − part of the research methodology − with the initial research question. This chapter deals with the following four areas: what questions were studied; what data were relevant; what data were collected; and how the results were analysed to design a relevant decision tree.

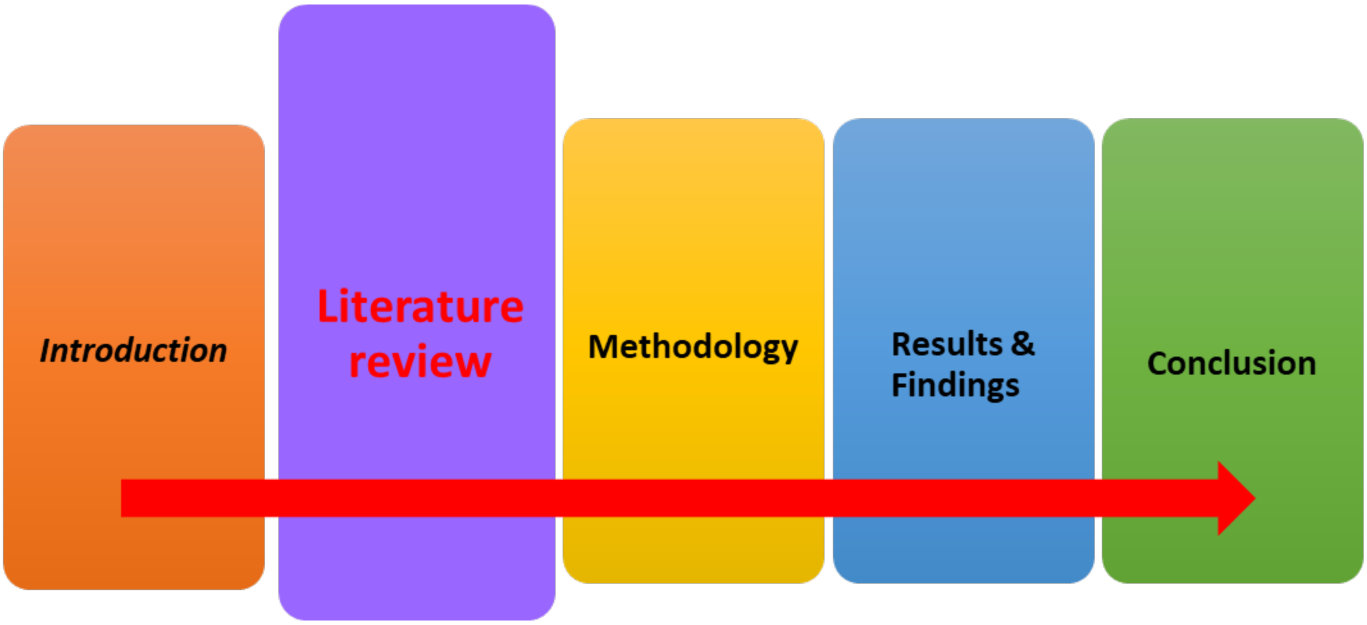
Chapter 4: Results and findings

Findings are arranged based on the capital investment decision of Company X and the viability of alternative energy. The data from the financial statements of Company X were analysed. The analysis was done with the aid of various management accounting techniques and methods. At the end of the study the results showed what financing option was the most viable for Company X, thus completing the decision tree.

Chapter 5: Conclusions

This chapter summarises all of the aspects of the study. The study was concluded with the designing of a holistic decision tree, highlighting the originality of the study and assisting businesses in future decision-making with regard to the use of energy resources.

The decision tree confirmed the practical value of the study.



CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

In Chapter 1, the background and motivation of this study were explored. It is evident that alternative energy resources must be considered for the sustainability of farming operations due to the ever-changing electricity climate. Energy is the most important resource for advancement in and growth of agriculture. Sustainable agriculture should, therefore, be integrated with agricultural production systems without damaging the environment for future generations (Bhutta, 2018).

The literature review was undertaken to provide an in-depth understanding of the issues and debates investigated in this study. It yielded current theoretical contributions and definitions, and substantive findings from previous studies carried out (Mouton, 2015). The use of alternative energy resources is still fairly new to business managers and farmers, and the purpose of Chapter 2 was, therefore, to explore all of the possible alternative energy resources available. The purpose of this chapter was not to focus on a single, specific alternative energy resource, but to investigate available alternative energy resources in general. Three alternative energy resources were, therefore, investigated: nuclear energy, fossil fuels, and renewable energy. An explanation of what each type of energy resource entails and the advantages and disadvantages of alternative renewable energy are provided. Faced with the challenges of rapidly depleting fossil fuel reserves, and the environmental crises emanating from the use of fossil fuels, it is increasingly necessary to find sustainable and clean fuel for future use (Oludaisi *et al.*, 2017). The first secondary objective was, therefore, completed – alternative energy resources available to Company X were investigated.

In this chapter, the capital investment decision is also explained. Clarification is given regarding the criteria for making sound capital investment decisions, how other scholars approached capital investment decisions, and what formulas were used to determine the capital investment decision, according to the decision tree. After the capital investment decision was made, the finance decision was investigated by making use of previous studies and texts to determine available options when businesses are considering financing alternative energy resources. The finance decision is the next step in the capital and finance investment decision tree, as indicated in Figure 1-1.

At the end of this chapter there was progression in achieving the primary objective, namely to develop a decision tree as an aid to capital investment and financing decisions when the implementing of alternative energy resources in Company X were considered.

2.2 Energy resources

Energy is the most important resource for progress and growth to occur in any agricultural venture (Bhutta, 2018). Energy resources can be divided into three main categories: nuclear power, fossil fuels, and renewable resources. According to Cilliers (2017), every energy resource has its own value, and it is, therefore, unnecessary to play one against each other, as they all have unique benefits and challenges. The optimum decision based on what types of energy resources should be utilised, must be made on the basis of economic, social, environmental, and safety considerations (Azadeh *et al.*, 2013).

Kaley (2016) describes nuclear power as the generation of electricity when energy is released during fission – the splitting of uranium atoms. Fossil fuels can be explained as a conventional energy resource based on oil, coal, and natural gas. Renewable energy is continually replenished by nature and comes from natural sources, such as sunlight, wind, rain, tides, and geothermal heat (Ellabban *et al.*, 2014).

Energy and water scarcity are two major obstacles to sustainable agriculture (Bhutta, 2018). The main advantage of alternative energy resources is these resources allow farmers to save on their rising energy costs of running a successful farm. Alternative energy allows farmers to stop relying so heavily on depleting resources, such as fossil fuels, which are not only costly but also harmful for the environment (Anon, 2014b). According to Herbert *et al.* (2014) farmers can, by utilising alternative energy resources, produce their own energy and can become even more self-sufficient by reducing external inputs.

2.2.1 Nuclear power

Nuclear power is a very feasible alternative for the generation of electricity on a large scale, due to the fact that nuclear plants produce electricity all day long with an annual capacity factor of 90% (Cilliers, 2017). Conventional fission power is occasionally referred to as sustainable, but this is a controversial matter, because of concerns about radioactive waste disposal and the risks of possible accidents.

There are very different views with regard to the use of nuclear power. In a study carried out by Hartley (2018), a few of these concerns were discussed:

- The widespread use of nuclear power can increase the proliferation of nuclear weapons.
- Nuclear power is less effective at reducing carbon dioxide (CO_2) emissions.
- Construction time and costs keep escalating − especially in France and the United Kingdom.
- Nuclear plants have high capital inputs, but low operating costs.
- The unknown impact that nuclear will have on the environment in the long run.

All of these concerns raised doubts about the long-term viability of nuclear power.

2.2.2 Fossil fuels

Fossil fuel energy contains carbon and was developed through geological processes several million years ago, and the key components of this energy can mainly be attributed to the remains of organic matter from plants and animals (Oludaisi *et al*., 2017). According to Azadeh *et al*. (2013), fossil fuel resources have a harmful impact on health and the environment.

Hartley (2018) investigated the cost of displacing fossil fuels. According to him, the technological progress can alter the relative costs involved when making use of different energy resources, but fossil fuels inevitably will be displaced as depletion raises their costs and makes them uncompetitive. Daraei *et al.* (2017) noted that population growth and urbanisation have led to increases in energy demand and therefore, greenhouse gas emissions. The availability of fossil fuels as the main source of energy supply has, therefore, changed. The utilisation of renewable resources together with the distribution of energy systems can eliminate the dependency on fossil fuel energy resources. According to Uysal *et al.* (2017), global climate change can be limited by substituting fossil fuel demand with green energy production (renewable energy). The main reason for greenhouse gas is an increase in CO_2 and other heat trapping gases, and is caused by burning fossil fuels, changes in land use, and deforestation, which release large amounts of CO_2 (Uysal *et al*., 2017).

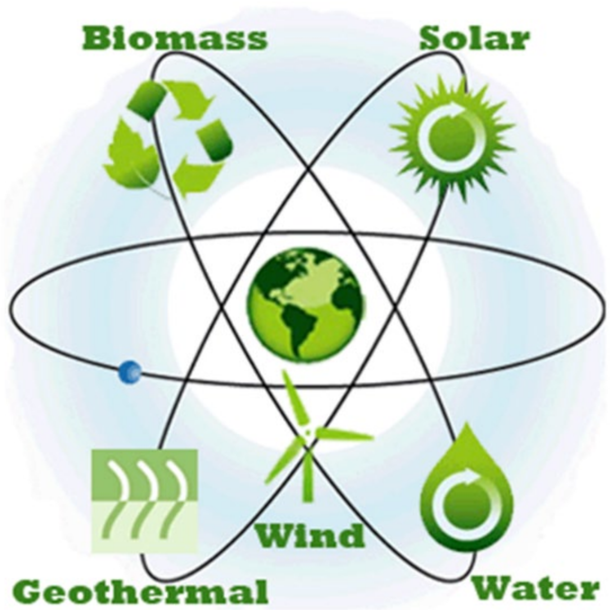
Marques *et al.* (2018) asked the question whether fossil fuels have been substituted by renewables. These authors are of the opinion that it is important that cleaner and green electricity sources must be introduced in order to lessen the effects of climate change *and* to obtain sustainable development. The high cost and limited sources of fossil fuels − in addition to the need to reduce greenhouse gases emission − have made renewable resources attractive. Since environmental protection concerns are increasing, both clean fuel technologies and new energies are being intensively pursued. Traditional power generation based on fossil fuels are largely considered to be unsustainable in the long term due to the deficiency experienced in inexhaustible resources, and environmental problems caused by emissions (Ellabban *et al.*, 2014). Reducing fossil fuel demands and finding new renewable and sustainable energy sources can limit environmental problems and can be viewed as a new way to sustain the growing energy demands (Uysal *et al.*, 2017).

2.2.3 Renewable energy resources

Various renewable energy resources are available. In a study carried out by Ellabban *et al.* (2014), an up-to-date and detailed status and future projections of major renewable energy resources were presented − benefits, growth rate, investment and deployment were included. Walwyn and Brent's (2015) study focused on how renewable energy is gathering steam in South Africa. This study was based on the concerns over the present dependence of South Africa on nuclear power and coal as their primary energy source. Some alternative energy resources are more freely attainable and implementable, while others are more affordable. The question of how the different renewable energy resources will affect the environment and surroundings also plays a pivotal role. The main renewable energy resource categories are (Figure 2-1):

- Solar power
- Wind power
- Hydropower
- Biomass
- Geothermal energy

Figure 2-1: Renewable energy resources



Source: Miller (2018)

2.2.3.1 Solar power

In a study carried out by Powell *et al.* (2014) on the dynamic optimisation of a hybrid solar thermal and fossil fuel system, they found that solar power has the capacity to produce emission-free electricity. With resemblances to conventional power generation procedures, solar thermal or concentrated solar power can be a low-cost alternative to fossil fuel-based systems (Powell *et al.*, 2014).

Solar power is possible through the technology of photovoltaic (PV) panels (Picture 2-1) that convert solar light radiations into electrical energy. Ellabban *et al.* (2014) explain that the basic building block of a PV system is the PV cell, which is a semiconductor device that converts solar energy into direct-current electricity. The amount of energy from the sun that reaches the earth every day is enormous. All the energy stored in the earth's reserves of coal, oil, and natural gas is equal to the energy accumulated from only 20 days of sunshine (Union of Concerned Scientists, 2008). Alberts (2005:18) states in his study regarding solar energy, that "solar power as a resource is by far the most accessible renewable energy resource in South Africa and lends itself to a number of PV applications".

According to Huttes (2017), solar energy is particularly appealing these days, due to advances made in technology and plummeting costs. In South Africa, most areas receive enough sunshine to make the generation of solar energy practical. Solar energy can be used for agricultural purposes in a number of ways: money is saved, self-reliance is increased, and pollution is reduced. Solar energy can lower a farm's electricity and heating bills. PV panels can power farm operations and remote water pumps, lights and electric fences.

Picture 2-1: Photovoltaic (PV) panels

Source: Google (2016)

PV has the advantage that it uses not only direct sunlight but also the diffuse component of sunlight. Solar PV produces power even if the sky is not completely clear. This ability allows for effective deployment in many regions in the world (Ellabban *et al.*, 2014).

Research by Bhutta (2018) determined that the generation of solar electricity can occur in three forms: off-grid, hybrid and on-grid.

Off-grid – the only source of power during the generation of off-grid electricity is solar. Batteries are charged and then stored as direct current (DC) energy that can be converted into alternating current (AC) electricity used for lighting, running farm machinery, and water pumps. One weakness of an off-grid system is that when solar-charged batteries are discharged, the system stops functioning. The major components used in such a system are solar PV modules, solar charge controllers, solar inverters, solar mountings and DC cables. Solar systems vary from 20 kilowatts (kW) to 500 kW.

Hybrid – the batteries of a hybrid system can be charged from a solar source, from the grid, or any other alternate AC source. A hybrid system works well when the grid or an alternative resource of electricity is available.

On-grid – an on-grid system does not make use of batteries but is in sync with the grid. When there is no grid or the grid is unavailable and the system is not producing electricity, a generator is needed to provide AC electricity. This type of system is very useful when the grid is available and load shedding does not occur frequently.

2.2.3.2 Wind power

Wind is the movement of air from a high-pressure area to a low-pressure area (National Geographic, 2009b). Wind power captures the wind that flows freely through our atmosphere and converts it into mechanical energy. Mechanical energy is then turned into electricity (Sykes, 2018). Wind power potentially exists when wind occurs at the rate of seven to nine meters/second (Bhutta, 2018). According to Ellabban *et al.* (2014), the amount of kinetic energy theoretically available in the wind for extraction increases with the cube of wind speed. However, a turbine (Picture 2-2) only captures a fraction of available kinetic energy.

To minimise costs, the wind turbine design is motivated by a desire to reduce material usage but to increase turbine size (Ellabban *et al.*, 2014). According to National Geographic (2009b), turbines can be as tall as a 20-story building with three 60-meter long blades. The wind spins the blades that turn a shaft connected to a generator that produces electricity. Higher wind speeds mean more electricity, and wind turbines are built higher to reach heights above ground level where it is even windier (Hartman, 2017). The electricity produced by wind power can be used for running farm machinery and pumps. Wind power systems are available in small, medium or large sizes. Small and medium systems can produce up to 200 kW (Bhutta, 2018).

Sykes (2018) established three main types of wind power: unity-scale wind, distributed or 'small' wind, and offshore wind.

Unity-scale wind – these turbines are enormous; larger than 100 kW. They are developed to supply large amounts of energy to power grids. The energy that is created is managed and distributed accordingly.

Picture 2-2: Wind turbine

Source: Photograph by Carlos Barria, Reuters

Distributed or 'small' wind – these are smaller turbines of 100 kW and often supply power directly to private homes, farms, or small business.

Offshore wind – these wind turbines are erected in bodies of water and are operated globally.

Wind is one of the most important sustainable energy resources (Ellabban *et al.*, 2014), due to the fact that wind power does not generate waste or contaminate; it is inexhaustible and reduces the use of fossil fuels and greenhouse emissions.

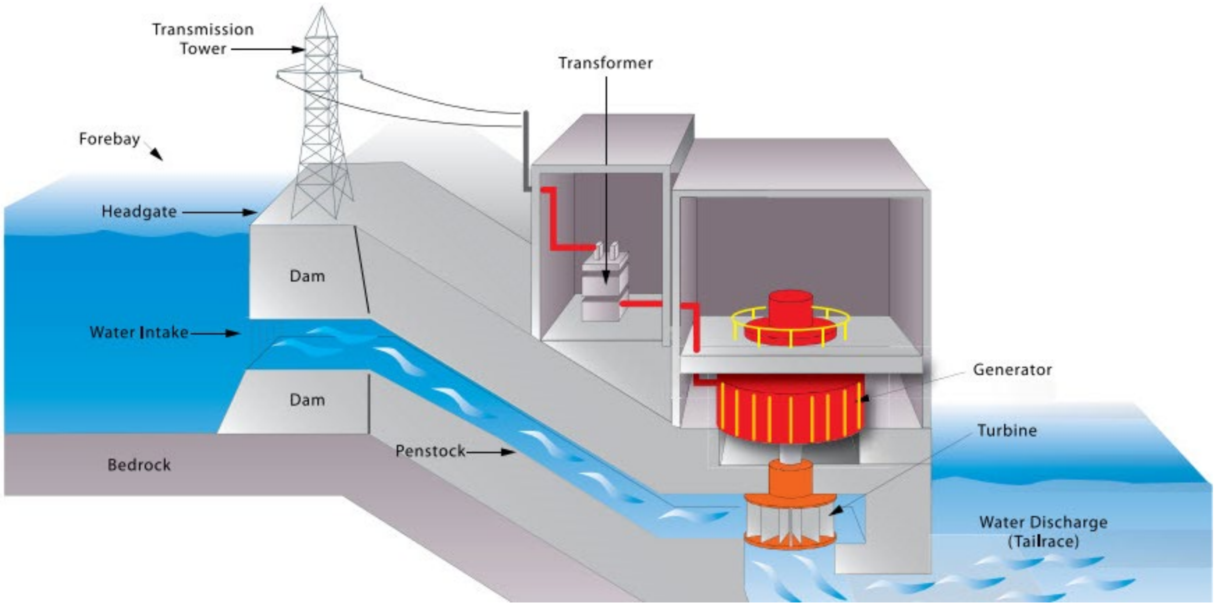
2.2.3.3 Hydropower

Hydropower is energy generated in the form of electricity by making use of moving water (National Geographic, 2009a). According to Ellabban *et al.* (2014), flowing water creates energy that can be captured and converted into electricity by using turbines. The flow of water in rivers − driven by the force of gravity to move from a higher to a lower elevation − can be used to generate hydropower.

A typical hydro plant is a system consisting of three parts: an electric plant where the electricity is produced, a dam that can be opened or closed to regulate water flow, and a reservoir where water can be stored.

Miller (2018) explains that to convert water into energy, a dam needs to be built in a large river that has a large drop elevation. Then the water would need to move through the penstock (Figure 2-2), inside the dam in order to reach the turbine where power is generated. The flowing water needs to turn the turbine propeller, which then turns the shaft connecting the propeller to the generator above the dam. The generator then generates electricity from the shaft. Hydropower projects are always site-specific, and are, therefore, designed according to the river system they are built in (Ellabban *et al.*, 2014).

Figure 2-2: Hydropower generation



Source: Miller (2018)

According to National Geographic (2009a), the amount of electricity that can be generated depends on how far the water drops and how much water moves through the system. This creates the possibility that hydropower facilities can be small too. Municipal water facilities or irrigation ditches can, therefore, be utilised (Hartman, 2015). In a canal or in the run of a river, small heads micro and mini hydro (MHPs) can generate electricity varying between 5 kW and 500 kW. MHP systems generate electricity that can be used for operating farm machinery and water pumps. These plants consist of intake, canal, forebay, penstock, turbine, generator and control system (Bhutta, 2018).

Hydropower plants are categorised into three groups according to operation and the type of water: run-of-river (RoR), storage (reservoir), and pumped storage hydropower plants. These vary from small to large in terms of scale and depends on the hydrology and topography of the watershed. A

RoR hydropower plant draws its energy for electricity production mainly from the available flow of the river. Hydropower plants with a reservoir are called storage hydropower, because they store water for delayed consumption. Reservoirs reduce dependence on the variability of the inflow, and generating stations are located downstream connected to reservoirs through pipelines. Pumped storage hydropower plants are not energy sources (Ellabban *et al.*, 2014).

As stated by Ellabban *et al.* (2014:757)," hydropower is a proven and well-advanced technology based on more than a century of experience". Daraei *et al.* (2017) investigated the use of hydropower as a potential fossil-free energy system, specifically with regard to the changes occurring in climate conditions, the demand for different energy products, and the availability of these products.

"Hydropower is an extremely flexible power technology with the best conversion efficiencies of all the energy sources, due to its direct transformation of hydraulic energy to electricity" (Ellabban *et al.* (2014:757).

2.2.3.4 Biomass

Biomass is a term used for all organic material originating from plants, trees and crop, and is essentially the collection and storage of the sun's energy through photosynthesis (Ellabban *et al.*, 2014). Biomass energy (bioenergy) is the conversion of biomass into useful forms of energy, such as heat, electricity and liquid fuels (biofuels). Sugar and oils from plants can be used to make fuel for vehicles (biofuel or biodiesel) and the burning of biomass for heat or electricity is simply called biopower (Herbert *et al.*, 2014). Biomass energy is the burning or fermenting of organic material, such as wood, straw, or crop. Biomass can also be converted into energy via anaerobic digestion. In this process, organic material is broken down by bacteria being starved of oxygen in order to create a gas rich in methane that is burned to generate heat and electricity.

According to Constant (2018), "an additional benefit of anaerobic digestion is that the solid waste (digestate) can be used as compost". However, an environmental permit is required for the anaerobic digestion of waste, while the storing of biomass fuels need a great deal of space − finding an adequate supply can also be difficult (Constant, 2018).

Uysal *et al.* (2017) performed a critical review on energy generation from biomass to limit climate change. They came to the conclusion that two of the main driving forces behind policies promoting biofuel development are energy security and climate change mitigation − reduced greenhouse gas emissions combined with the desire to support agriculture and promote rural development also play a pivotal role.

Biomass is certainly not without controversy. Claims are made that healthy trees are used to generate fuel and not waste wood. In addition, the importation of wood pellets defeats the objective of sustainable renewable energy. According to Herbert *et al.* (2014), another burning issue is the fact that valuable agricultural land is being used to grow energy crops rather than food.

Moreover, Ellabban *et al.* (2014) are of the opinion that biomass fuels have a low energy density, and the collection and transportation of these fuels are cost-prohibitive. Bioenergy fuels are intensive with regard to the inputs used, such as land, water, crops, and fossil energy – all of which represent opportunity cost.

2.2.3.5 Geothermal energy

Geothermal energy is a powerful and efficient way to extract renewable energy from the earth by making use of natural processes (Ellabban *et al.,* 2014). Geothermal power and ground source heat pumps use heat that is naturally contained in the ground. Geothermal energy resources are thermal energy found in the earth's interior stored in both rock and in trapped steam of liquid water. Geothermal energy can be resourced in areas where heat from the earth's interior rises to the surface in the form of hot springs or steam. Boreholes in the ground can harvest geothermal energy (Figure 2-3). Once harvested, it can provide heating, hot water, and drive geothermal power plants. Geothermal energy is considered a cost-effective, reliable and environmentally-friendly energy source and under appropriate conditions high, intermediate, and low temperature geothermal fields can be utilised for both power generation and use of heat (Ellabban *et al.*, 2014).

Geothermal energy sources are classified as hydrothermal systems, conductive systems, and deep aquifers. Hydrothermal systems can be either liquid-dominated or vapour-dominated. Conductive systems include hot rock and magma over a wide range of temperatures, while deep aquifers contain circulating fluids in porous media or fracture zones at depths typically greater than three kilometres (Ellabban *et al.*, 2014).

Figure 2-3: Geothermal power generation

Source: Herbert *et al.* (2014)

Geothermal energy is a well-understood technology and can provide both heating and cooling. However, installation requires major civil works. The initial installation can be expensive with payback periods usually more than 15 years (Constant, 2017).

2.2.3.6 Comparison of alternative energy resources

According to Davison (2018), our dependence on fossil fuel must be minimised because it is critical to the health of all living things and the sustainability of most businesses. Nuclear are also not a viable option when considering alternative energy for farming, due to the fact that the cost of nuclear energy keeps on increasing and thus making it only viable for mass production.

Alberts (2005) stated in his study on solar energy that the following four basic reasons explain why the development of alternative energy sources is crucial:

1. The rapid depletion of cheap oil and gas resources.
2. The urgent need to curb the generation of greenhouse gases, such as CO^2 and methane (CH_4).
3. The known dangers of nuclear energy and the lack of a long-term waste disposal strategy.
4. The escalating demand for electrical energy worldwide.

National Geographic (2009a) stated that “harnessing the power of water is the cheapest form of energy, but environmental and other concerns cast doubts on its worth”. Davison (2018) stated that the advantages of wind power heavily outweigh the disadvantages. However, wind power can be fickle − if the wind is not blowing, no electricity can be generated (National Geographic, 2009b).

When it comes to South African resources, a lack in water is experienced but our country boasts abundant sunshine. Most alternative energy resource decisions depend heavily on the difference between individual values (Ohio State University, 2018).

Table 2-1 lists the advantages and disadvantages of making use of alternative energy resources. These advantages and disadvantages can be of assistance when alternative energy resources are considered:

Table 2-1: Comparison between the advantages and disadvantages of utilising alternative energy resources

Solar power	✓ Low maintenance − no moving parts that can break. ✓ Environmentally friendly (non-polluting). ✓ Life expectancy of 20-30 years with low running costs. ✓ Potentially an infinite energy supply.	❖ Reliability depends on the availability of sunlight. ❖ Cost of equipment (can pay for itself in two to three years). ❖ Storage and backup are necessary.
Wind power	✓ Requires little space. ✓ Clean fuel source – do not produce atmospheric emissions. ✓ Cost-effective. ✓ Land around wind farms can have other uses.	❖ Moving parts involve maintenance. ❖ Good winds are found in remote areas. ❖ Turbines can cause both noise and aesthetic pollution. ❖ Turbine blades may harm wildlife.
Hydropower	✓ Relatively inexpensive way to produce electricity. ✓ Clean fuel source. ✓ Renews on a yearly basis due to snow and rainfall. ✓ Flow of water can be controlled.	❖ Damming rivers up may destroy or disrupt wildlife. ❖ Low dissolved oxygen levels in the water. ❖ Potential methane pollution. ❖ Strain on communities around the dams.
Biomass	✓ Lowered levels of greenhouse emissions. ✓ Use of waste materials reduces the need for landfill sites. ✓ Relatively inexpensive resource.	❖ Low energy density. ❖ Collection and transportation can be cost-prohibitive. ❖ High demand for fertiliser, herbicides and pesticides, leading to

	✓ Inexhaustible fuel source.	an increase in air and soil pollution. ❖ High costs are involved regarding technology manufacturing and maintenance.
Geothermal energy	✓ Provides an unlimited supply of energy. ✓ Produces no air or water pollution.	❖ Start-up development costs can be expensive. ❖ Maintenance costs due to erosion can be a problem.

Source: Adapted from various sources

Determining what type of alternative energy to use in farming forms only one part of the decision tree. Another part of the alternative energy resource decision is based on how sufficient, attainable and affordable the alternative energy resource will be. Purchasing a new capital asset requires a valuation, an accurate idea of the total cost over time and a way to finance the acquisition, while leaving enough cash available for other future expenses (Lumen Learning, 2017).

To determine how acquisition takes place, a clear understanding is needed about what a capital investment decision entails and how a finance decision works.

2.3 Capital investment decisions

According to Bragg (2018), a capital investment decision involves the judgement of a business management team on how funds will be spent to procure capital assets. Nikhila (2018) explains that the acquisition of assets should form part of the enterprise expenditure, which will increase production and wealth. Capital expenditure is expected to result in benefits in a future period consisting of one or more years.

Correia *et al.* (2015) define a capital investment decision "as the analysis and evaluation of investment projects that normally produce benefits over a number of years". BPP Learning Media (2015) emphasises that an investment decision is made when an investment opportunity is identified, evaluated, and a decision is made. When businesses decide where to invest their money, they weigh the potential return against the risk. Low expected returns are rarely tolerated (Schwartz, 2011). Capital investment decisions are important, because the future success of companies often depends on the investment decisions made (Correia *et al*., 2015).

Investments must meet at least the following three criteria (Lumen Learning, 2017):

1. The value of the company must be maximised after the amount of risk was considered.
2. It must be financed appropriately.
3. If two of the mentioned criteria cannot be met, the money must be returned to the shareholders or owners.

According to Puška *et al.* (2018), an investment made by companies can in future generate an income that far surpasses the initial investment. It is, therefore, necessary to perceive an investment as a tactic to be used by a company to combat constant changes in the market. When considering investments, companies are faced with making one of the most difficult decisions – the actual investment decision. A wrong decision can cause long-term catastrophic consequences for a company. In a study carried out by Puška *et al.* (2018), a model for improving the decision process was proposed. Puška *et al.* (2018:7) stated that "the purpose of this model is to indicate the need for using methods, such as the multi-criteria analysis method, in order to evaluate the effectiveness of an investment".

Tămășilă *et al.* (2018) tested the relationship between cash flow and the investment decision of companies. They found that cash flow positively influences the level of investment. When the level of an investment is considered, the cash flow influences the asset structure of a company. In the case of financially constrained companies, liquid capital is considered as current assets.

Chaturvedi *et al.* (2014) explored the capital investment decision requirements for the generation of electricity, while Bistline et al. (2018), investigated the important role of capital investments as an essential managerial duty where the generation of electricity is concerned. Painting (1985) compared the theory and practice of corporate finance in the South African mining industry. The researcher first examined the investment decision and then the financing decision. Six major mining houses were interviewed. In the current study, an additional step was taken − the capital investment decision and financing decision were scrutinised, and an interview was conducted as part of the case study. A decision tree was then designed to assist with these two decisions.

When a business is in the process of deciding which project they should invest in to assist in business growth, one question moves to the forefront: Will the generation of cash flow be worth the result of the investment required (Merrit, 2018).

Various techniques exist that can be used in the evaluation of capital investments. For the purpose of this study, net present value (NPV), internal rate of return (IRR), and discounted payback period were used, because these techniques take time value of money into account. Marchioni and Magni (2018) focused in their study on investment decisions and a sensitivity analysis: NPV consistency of rates of return. They noted that in capital budgeting, different criteria are used for evaluating a project, measuring economic efficiency, and making decisions. NPV is considered the most theoretically reliable tool. Traditional NPV consistency is important, but under uncertainty a NPV or a rate of return are not the only factors that drive a decision. With their paper, Marchioni and Magni (2018) positioned themselves in the interface of operational research and finance.

The NPV technique considers the time value of money. It involves the future cash flow of a project, discounting the cash flow at the company's required rate of return (cost of capital), and subtracting the cost of the investment from the present value (Correia *et al*., 2015). If the result is positive, it can be viewed as an indication that the project results will increase the value of the company (Correia *et al*., 2015). As indicated by Puška *et al.* (2018), the NPV is the sum of all future net cash flows of an investment project reduced to present value by making use of the discount technique, which involves lessening the initial investment in the investment project.

As stated by Schwartz (2011), when it comes to alternative energy the return on investment is measured by money saved, compared to what would have been spent on traditional forms of electricity.

The formula for the NPV is as follows:

$$\text{NPV} = \sum_{t=1}^{n} \frac{C_t}{(1+k)^t} - I$$

Where: C_t = net cash flow at time *t*

I = cost of the investment

k = cost of capital

Source: Correia *et al*. (2015)

When using the NPV to determine the value of a proposed capital investment, the cost of capital of a business must first be determined, because the return on a project must exceed the required return of the business as indicated by its cost of capital. The cost of capital of a company is the rate that must be earned in order to satisfy the combined required rates of return of the providers of capital. BPP Learning Media (2015) explains that weighted average cost of capital (WACC) is appropriate to use as a discount rate to discount cash flows after taxation, but before interest since these represent the earnings available to all the providers of finance. The value of equity is then determined by subtracting the value of debt. According to Correia *et al*. (2015), the formula one would use to determine the WACC of a company should reflect the after-tax cost of each source of finance weighted by its contribution to the value of the company.

The formula for WACC is as follows:

$$\text{WACC} = K_d(1-t)(D/V) + K_e(E/V)$$

Where: K_d = cost of debt

K_e = cost of ordinary equity

t = marginal tax rate

D = market value of debt

E = market value of ordinary equity

V = market value of the company

Source: Correia *et al*. (2015)

The use of this formula is limited and only applicable to listed companies due to the fact that this formula is based on market values.

To calculate the WACC, the following three steps must be followed (Correia *et al*., 2015):

1. Establish the component cost of the company.
2. Determine the weighting of each component.
3. Calculate the WACC.

The IRR is the discount rate that causes the present value of the net future cash flow to equal the cost of the investment (Correia *et al*., 2015). The IRR is used in capital investment decisions to estimate the profitability of potential investments. When the IRR is calculated, the company's cost of capital is not required for the calculation. However, when projects are evaluated the project with the highest IRR will be selected, provided that the IRR exceeds the cost of capital (Correia *et al*., 2015).

The formula for IRR is as follows:

$$\sum_{t=1}^{n} \frac{C_t}{(1+r)^t} - I = 0$$

Where: C_t = net cash flow at time *t*
I = cost of the investment
r = internal rate of return

Source: Correia *et al*. (2015)

The discounted payback period is used to determine the profitability of a project. Correia *et al*. (2015) states that a discounted payback period is the time it takes for the present value of a project's cash flows to equal the cost of the investment. It is the position where the NPV of a project is equal to zero.

2.4 Finance decisions

Finance decisions are based on how companies will pay for their investments (Merrit, 2018).

There are two ways to finance an investment (Lumen Learning, 2017):

1. By using the internal funds – money that the company already has.
2. By raising money from external funders – borrowing funds.

When raising money from external funders, the loan has to be paid back with interest; the interest is also known as the cost of borrowing. It is, therefore, important to make sure that the cost is not too high, and that the company can afford the extra costs involved.

Tindale (1977) completed a technical study that focused on the different methods of financing and created a computer model to make the computation of costs easier. He also studied finance decisions within a business as a whole. He concluded that it is impossible to generalise as to which method of financing is the most favourable. Existing conditions in a company, the industry, and the economy must be considered. In this study, a decision tree with calculations was, therefore, designed that works closely with the investment decision to make the choice easier with regard to the implementation of alternative energy resources.

Determining the value of an investment is one thing, but to determine whether an investment is worth financing is very challenging. To invest the money involves costs, either the opportunity cost of not investing it elsewhere, the cost of borrowing money, or the cost of selling equity (Lumen Learning, 2017).

Loan financing may take place in the form of a term loan, which is a loan that is repayable over a fixed period and often relates to a specific financing requirement, such as an investment in a plant and the equipment (Correia *et al*., 2015). The major source of long-term financing is bank loans. An important decision when borrowing money, will be whether management should take on a variable interest rate or fixed interest rate, if the company is going to repay the loan in equal instalments or perhaps in the form of a balloon payment at the end of the project.

Baker (2015) investigated the fundamental roles that the different modes of finance play in shaping the renewable energy sector and how the relationship between finance and renewable energy in South Africa has evolved thus far. Though fuel costs for wind and solar projects are non-existent, the high upfront capital cost of a project must be met by the developer and the related debt investment and equity finance. Lenders provide finance-based debt on a fixed loan term and are not liable for any losses the project may make and to minimise risk is their key priority. While lenders are in first receipt of the financial revenues generate by a project, returns for equity investors are more dependent on a project’s successful generation of a return.

Lam and Law (2018) investigated financing for renewable energy projects: a decision guide indicating development stages in a case study. In this study, they determined that the funding of renewable energy projects entails the use of different types of financial instruments. While well-established renewable energy developers may be experienced with regard to the financial market from which they tap on funding resources regularly, start-ups are usually inventors who lack financial background. In the study carried out by Lam and Law (2018), their aim was to identify suitable financing modes for renewable energy projects with the specific objective of providing guidance on funding decisions.

Mazzucato and Semeniuk (2017) researched the financing of renewable energy: who is financing what and why it matters. They stated that "successful financing of innovation in renewable energy requires a better understanding of the relationship between different types of finance and their willingness to invest in renewable energy" (Mazzucato & Semeniuk, 2017). Cheung *et al.* (2016) recommend measures to be used, such as financial evaluation tools, in small-scale renewable energy projects.

The financing structure of renewable energy projects depends on the availability of natural resources, technical maturity, and the financial viability of renewable energy technologies (Lam & Law, 2018). When the decision tree is used, the finance decision is the next step in determining the implementation of alternative energy resources.

In order to determine the current amount of debt held by a company (the financial risk), the implications of the returns of that debt and the extent to which additional external fund can be acquired, four ratios can be calculated (Correia *et al.*, 2015): 1) debt ratio; 2) debt to equity; 3) times interest earned; and 4) EBITDA coverage ratio. Due to the scope of this study, only one debt ratio and one profitability ratio were calculated.

When investigating the liquidity of a company to determine whether the company can purchase a capital asset with its own funds, two ratios were discussed by Correia *et al.* (2015): the current ratio and the quick ratio. The current ratio was used to determine the liquidity of the company due to the fact that the farm does not keep stock on hand for long periods of time.

The following ratios were, therefore, taken into consideration when the financing route was determined:

1. Debt ratio:

$$\text{Debt to equity} = \frac{\text{Total debt}}{\text{Total equity}}$$

2. Profitability ratio:

$$\text{Times interest earned} = \frac{\text{EBIT}}{\text{Interest}}$$

3. Liquidity ratio:

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

By analysing these ratios, a clear understanding was obtained (Correia *et al*., 2015):

1. Debt to equity – to what extent the debt was covered by the shareholders' funds.
2. Times interest earned – to what extent the earnings can decline without causing financial loss to the business and an inability to meet the interest cost.

3. Current ratio – to what extent the claims of short-term creditors are covered by assets that can be translated into cash in the short term.

It was very important to look at the separation principle in this instance. With the separation principle the capital investment decision must be separated from the financing decision. If a capital project is viable, then it is worth doing regardless of whether the company makes use of their own money for funding or borrows money.

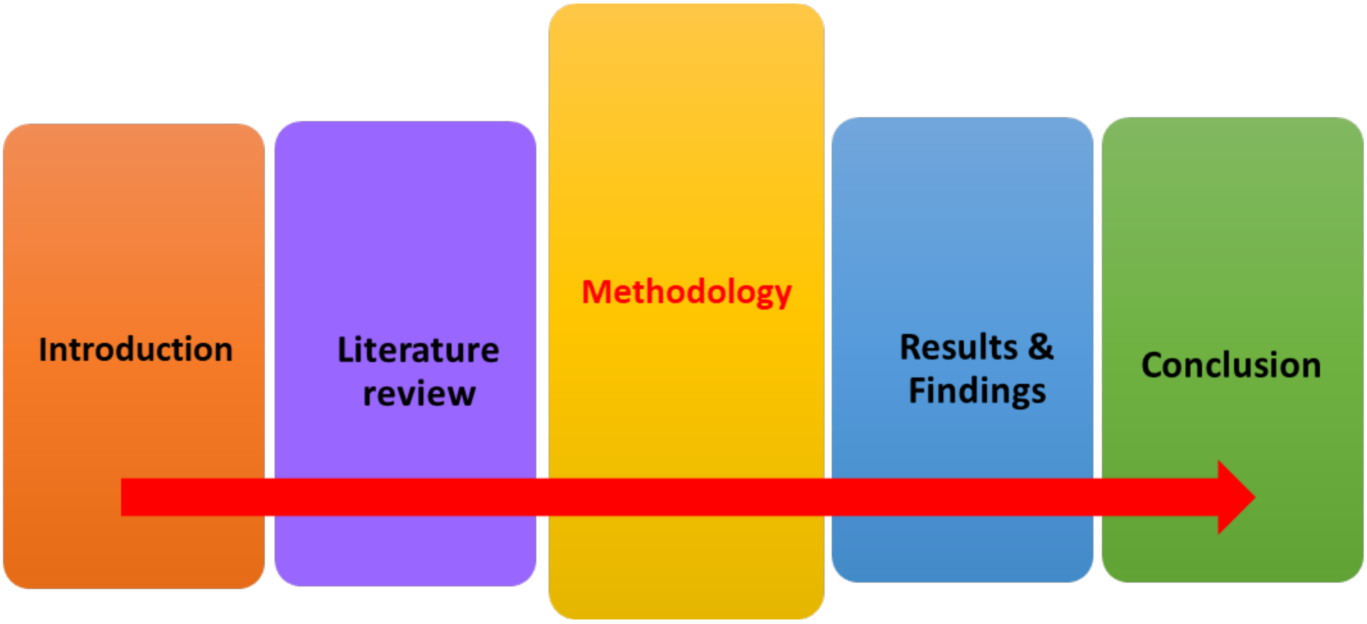
2.5 Summary

At the end of this chapter it was important to understand what types of alternative energy are available, how each type of alternative energy resource can impact the farm, how the investment decision works and after the investment was determined, how the financing of an investment can take place.

An in-depth explanation was given to highlight the importance of an investment decision and the formulas used in this study were discussed. The formulas used for making the finance decision were also discussed comprehensively.

By understanding the above-mentioned, the first secondary objective of this study, namely to investigate the alternative energy resources available for Company X, was met. The process to complete the capital investment and finance decision tree was also completed.

In Chapter 3, the second secondary objective of the study is examined by identifying and explaining the appropriate methodology of this study. The methodology focused on a case study in conjunction with a semi-structured interview. The case study and interview assisted the researcher in understanding the data to enable her to finish the designing of the decision tree.



CHAPTER 3 METHODOLOGY

3.1 Introduction

Chapter 2 focuses on the literature review. In order to achieve the first secondary objective of this study – to investigate the alternative energy resources available to Company X – the approach of other scholars was investigated. The capital investment and finance decision are also discussed in Chapter 2 to gain insight from the perspectives of other scholars with regard to capital investment decisions and financing decisions.

Chapter 3 focuses on the second secondary objective – appropriate methodology. Methodology is concerned with how a research process was approached and includes everything from the theoretical application to the collection and analysis of data (Wilson, 2013).

Bless *et al.* (2008:1) stated that “in order for society to progress, new knowledge about the world must be constantly generated. Gaining new knowledge involves a process of formulating specific questions and finding answers to them in order to gain a better understanding of ourselves and our environment”.

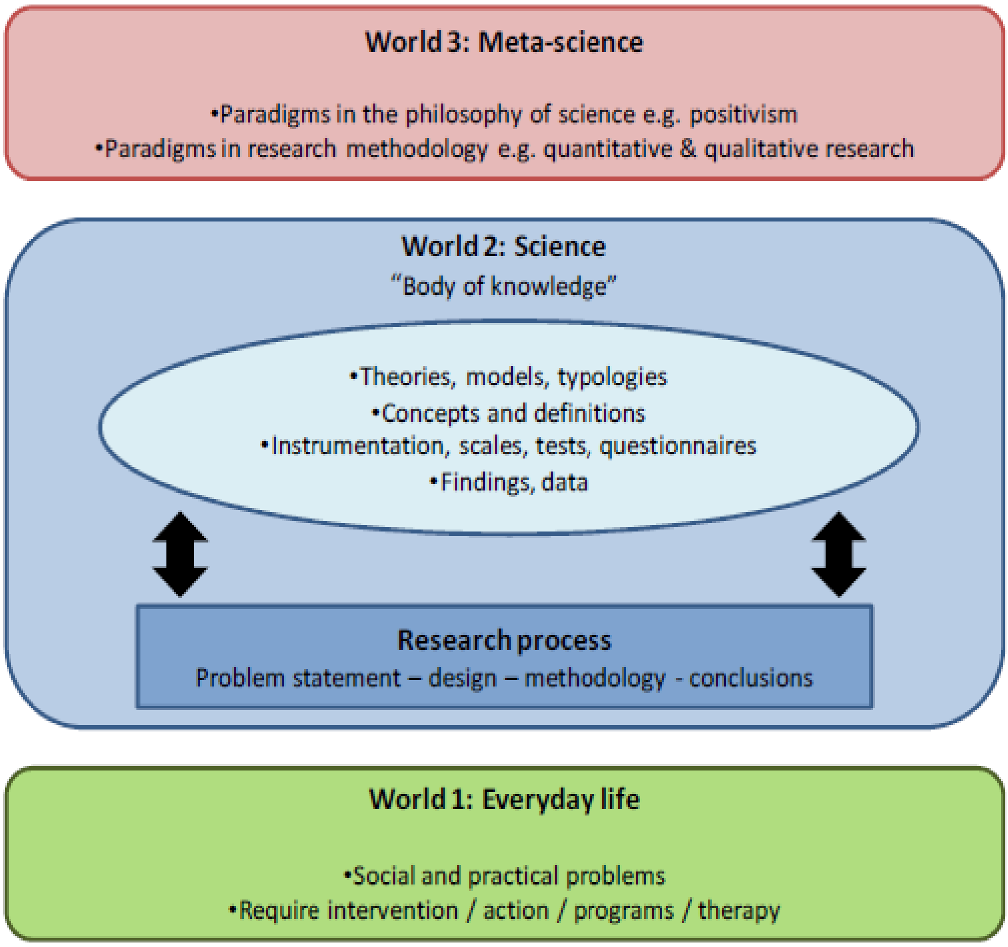
It was important to distinguish between real-life problems and research problems. Mouton (2015) explains this phenomenon by defining or conceptualising the research problem as a process in which a real-life problem is identified and ‘translated’ into a research problem. This logic can be explained by the Three Worlds framework.

This framework (Mouton, 2015) is based on a distinction between three ‘worlds’:

World 1: The world of everyday life and lay knowledge.
We live in this world as ordinary human beings in multiple contexts. In the world of everyday life, we produce and use different kinds of knowledge. This knowledge is referred to as lay knowledge and enables us to cope effectively with our daily tasks.
World 2: The world of science and scientific research.
The most distinctive feature about this world is that scientists select phenomena from World 1 and make these into objects of enquiry. The search for 'truth' or 'truthful knowledge' is the overriding goal of science. The aim of science is, therefore, to generate truthful descriptions, models and theories of the world.
World 3: The world of meta-science.
In World 3, the focus is on meta-disciplines that are involved in a reflection of the nature of science and scientific research.

Figure 3-1 shows the three worlds from the perspective of doing research, and how to distinguish between research problems in World 2 and real-life problems in World 1. At the end of the chapter, after discussing the research methodology, it was clear that this study fell in the category of a World 3 study.

Figure 3-1: The relationship between meta-science, science and everyday life knowledge (a focus on research problems)



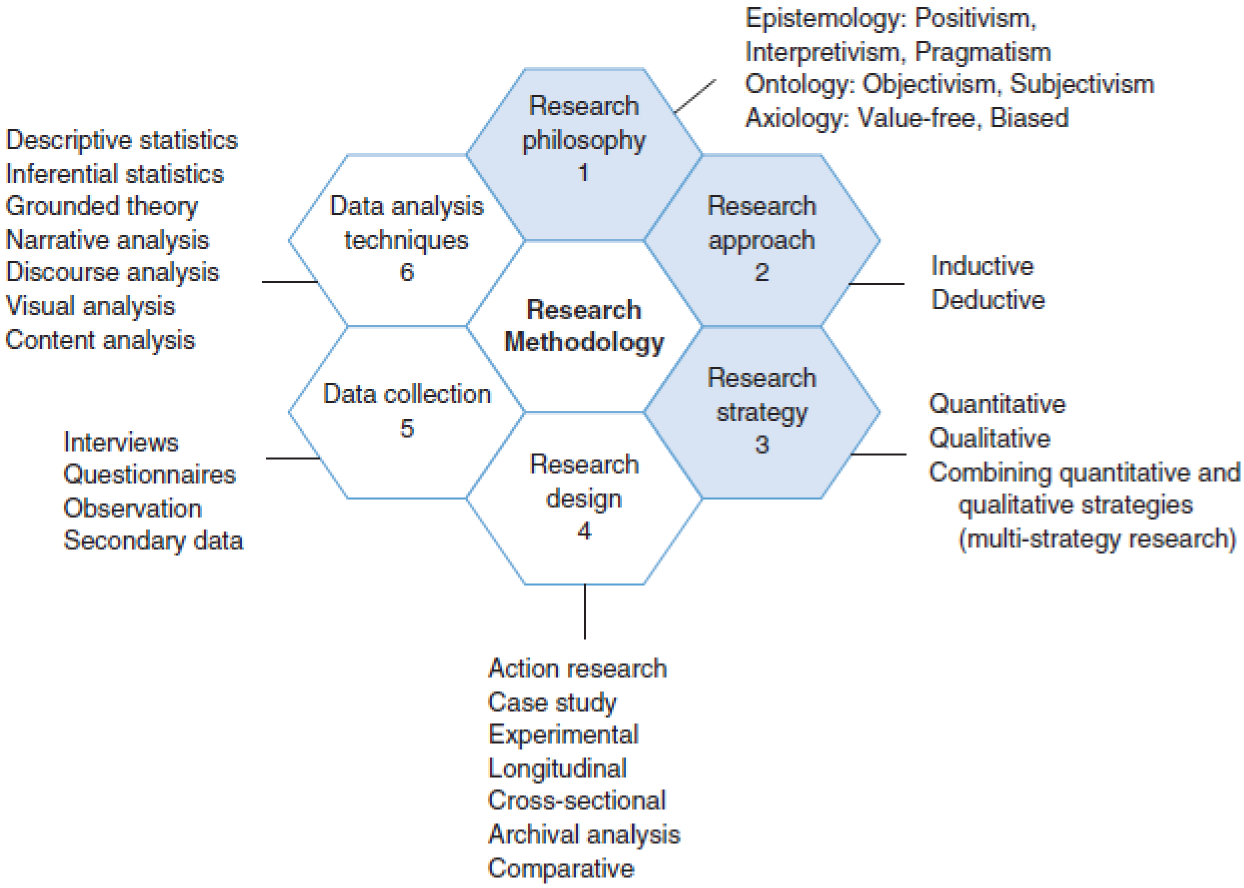
Source: Mouton (2015)

Research problems are often formulated as research questions to assist with focusing on the research problem. The research question for this study was as follows:

Can alternative energy be purchased for the vegetable farm and how will it be financed?

Research methodology can be defined as follows: "The approach and strategy used to conduct research" (Wilson, 2013:3). Mason (2014:52) states "that if we accept that our understanding of reality affects the way we gain knowledge of reality, then we need to accept that this will affect how we actually conduct research about reality". Research philosophy, research approach, and research strategy are the three key concepts of research. If they are joined with three other elements, namely research design, data collection, and data analysis techniques, they come together to form research methodology. The research methodology of this study can be explained with the aid of the *Honeycomb of Research Methodology*, as illustrated by Wilson (2013) in Figure 3-2:

Figure 3-2: The Honeycomb of Research Methodology



Source: Wilson (2013)

3.2 Research philosophy

Research philosophy refers to a study of the universe in an orderly and logical fashion. Research philosophy focuses on the world and the nature of research that researchers add to a study (Cresswell, 2014). According to Mason (2014), the different views of the world and the processes that operate within these views, all form part of what is known as philosophy. Philosophy is concerned with views about *how* the world works. What you think constitutes knowledge, will impact the way that you go about your research (Wilson, 2013). The paradigm we use to view the world on a day-to-day basis is very probable to also impact how we conduct research (Mason, 2014). An understanding of the research philosophy is, therefore, fundamental to how a research study is approached.

Research philosophy can be divided into two subdivisions: epistemology and ontology.

3.2.1 Epistemology

According to Wilson (2013), epistemology refers to the nature of knowledge and how we perceive our surroundings. Epistemology is concerned with how we gain knowledge (Mason, 2014). What we think of as real, affects the way we gain knowledge. The key questions when it comes to epistemology are: What is acceptable knowledge? and How can we know anything? (Mason, 2014).

A paradigm consists of the assumptions researchers make about reality, it serves as the lens through which reality is interpreted. Two main opposing epistemology paradigms exist: positivism and interpretivism. Both of these paradigms are different in terms of what constitutes knowledge, although certain aspects correlate with both.

3.2.1.1 Positivism

If you assume a positivist approach, you are independent of your research and your research can be truly objective – you are able to maintain minimal interaction with your research participants when carrying out your research (Wilson, 2013). Mason (2014) states that universal truths can be discovered by carrying out objective research by not interacting with what is being researched.

A positivism paradigm follows a strict set of guidelines. Positivists search for what they consider to be objective, universal truths by making use of standardised data-gathering techniques (Rubin & Rubin, 2012). As stated by Rubin and Rubin (2012), positivists assume that there is one correct version of reality and that it can be discovered by applying quantitative measurement tools. This kind of research is usually based on a deductive approach, moving from theory to observation. According to Wilson (2013), positivists want their findings to apply to the whole of a population. Positivist research also boasts a high level of reliability due to a highly structured approach.

"Researchers critical of the positivist approach are likely to argue that interesting insights are liable to be lost if one adopts positivism" (Wilson, 2013:10).

3.2.1.2 Interpretivism

Interpretivists take on an active role when carrying out their research. They often research a particular subject comprehensively. The purpose of interpretivist research is not to generalise, but to be actively engaged through high levels of interaction and participation (Wilson, 2013). According to Mason (2014), the attitudes and behaviour of participants can be determined when researchers interact with them.

Interpretivism is, therefore, an epistemology paradigm that supports the view that researchers must enter the social world of what is being examined (Wilson, 2013). A key factor during interpretivist research is to understand the social world of the research participants. Interpretivist researchers are often interdependent with their research and, therefore, truly subjective. Interdependent means that researchers are likely to interact with their research participants – they accept that there is a reality, but argue that it cannot be measured directly but only perceived by individual persons. Individuals have their own unique lens through which reality is perceived and this lens affects what they see and how they interpret what they find (Rubin & Rubin, 2012). Interpretivist research is usually based on an inductive approach, moving from observations to theory.

Researchers critical of interpretivism tend to focus on the issues of measurement and reliability. Most research studies tend to be qualitative of nature and do not normally adopt any precise system of measurement. Therefore, reliability in the sense of accuracy and repeatability can be questionable (Wilson, 2013).

3.2.2 Ontology

Ontology is concerned with the nature of reality. According to Wilson (2013), the main question when it comes to ontology is, How do we perceive the social world? or How do we view the world? Mason (2014) asks the question, What is real?

When researchers are of the opinion that the perceptions and actions of social actors create social phenomena, then a subjectivist view is adopted. Subjectivism can be clearly linked to interpretivism in that researchers examine the motivation and social interaction of participants (Wilson, 2013).

If researchers favour an external view of the world, objectivism is highlighted. According to Wilson (2013:11), "objectivism is an ontological stance that implies that social phenomena are based on external realities that are beyond our reach or control".

In this study, epistemology was the research philosophy within an interpretivism paradigm due to the fact that there was interaction between the researcher and Company X through a semi-structured interview and the analysis of secondary data.

3.3 Research approach

Research methods are often associated with an inductive or a deductive approach. These methods differ based on the goals of a research study and how these goals are achieved. "Is the purpose of a study to test theories and discover general principles or to describe and explain complex situations?" (Rubin & Rubin, 2012:15).

3.3.1 Inductive approach

When researchers decide to follow an inductive approach, they make observations about their research and may contribute to the development of a new theory (Wilson, 2013). Mouton (2015) states that an inductive approach involves applying interpretations from specific observations to a theoretical population. If researchers work inductively, they will build an explanation from the ground up, based on what is discovered (Rubin & Rubin, 2012).

During an inductive approach, data are collected and a theory is developed as a result of the data analysis. This type of research is often associated with qualitative methods.

3.3.2 Deductive approach

When researchers decide to follow a deductive approach, they apply theory rather than attempting to generate new theory (Wilson, 2013). According to Rubin and Rubin (2012), a deductive study starts with broad theories and ideas and then implications are systematically tested.

A deductive approach focuses on the development of a hypothesis based on existing theory. A research strategy is designed to test the hypothesis. This type of research is often associated with quantitative methods.

Figure 3-3 shows the interrelation between an inductive and deductive research approach and where theory applies to both these approaches.

Figure 3-3: The interrelation between an inductive and deductive research approach and theory

Source: Wilson (2013)

In this study, an inductive approach was followed. The focus moved from the particular (Company X) to the general (various South African vegetable farms). The data were collected from Company

X and a decision tree was designed to assist with the decision to make use of alternative energy sources.

3.4 Research strategy

According to Bless *et al*. (2008), the following distinctions can be made when it comes to research strategies:

The first distinction in terms of research strategies is what methodology was used. The two terms that are often used are qualitative and quantitative research strategies (Wilson, 2013).

- *Quantitative research* relies on measurements to compare and analyse different variables. It examines data that are numerical. A quantitative strategy is viewed as objective and involves data collection methods, such as questionnaires (Wilson, 2013).
- *Qualitative research* uses qualifying words or descriptions to record aspects of the world. It examines data that are narrative. A qualitative approach is viewed as subjective and involves data collection methods, such as interviews (Wilson, 2013).

The second distinction in terms of research strategies is the reason why research is conducted (Bless *et al*., 2008). The aim of research can be basic or applied and affects the way in which the research is conducted.

- *Basic research* – studies that primarily aim to increase an understanding of a particular aspect of society.
- *Applied research* – studies that primarily aim to solve a particular problem confronting a group of people.

The third and most traditional distinction in terms of research strategies is the demands of the research question (Bless *et al*., 2008). The choice of research questions is rarely arbitrary and depends on the aim of the research.

- *Exploratory research* − very little is known about the research topic. Research is carried out to obtain a broad understanding of a situation, phenomenon, community or person.
- *Descriptive research* – researchers are interested in describing a phenomenon.
- *Correlation research* − the research questions require an understanding of the relationship between variables.
- *Explanatory research* − the research questions require an understanding of the relationship between variables and demonstrate that change in one variable causes change in another variable.

This study made use of applied research − the problem concerning electricity usage in a specific community (Company X) was investigated. Exploratory research was also applied − a lack in basic information with regard to alternative energy resources, and investment and finance decisions. In this study, a qualitative research strategy was followed. In the case where research is conducted on a topic that is immature, as such in this study, and the phenomena under investigation have not been adequately described, qualitative research is used (Bless *et al*., 2008). Qualitative research produces descriptive data and researchers seek to understand phenomena in a real-life context. Researchers are objective, and an instrument during the gathering of data. Researchers collect data by interacting with selected participants in a natural setting (Range, 2013). In addition to the semi-structured interview, a document analysis of secondary data was used as a data collection method.

3.5 Research design

A research design entails a plan or blueprint of how the research is going to be conducted. A research design needs to answer the research question, what type of study is undertaken in order to provide adequate answers to the research problem and what kind of evidence is essential to address the research question (Mouton, 2015). According to Yin (2009), the design is the logical order that connects the empirical data to the original research question and lastly, to its conclusion.

The research design in this study was in the format of a case study. In a case study, social data is organised and the object of the study is viewed as a whole (Bless *et al*., 2008).

According to Yin (2009:18), the technical definition of a case study is as follows:

> "*A case study is an empirical inquiry that*
> - *investigates a contemporary phenomenon in depth and within its real-life context especially when*
> - *the boundaries between phenomenon and context are not clearly evident."*

Case study research is considered a qualitative experimental method, due to the fact that researchers collect data by interacting with selected participants in a natural setting. Case studies focus on an issue to provide insight into that issue (Range, 2013).

According to Johansson (2003), a case study is expected to capture the complexity of a single case − in this instance, Company X. Critics of the case study method believe that the study of a small number of cases can offer no grounds for establishing reliability or generality of findings (Soy, 1997). How can generalisations then be made from a single case study? Generalisations from cases are not statistical, they are analytical and based on reasoning (Johansson, 2003). Case studies are generalised to theories. Case studies do not represent a sample. In doing a case study, the goal is to expand and generalise theories and not to enumerate frequencies. The analysis was, therefore, not done to generalise but to particularise (Yin, 2009).

Soy (1997) proposes six steps that should be used when executing research in the form of a case study:

1. Determine and define the research questions (Chapter 1).
2. Select the case study and determine the data gathering and analysis techniques (Chapter 2 and 3).
3. Prepare to collect the data (Chapter 4).
4. Collect data in the field (Chapter 4).
5. Evaluate and analyse the data (Chapter 4).
6. Prepare the report (Chapter 4 and 5).

Case study research present various advantages and disadvantages. The advantages of a case study are as follows:

- ✓ Well suited to study certain phenomena (Range, 2013).
- ✓ Provide compelling illustrations to support a theory (Range, 2013).
- ✓ High construct validity (Mouton, 2015).
- ✓ In-depth insight is gained (Mouton, 2015).
- ✓ Rapport is established with the research subjects (Mouton, 2015).
- ✓ Important evidence is obtained to complement experiments (Yin, 2009).
- ✓ Applicable to real-life issues (Soy, 1997).
- ✓ Publicly accessible through written reports (Soy, 1997).

The disadvantages of a case study are as follows:

- ❖ Depending on what observers choose to include, their choices may be biased (Range, 2013).
- ❖ Data collection and the analysis can be very time-consuming (Bless *et al*., 2008; Mouton, 2015; Yin, 2009).
- ❖ Data cannot be easily compared to other results (Bless *et al*., 2008).
- ❖ Reduces the ability to generalise (Mouton, 2015; Yin, 2009).
- ❖ Non-standardisation of measurements (Mouton, 2015).
- ❖ Lack of rigour (Yin, 2009).

Case study results relate directly to the everyday experiences of individuals and facilitate an understanding of complex real-life situations (Soy, 1997).

3.6 Data collection

Data are collected to measure observations in a scientific manner. Measure in this sense does not necessarily mean numerical, as an attitude and feeling can also be measured. (Bless *et al*., 2008). Data are gathered by making use of a variety of data collection methods. These methods include: Observations, interviewing, testing, as well as selecting and analysing of texts (Mouton, 2015).

When researchers collect their own data for the purpose of a specific study, the data are viewed as primary data (Bless *et al.*, 2008). This is the most appropriate way to collect data, since the data gathering is directed towards answering exactly the questions raised by researchers. Sometimes researchers make use of data collected by other investigators regarding other research problems or as part of the normal gathering of social data and are viewed as secondary data (Bless *et al.*, 2008). In Table 3-1 the main data collection techniques are compared with the advantages and disadvantaged of each technique. When deciding what data collection technique to use in a study, it is important to consider all of the elements associated with a specific technique so that the most appropriate technique is applied in a study.

Table 3-1: Different data collection techniques

Method	Description	Advantages	Disadvantages
Interviews	Involves direct personal contact with participants who are asked to answer questions relating to the research problem. The interview can be: o Structured (questions detailed and prepared in advance). o Semi-structured (have questions, but can probe and ask follow-up questions). o Unstructured (open conversations).	✓ Very helpful in exploratory research. ✓ Help clarify concepts and problems. ✓ Allow for the discovery of new aspects of the problem by exploring the explanations supplied. ✓ Networking opportunities.	❖ Biases may be introduced. ❖ Time-consuming. ❖ Expensive. ❖ Difficult to arrange interview times. ❖ Difficult to compare and analyse information.
Questionnaires	Questionnaires are completed by the participants themselves without the assistance of an interviewer. This can be done either by distributing questionnaires and collecting them once the documents have been	✓ A large coverage of the population can be realised with little time or cost. ✓ Anonymity is assured, and at the same time bias is avoided. ✓ Some types of	❖ Sufficient level of literacy is needed. ❖ Response rate may be low. ❖ Responses from undesired participants. ❖ Questions may be

	completed, or by mailing it and asking participants to send it back. (Non-personal method of gathering information.)	questions can be more appropriately dealt with due to no time constraints. ✓ Cost-effective.	misinterpreted. ❖ Responses may not be specific enough.
Observations	Recording of the behavioural patterns of participants, events, or objects without interaction taking place. These observations can be done in the following ways: o Non-participant observation. o Participant observation. o Modified participant observation.	✓ A better understanding of a research area is gained. ✓ Assists researchers in asking questions they may not have thought of.	❖ Costly. ❖ Time-consuming. ❖ Cannot be applied to many aspects of social life. ❖ Travelling costs. ❖ Authorisation and consent.
Document analysis	Focus on all types of written documents that can shed light on a topic.	✓ Unobtrusive method. ✓ Easy to conduct. ✓ Can take place anywhere. ✓ Useful for large volumes of text.	❖ Authenticity of data sources. ❖ Difficult to obtain information.
Focus groups	Discussions with two or more participants. Researchers must have a good understating of the topic. Debate interaction is necessary.	✓ Participants can discuss the issues with one another. ✓ A deeper insight into the topic is gained. ✓ Inputs from a number of individuals are received	❖ Dominant behaviour displayed by some members of the group. ❖ Biases may be introduced. ❖ Language barriers. ❖ Sensitivity issues.

		simultaneously.	

Source: Adapted from Wilson (2013)

In a case study, data are collected from individuals and institutions in everyday situations (not in a laboratory, library or with the use of a survey questionnaire), and researchers must, therefore, learn how to integrate real-world events with the requirements of the data collection plan (Yin, 2009). Control over the data collection environment is, therefore, minimal.

In this study, data collection was done by conducting an interview and performing a document analysis. The document analysis consisted of scrutinizing and analyzing the figures and information as obtained in the financial- and management statements and the electricity bills.The interview was conducted with the farm owner and relevant information was collected from the vegetable farm. This interview was not transcribed due to the fact that it was informative in nature. The information obtained from the interview was used as background information on the farm activities. A site visit was done as part of the interview to gain a better understanding of the environment, farming operations and how the potatoes are processed. Relevant information that was collected for the document analysis includes financial statements, management statements and the kilowatt-hours of electricity being used (electricity bills).

When an interview is conducted as part of a case study, additional limitations may occur:

- The interviewee's schedule and availability must be taken into consideration.
- The interviewee may not necessarily cooperate fully, due to the open-ended questions asked.
- While making observations about real-life activities, the researcher can be viewed as an intruder in the world of the subject being studied. Special arrangements must, therefore, be made to limit strained behaviour.

When a document analysis is performed as part of a case study, additional limitations may occur (Maree, 2017):

- Unfair treatment of authors.
- Misinterpretation of the ideas of authors.
- Selective interpretation to suit the argument of the researcher.
- Poor organisation of the information.
- Difficulty in selecting appropriate data.
- Poor integration of data.

3.7 Data analysis techniques

Once the data collection and checking have been completed, researchers should analyse the data. According to Mouton (2015), an analysis involves the breaking up of the data into manageable themes, patterns, trends, and relationships. The process followed during a data analysis can take many different forms depending on the nature of the research question and design (Bless *et al.*, 2008).

Bless *et al*. (2008) explains that quantitative data are often analysed by making use of a range of descriptive inferential statistical procedures, while qualitative data are analysed with techniques especially designed for this kind of data.

According to Yin (2009), there are five analytical techniques that can be applied when making use of a case study:

1. Pattern matching – this technique compares an empirically-based pattern with a predicted one (or several alternative predictions). If the pattern coincides, the results can help a case study to strengthen its internal validity.
2. Explanation building – the goal with explanation building is to analyse the case study data by building an explanation about the case.
3. A time-series analysis – this technique is to conduct a time-series analysis, directly analogous to the time-series analysis conducted in experiments and quasi-experiments. The essential logic underlying a time-series analysis is the match between the observed trend and some rival trend specified earlier.
4. A logic model – this model deliberately stipulates a complex chain of events over an extended period of time. The events are staged in repeated cause-effect-cause-effect patterns.
5. A cross-case synthesis – this technique is especially relevant if a case study consists of at least two cases. A cross-case synthesis can be performed whether the individual case studies have previously been conducted as independent research studies or as a predesigned part of the same study.

The data analysis technique that was used in this case study was explanation building, as this research was explanatory in nature. Explanatory research is used when a broader understanding of a situation is gained.

The following process was followed (Yin 2009):

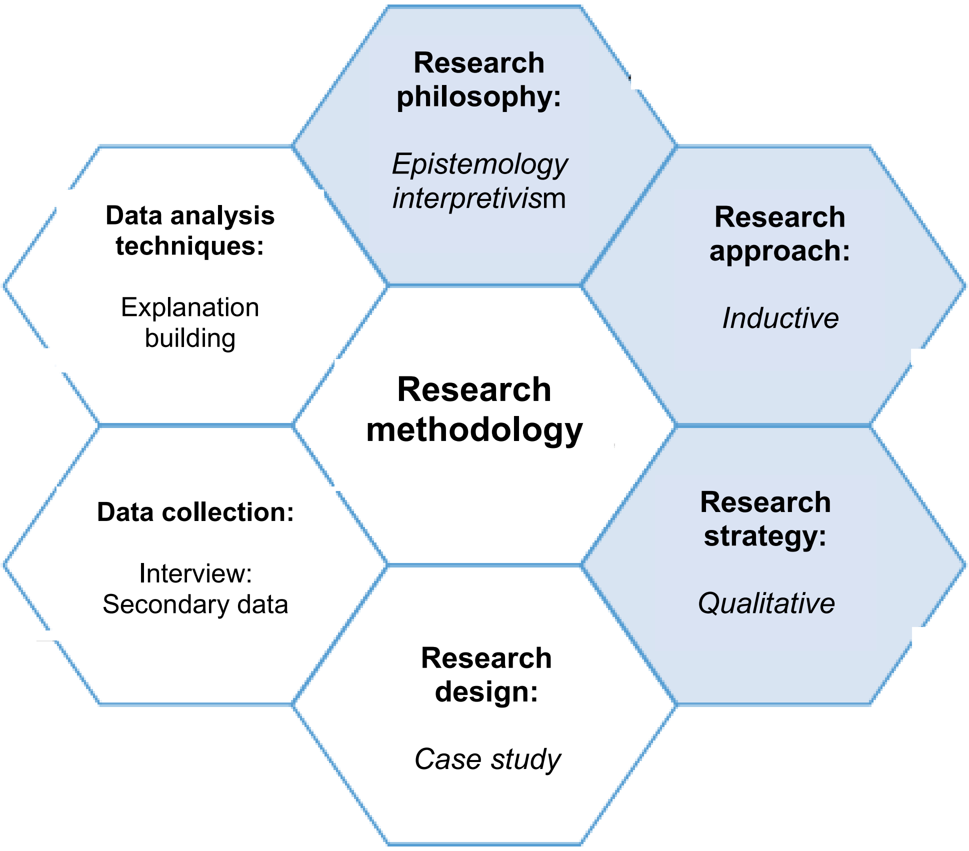
- An initial theoretical statement about the use of electricity on the vegetable farm was made.
- The initial findings of the case study were compared to the initial statement.
- The statement was revised.
- Other details of the case study were compared to the revision.

In this sense, the case study evidence was examined, theoretical positions were revised, and the evidence was examined from a new perspective.

3.8 Summary

In Chapter 3, the second secondary objective, namely the research methodology of this study, was discussed. This was done by following the *Honeycomb of Research Methodology*, as illustrated by Wilson (2013) in Figure 3.2. After a discussion of all the elements of research methodology, the honeycomb for this study can be illustrated as follows (Figure 3-4):

Figure 3-4: The honeycomb of the research methodology for the developing of a capital investment and finance decision tree for alternative energy resources at Company X

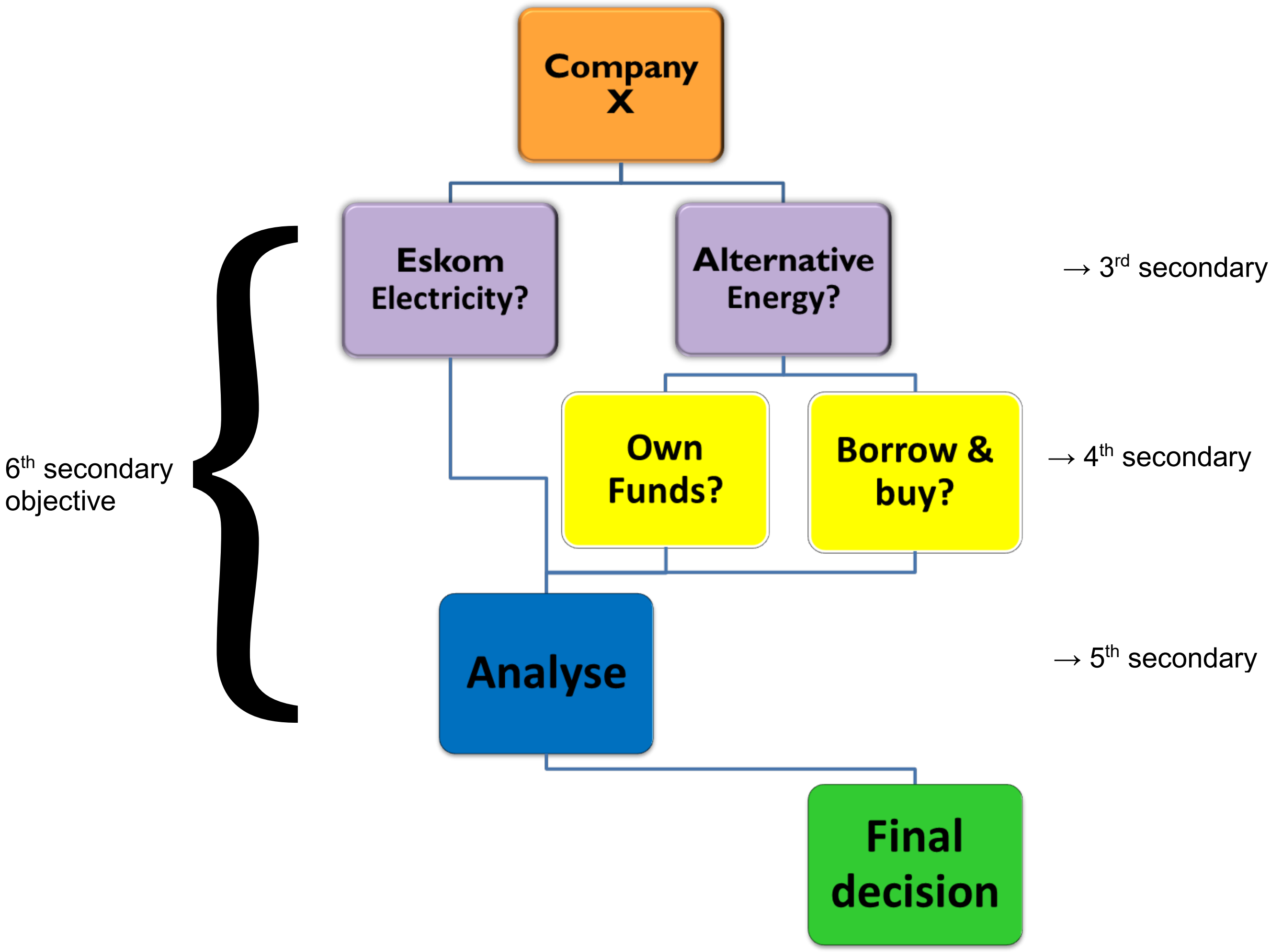


Source: Adapted from Wilson (2013) (own research)

A capital investment and finance decision tree for alternative energy resources at a vegetable farm (Company X) was designed. To design this decision tree, an inductive reasoning approach was applied because one vegetable farm (specific) was used to create a decision tree that will be usable for other vegetable farms (in general). Note that the general does not imply generalization. The general implies that no specifics need to be included in the framework.

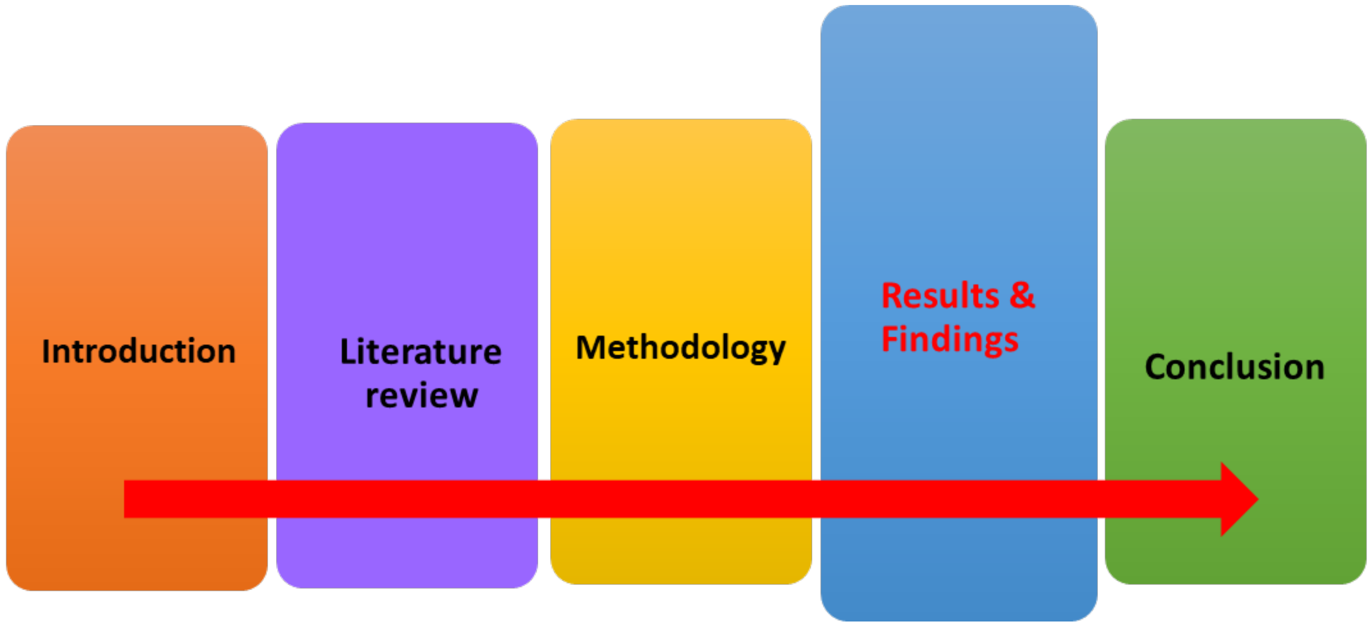
This was a qualitative and interpretive study that investigated a vegetable farm (Company X). The financial records of the vegetable farm were analysed and an interview was conducted to obtain all of the relevant information. The design of the decision tree was based on interpretations of the information gathered on the vegetable farm and is unique to this study. This study was, therefore, classified as a World 3 study, because studies that operate in World 3 make use of interpretive research that is inductive and qualitative in nature. All these elements of the study were building blocks to create a new model/theory or in this instance, a decision tree.

Figure 3-5: Decision-making process with secondary objectives



In Chapter 4, the results and findings of this study are discussed. Chapter 4 focuses on the third, fourth and fifth secondary objectives, namely:

iii. To analyse the viability of alternative energy resources by applying selected capital investment decision-making techniques.
iv. To analyse the finance decision.
v. To solve the problem for Company X: Can alternative energy be purchased and how will it be financed?



CHAPTER 4 RESULTS AND FINDINGS

4.1 Introduction

The research question for this study was to determine whether alternative energy can be purchased and financed for Company X.

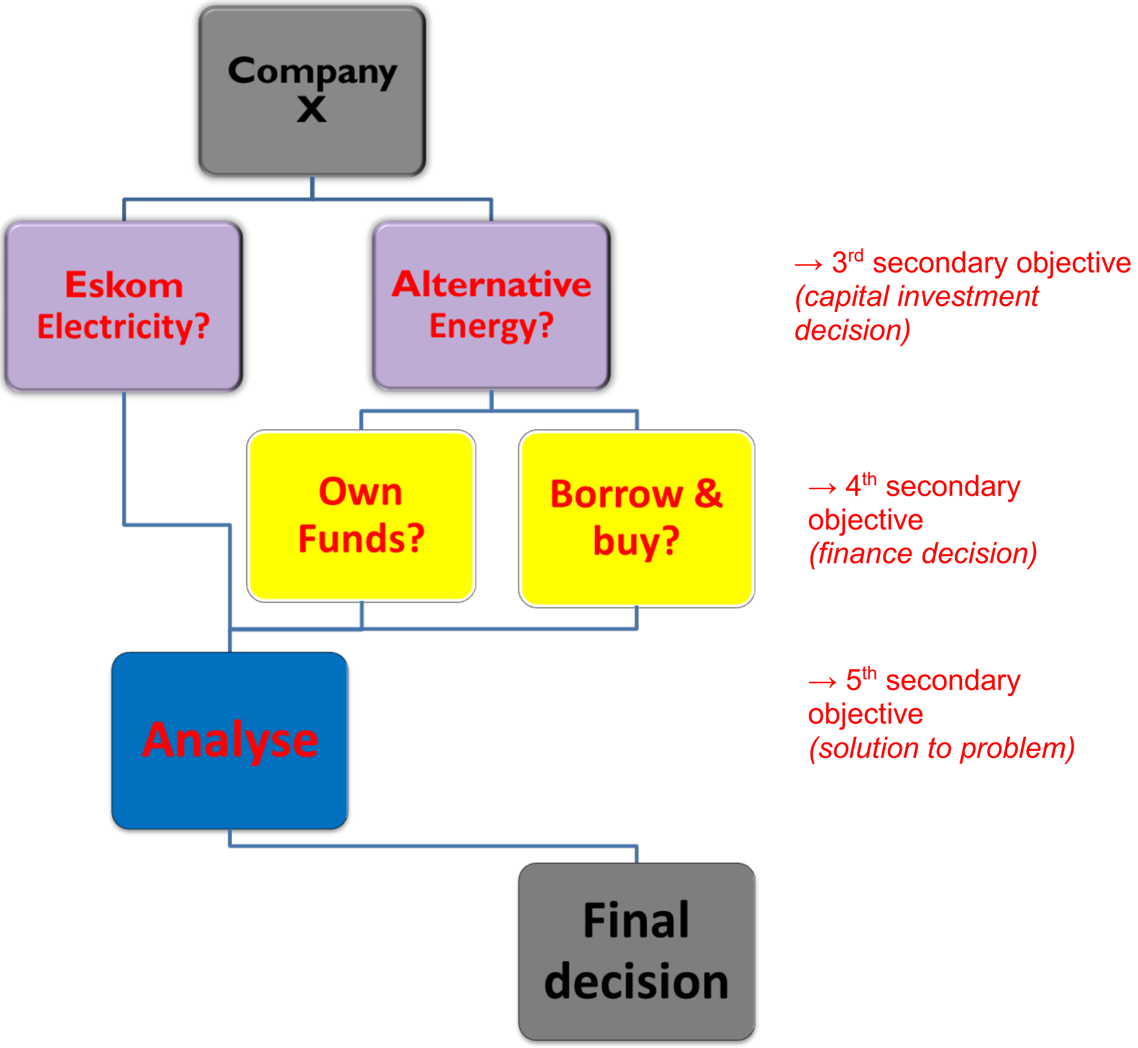
In Chapter 2, a literature review was completed to investigate the insights of other scholars with regard to the same topic. An explanation was given in Chapter 3 with regard to what methodology was followed in this study and the second secondary objective was achieved.

In Chapter 4, the focus was on the third, fourth and fifth secondary objective (Figure 4-7), namely:

- To analyse the viability of alternative energy resources by applying selected capital investment decision-making techniques.
  The WACC of Company X was determined, and was used as the discount rate in the NPV calculation. The NPV calculation determined whether alternative energy could be a good investment.
- To analyse the finance decision.
  The finance decision was made with the use of two separate scenarios. Firstly, the debt to equity ratio was calculated, and the times interest earned ratio to determine how much debt Company X currently had and if there was any scope for additional debt. Secondly, the liquidity of Company X was scrutinised. The current ratio was calculated to determine if there was enough cash available to purchase alternative energy outright.
- To solve Company X's problem.
  All the calculations that were done in the third and fourth secondary objectives were analysed to reach a conclusion with regard to whether alternative energy could be purchased and

financed. All these calculations were done based on information that was collected during the course of the case study.

Figure 4-1: Decision-making process with the 3rd, 4th, and 5th secondary objectives



4.2 Case study

4.2.1 Research process

In research, every approach has its own purpose, methods of conducting the enquiry, strategies of collecting and analysing the data, and criteria for judging quality (Maree, 2016). Qualitative research is a process in which a study is conducted in a natural setting. As mentioned in Chapter 3, Soy (1997) proposes six steps that should be used when executing a case study as part of a qualitative research study. In this study, the six steps were used as follows:

Step 1: Determine and define the research questions

The focus of the study was established by forming questions about the research problem and by determining a purpose for the study. A literature review (Chapter 2) was, therefore, performed to determine the findings of prior studies that focused on the same issue and the literature was then used to define the research question for this study. The problem was identified in Chapter 1: the availability and uncertainty of electrical supply to businesses/farms. Guidance was needed during the decision-making process regarding the capital investment and the finance decision when alternative energy was considered for Company X. The research question for this study was: *Can alternative energy be purchased for the vegetable farm and how will it be financed?*

The question pinpointed the angle that was used to search for evidence and assisted with determining the methods of analysis to be used in the study. The literature review, definition of the purpose of the study and the early determination of the potential audience for the final report guided how the study was designed, conducted and reported on (Soy, 1997).

Step 2: Select the case study and determine data gathering and techniques of analysis

During the design phase of this study, the data gathering approaches and techniques of analysis were determined. During this process, it was important to constantly refer back to the purpose of the study, so that evidence was collected in such a way to satisfy the purpose of the study and answer the research question (Soy, 1997).

Chapter 2 and 3 focus on the data gathering approaches and techniques of analysis. In the methodology chapter, it was identified that this study would be best executed by making use of a case study. According to Soy (1997), "a key strength of the case study method involves using multiple sources and techniques in the data gathering process". The data required for this study were collected by conducting i) a semi-structured interview and performing ii) a document analysis.

i) The semi-structured interview was conducted with the manager/owner of the farm and was informative in nature. Although questions were prepared (Annexure A), the purpose of the interview was to gain background knowledge on how the farm operates and what the requirements are in terms of electricity consumption. A site visit was also included with the interview to experience the activities and packing operations of the farm.
ii) A document analysis was performed by collecting documents that assisted in answering the research question. Financial statements, management statements and the kilowatt-hours of the electricity being used (electricity bills) were collected. The electricity bills were used for an analysis on the kilowatt-hours used to determine the electricity requirements before installing alternative energy. The financial and management statements were used during the management accounting calculations and ratios to determine the capital investment decision and financing decision.

Step 3: Prepare to collect the data

Case study research generates a large amount of data from multiple sources. A systematic organisation of the data is, therefore, important to prevent researchers from becoming overwhelmed by the amount of data and to prevent them from losing sight of the original research purpose and question (Soy, 1997).

In this study, a vegetable farm was located with problems regarding electricity and whose owner was willing to share adequate information. The purpose, confidentiality, and contributions of the study were explained. A list of questions was compiled for use during the semi-structured interview. These questions were specifically chosen to obtain additional insights into the operations of the farm and their needs concerning electricity requirements. Documents were selected to aid with the calculations in order to conclude with a capital investment decision and finance decision.

Step 4: Collect data in the field

To collect the data, a site visit was arranged with the owner of the farm. During the site visit, the auditor of the farm was also present. The semi-structured interview was conducted with the predetermined questions. Although the questions were predetermined, the interview was semi-structured to obtain background information. The interview was approached in a very informal manner focusing on the research question. The financial statements, management statements, and the Eskom electricity bills were collected and used during the document analysis of secondary data.

Step 5: Evaluate and analyse the data

The tactics used during the analysis of the data forced the researcher to move beyond her initial impressions to improve the accuracy and reliability of the findings (Soy, 1997). The data obtained during the site visit was evaluated first to determine the relevance and accuracy of the information gathered.

The data were then analysed by making use of content analysis, narrative analysis and observations. The climate patterns, electricity requirements, and management accounting calculations and ratios of the farm were tabulated to determine the capital investment and financing decision.

Step 6: Prepare the report

The report transforms complex issues into more straightforward information that can easily be understood. This process allows readers to question and examine the study and to reach an understanding independent of the researcher (Soy, 1997). In this study, the report is in the format of a decision tree. This decision tree can be used as a valuable tool when companies experience similar challenges. At the end of the report (Chapter 5), suggestions are made with regard to future research and possible shortcomings are summarised.

4.2.2 Farming

The case study was done on a farm outside Bothaville in the Free State. The farm specialises in crop farming with a special interest in potatoes, mealies, sunflowers, and soya. The total hectares utilised for crop farming are 2,512 hectares of which 125 hectares are specifically used for potatoes.

The study focused on the requirements of the farming and processing of the potatoes, even though the potatoes still formed part of the bigger farming operations. The potato farming entails the planting and harvesting of the potatoes as well as the washing, sorting and packaging of the potatoes, so that the potatoes are ready for distribution.

After the potatoes are harvested, they are delivered to the storing facility. Here, the potatoes go through the sorting machine where they are washed. Any discolouration, defects and blemishes are detected and these potatoes are rejected. The potatoes are sorted according to size by making use of different sized screens; these screens keep the big potatoes behind and let the smaller potatoes through for further size sifting. When the potatoes are sorted according to size, they are packed and weighed in agreement with the specific selling requirements.

4.2.3 Storing facility and electricity

The storing facility is 1,200 m² in size (Picture 4-1), and is used for the processing of potatoes. Electricity is of crucial importance in the packing process of potatoes and without the storing facility, this process cannot happen. The processing of potatoes takes place in the storing facility and the sorting machine, conveyer belts, and scales are all dependent on electricity. If there is a power outage for whatever reason (maintenance, theft, or load shedding), the storing facility grinds to a halt and the product cannot be processed or distributed.

Picture 4-1: Aerial satellite picture of the potato storing facility

Source: Google Maps (2010)

The overall supply of electricity in South Africa is a big concern (De Vos, 2016). With Eskom implementing load shedding from time to time, the planning and executing of packaging are a challenge. Moreover, cable theft is escalating and is causing power outages without any prior warning. The other issue with electricity in South Africa is the rapidly increasing electricity tariff (Paton, 2018).

To be able to maintain the packaging process − without losing productivity due to power outages (or losing too much profit due to exorbitant electricity costs) − an alternative was investigated.

4.2.4 Energy requirements

The electricity use of the storing facility on the farm is shown in Table 4-1:

Table 4-1: Monthly electricity use of the storing facility on the vegetable farm

	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Total for 12 months
kWh	14,870	11,203	5,796	3,759 *	5,463	6,993	10,272	11,326	10,948	17,024 **	13,099	13,099	123,852
R/month	23,382	17,842	10,703	19,431	9,791	12,516	16,675	18,385	18,674	27,494	21,870	21,870	218,632

Average monthly kWh usage over a 12-month period: 10,321 kWh (123,852/12)
Lowest monthly kWh usage over a 12-month period: 3,759 kWh*
Highest monthly kWh usage over a 12-month period: 17,024 kWh**

The desired outcome for the farm was to be totally independent from the electricity grid, due to the fact that the storing facility is highly dependent on electricity and if power outages occur, the processing and packaging of the potatoes come to a standstill.

4.3 Alternative energy

As part of the literature review in Chapter 2, all of the alternative energy options were discussed. All of the mentioned alternative energy options are, however, not viable for every business, household or farm.

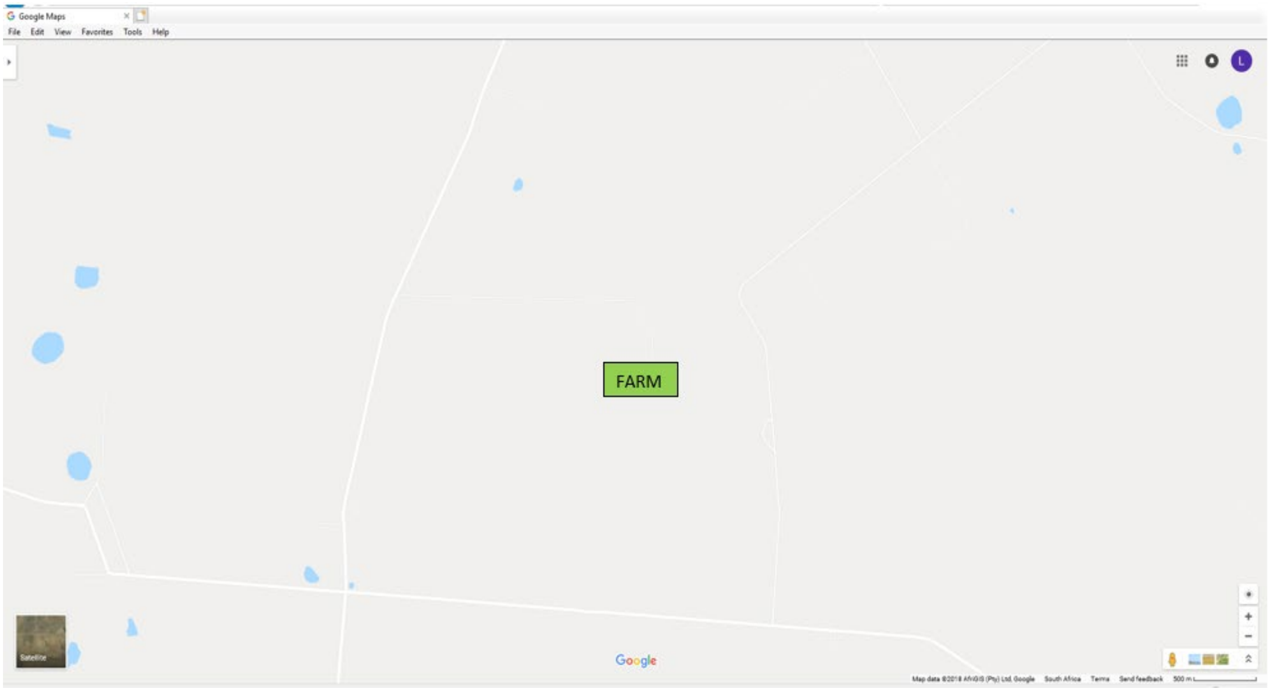
During the case study, the vegetable farm was visited to determine what environmental factors can be used as possible options as alternative energy resources. The environmental factors that were taken into account were as follows: the amount of sunshine on the farm; strength and regularity of wind; strong water resources in the vicinity; thermal energy under the ground; and biomaterial available for biomass.

It was decided to focus on the implementation of renewable energy resources, due to the fact that fossil fuels are harmful for the environment and not sustainable.

4.3.1 Hydropower

Hydropower is electricity generated by making use of the energy of moving water. The flow of water from a higher to a lower elevation can be used to generate hydropower. According to National Geographic (2009a), the amount of electricity that can be generated depends on how far the water drops and how much water moves through the system.

Picture 4-2: Aerial map of the vegetable farm and surroundings



Source: Google Maps (2010)

Picture 4-2 depicts the area around the vegetable farm. It is clear from the picture that there are no noteworthy water sources available near the farming operations (also no moving water). For hydropower to function at all, a strong water source is required. The generation of hydropower cannot, therefore, be accomplished, due to the fact that no water source is available near the vegetable farm.

4.3.2 Biopower / Biomass

Biopower occurs when biomass is burned to generate electricity. Biomass can also be converted into energy via anaerobic digestion. Anaerobic digestion requires environmental permits and a substantive amount of biomaterial to create biomass. Storing biomass fuels also require a great deal of space. Unfortunately, there is not enough space available on the farm to consider biopower.

4.3.3 Geothermal energy

Geothermal energy is a powerful and efficient way to extract renewable energy from the earth by natural processes (Ellabban *et al.*, 2014). Geothermal energy can be extracted in areas where the heat from the earth's interior rises to the surface as hot springs or steam. Boreholes in the ground harvest the geothermal energy, and it can then be utilised for power generation.

The installation necessary for harvesting geothermal power requires major civil works. On the vegetable farm, there is also no heat from the earth's interior that rises to the surface as hot springs or steam. Geothermal power was, therefore, also not a viable option for the vegetable farm.

4.3.4 Wind power

Wind power is converted into mechanical energy when wind is captured that flows freely through our atmosphere. Mechanical energy is then turned into electricity (Sykes, 2018). The Free State region is, however, not known for wind but for sunshine.

According to Bhutta (2018), wind power potentially exists wherever wind occurs at the rate of 7 to 9 meters/second. To convert the wind strength from meters/second to kilometres/hour, the wind strength per meters/second is multiplied by 18 and then divided by 5 (Math Worksheets 4 Kids, 2018). 7 to 9 meters/second are converted to kilometres/hour (7-9 x 18/5). A wind speed of 25.2 to 32.4 kilometres/hour are, therefore, required for the generation of wind power.

Table 4-2: Bothaville – average wind speed

WIND

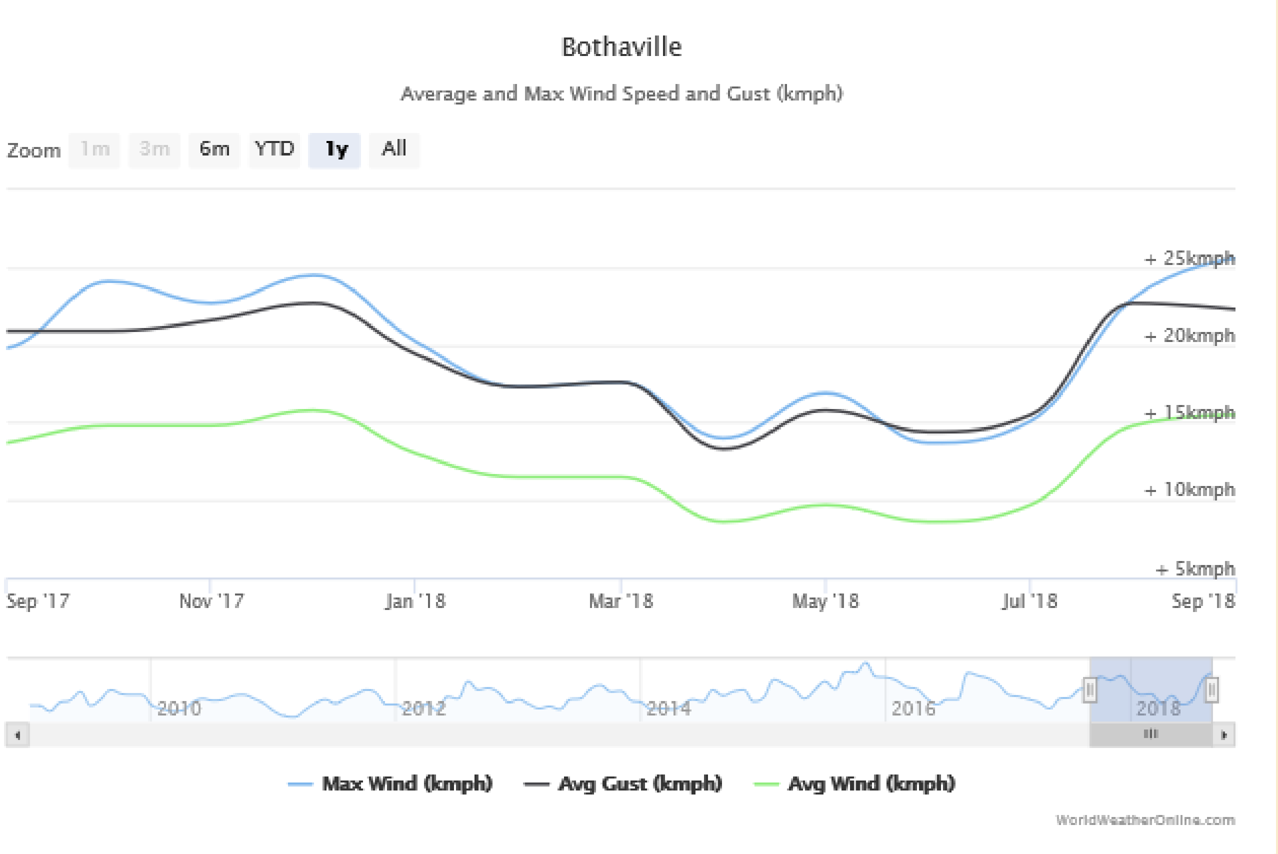
Average Wind Speed — Years on Record: 112

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
km/h	10	10.8	9.4	8.3	7.6	7.2	7.9	8.3	10.1	11.9	13	13	12.2

Source: Weatherbase (2018)

Table 4-2 and Graph 4-1 show the average wind speed for the Bothaville region. According to Graph 4-1, an annual average wind speed of 10 kilometres/hour was measured in Bothaville. According to Bhutta (2018), a wind speed of 25.2 to 32.4 kilometres/hour are required to effectively generate wind power. Unfortunately, the wind strength on the vegetable farm is not nearly as strong as the minimum requirement needed and, therefore, the generation of wind power was not an option for the vegetable farm

Graph 4-1: Bothaville – average and maximum wind speed and gust



Source: Worldweather Online (2018)

4.3.5 Solar power

Solar power makes use of the technology of PV panels that convert solar light radiations into electrical energy. PV has the advantage that it uses not only direct sunlight but also the diffuse component of sunlight. Solar PV produces power even if the sky is not completely clear. Most areas in South Africa receive enough sunshine to make solar energy practical.

Table 4-3 indicates the sky conditions of Bothaville and the sunshine experienced there. On average, a day in Bothaville consists of 12.5 hours of sunshine and annually, 77.6% of the days present sunshine. These statistics indicate that solar power can be quite successful on the vegetable farm.

Table 4-3: Bothaville – sky conditions

SKY CONDITIONS

Average Length of Day — Years on Record: 30

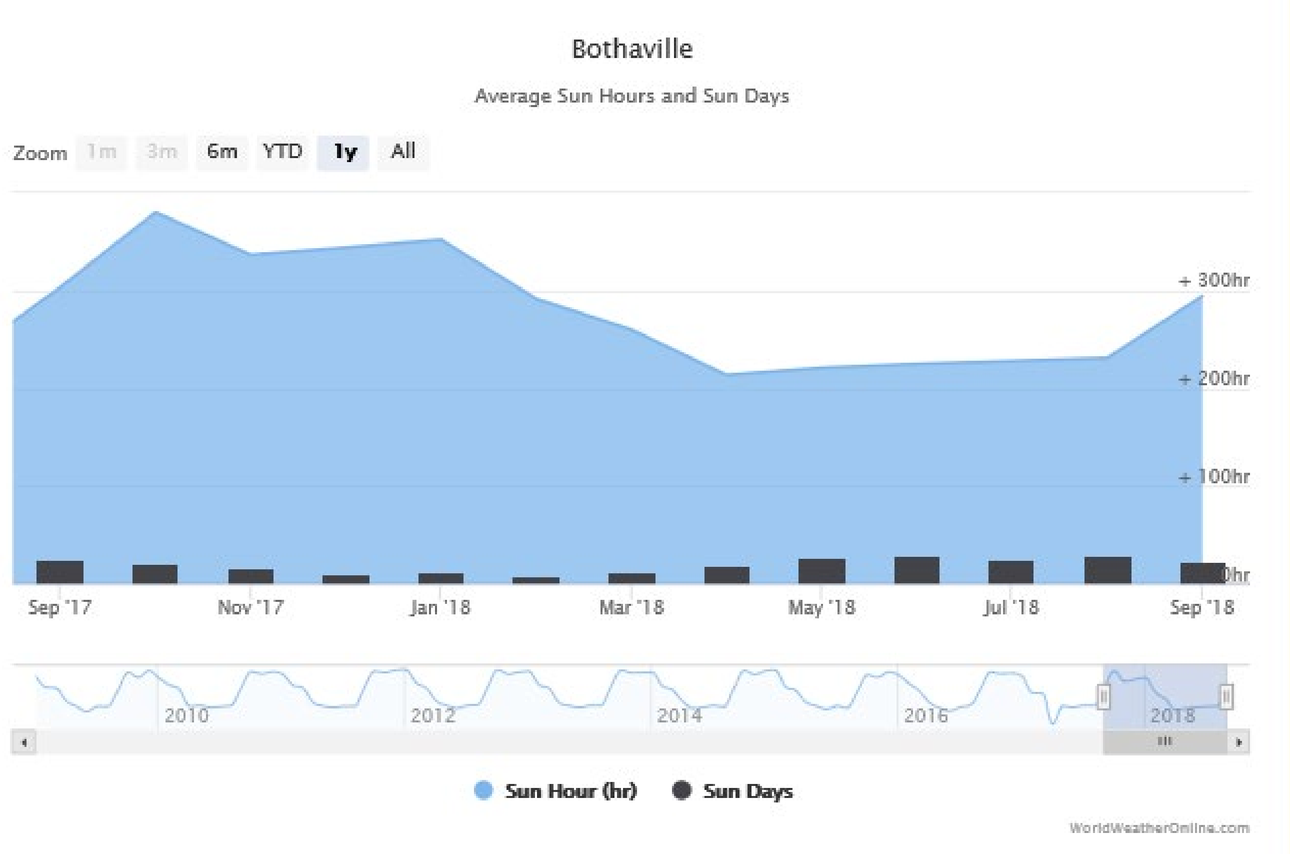
	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Hours	12.5	14.1	13.4	12.6	12.6	11.2	10.9	11	11.6	12.3	13.2	13.9	14.3

Average Possibility of Sunshine — Years on Record: 112

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
%	77.6	69.3	68.8	69.5	74.1	82.8	84.1	88.8	90.7	82.5	75.1	72.5	73.1

Source: Weatherbase (2018)

Graph 4-2: Bothaville – average sun hours and sun days



Source: Worldweather Online (2018)

Graph 4-2 illustrates the total number of sunshine hours experienced per month in Bothaville over the past year. During September to February, the average sun hours per month is high due to the fact that it is summer. In the winter months (March to July), a lower number of sun hours are experienced per month.

The average hours of sunshine per month on the vegetable farm are shown in Table 4-4. The peak months are from October to January (between 336-380 hours of sunshine per month). The lowest months are from March to August (between 213-260 hours of sunshine per month).

Table 4-4: Average hours of sunshine per month on the vegetable farm

	Sep-17	Oct - 17	Nov-17	Dec-17	Jan - 18	Feb-18	Mar-18	Apr - 18	May-18	Jun - 18	Jul- 18	Aug-18
Hours of sunshine	303.50	380.00	336.50	344.00	352.00	291.50	260.00	213.50	221.00	225.00	228.00	231.00
Sunshine days	25.00	22.00	16.00	10.00	12.00	9.00	14.00	19.00	27.00	30.00	25.00	28.00

Source: Worldweather Online (2018)

In Table 4-5 the amount of kWh required on the vegetable farm is shown. The average amount of kWh used on the farm per month is 10,321 kWh, while the lowest monthly usage the past 12 month was 3,759 kWh (Dec.). The highest monthly usage is 17,024 kWh (Jun.) (shown again in Table 4-5). According to Haw (2013), one hour of sunshine equals 1,000 Wh/m² equals 1 kWh/m². When looking at Table 4-4, the amount of sunshine hours on the farm has the potential to produce a large amount of kWh, depending on the diameter of the solar panels installed. On the vegetable farm, solar power panels could have potentially been installed on the roof of the storing facility. The size of the facility is 1,200 m². However, a calculation was used to determine if enough kWh could be produced if solar power panels were installed on a surface of 40 m².

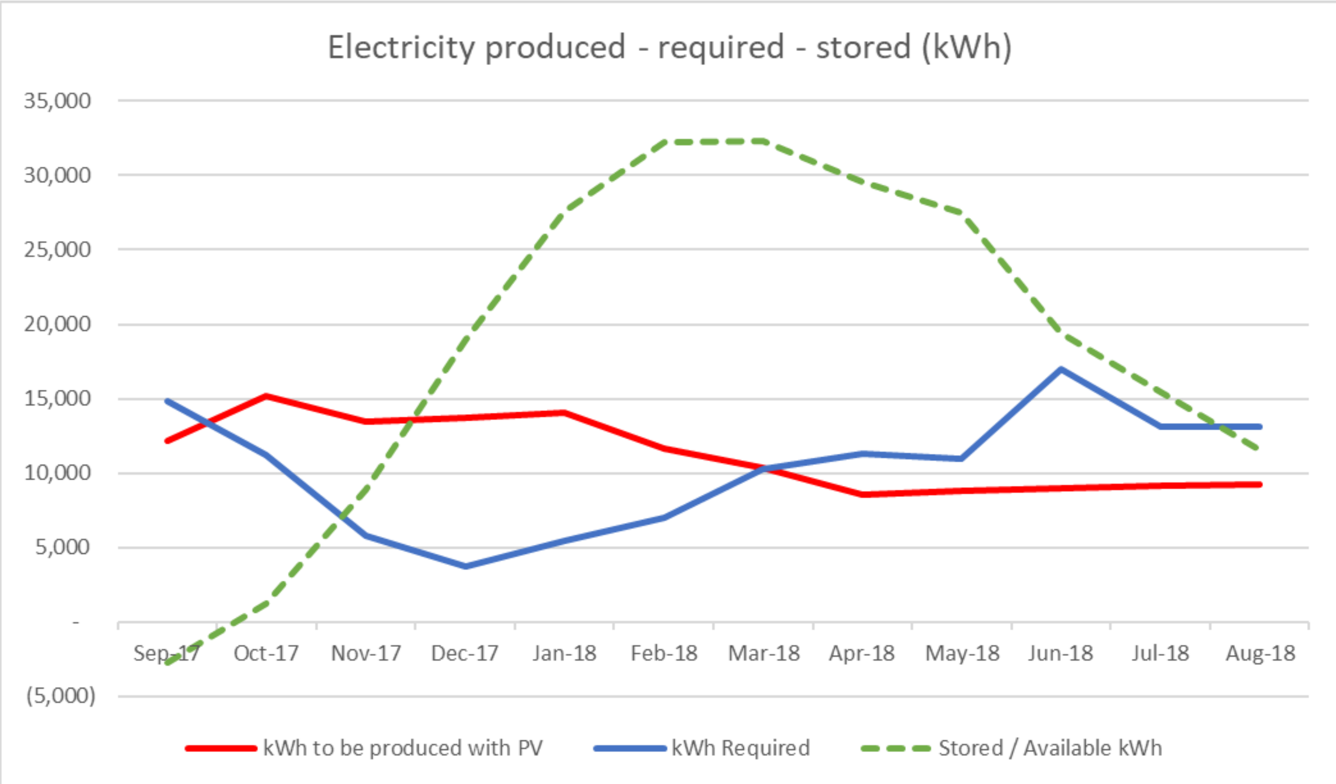
Table 4-5: kWh required and potential production of kWh on 40 m²

	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Total
kWh to be produced with PV	12,140	15,200	13,460	13,760	14,080	11,660	10,400	8,540	8,840	9,000	9,120	9,240	135,440
kWh required	14,870	11,203	5,796	3,759	5,463	6,993	10,272	11,326	10,948	17,024	13,099	13,099	123,852
Stored/ available	(2,730)	1,267	8,931	18,932	27,549	32,216	32,344	29,558	27,450	19,426	15,447	11,588	

Table 4-5 shows the monthly required amount of kWh, based on the usage over the past year. This table also shows that enough kWh can be produced if the solar power panels are installed on 40 m². The storing facility is 1,200 m² in size and the solar panels could be installed in such a way to maximise the amount of energy generated. November 2017 (Table 4-5) is a clear indication that although only 5,796 kWh are required, an amount of 13,460 kWh can potentially be produced. This meant that 8,931 kWh could be stored for usage in a month when the kWh produced was lower that the kWh required, as shown in April 2018.

The information contained in Table 4-5 is also illustrated in Graph 4-3. It is clear in this graph that although the required kWh might have been higher than the produced kWh in some months, the stored electricity can be more than sufficient after the project was active for a month or two.

Graph 4-3: kWh required, produced and stored on PV panels of 40 m²



According to these graphs and tables, the decision was, therefore, made that solar energy was the best possible solution to act as a replacement for Eskom electricity. Subsequently, quotations were obtained from solar providers to establish the cost of installing a solar PV system that can potentially sustain the potato storing facility (Annexure B).

In the process of answering the research question – can alternative energy be purchased for the vegetable farm and how will it be financed – the capital investment decision was then discussed. Was the capital investment in solar energy a viable option for the vegetable farm? After the capital investment decision was made, the finance decision was discussed to determine how solar energy was going to be financed.

4.4 Capital investment decision

The third secondary objective of this study was to analyse the viability of alternative energy resources by applying selected capital investment decision-making techniques.

The capital investment decision for this study was made by making use of a NPV, an IRR, and a discounted payback period calculation.

During a NPV calculation, a project's future cash flow is estimated. The cash flow is then discounted against the company's required rate of return (cost of capital) where after the cost of the investment is subtracted from the present value (Correia *et al.*, 2015). The NPV rule states that if the present value of a project's future cash flow exceeds the cost of the project, then the business should accept the project. If the NPV is negative, the business should reject the project (Correia & Cramer, 2008). A NPV calculation was used so that the time value of money could be taken into consideration.

A discounted cash flow was done for the solar project − the projected cash outflow of the project was used. In this instance, it involved the cost (excluding VAT) to install the solar system on the farm. The quotation for the installation of the solar system can be viewed in Annexure B. The cost for the installation of a 62.7-kWh solar system at that time was R1,122,984. The daily yield from this system was estimated at 344 kWh with a battery storage of 390 kWh.

The next step was to show what cash inflows could be generated in the years to come. As stated by Schwartz (2011), when it comes to alternative energy, the return on investment is measured by money saved, compared to what would have been spent on traditional forms of electricity. When solar power is used, the vegetable farm will no longer make use of Eskom electricity and the costs saved on the farm was shown as cash inflows. The electricity expenses that were used in Table 4-6, were the actual Eskom electricity costs for one year.

Table 4-6: Electricity expenses for one year

Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Total = 1 year
R 23,382	R 17,842	R 10,703	R 19,431	R 9,791	R 12,516	R 16,675	R 18,385	R 18,674	R 27,494	R 21,870	R 21,870	R 218,632

NERSA granted a 5.23% price increase for Eskom's direct customers in the 2018/2019 period (Eskom, 2018). That price increase was taken into consideration in year two. In year three to five, the cost of electricity increased by 15%, as per the indication that was received from Eskom (Paton, 2018; Slabbert, 2018). The assumption seems high, but Eskom and NERSA are very unpredictable. It is however very difficult to determine electricity increases and that is why 2 sources were used to substantiate this increase. The average inflation rate for the past five years

(5.62%) (Statistics South Africa) was used as an increase percentage for the electricity in year six to ten. These cash flows were discounted at the cost of capital rate of the farm.

4.4.1 Weighted average cost of capital (WACC)

According to Correia & Cramer (2008), the appropriate discount rate should be the opportunity rate of return, as measured by a company's WACC. However, there is more than one way to determine a company's WACC. In Chapter 2, the most recognised WACC calculation was described. Unfortunately, the vegetable farm is not listed as a company and Correia *et al.* (2015) explain that there are alternative methods available to determine the WACC for non-listed companies.

To determine the WACC for the vegetable farm (Table 4-7), the weight of the capital components (as per the 2017 financial statements) and the cost of that capital component were taken into consideration (as indicated in the semi-structured interview and the 2017 financial statements). Although the farm operates in departments, the balance sheet is not split by departments. When considering the implementation of alternative energy, although these calculations were only for implementation on the potato operations, it would be financed by the farm as a whole and would impact the total farming operation. Therefore, the balance sheet as a whole was used in the calculations.

To determine the cost of equity, the return on equity expected by the owners (who are also the shareholders) were used. In this instance the expected return on equity was 15%. The taxation implication of 28% in terms of interest paid was taken into consideration.

Table 4-7: WACC calculation for the vegetable farm

WACC calculation:				
	Weight	Cost	After tax	WACC
Equity	14.22%	15%	15%	2.13%
Non-current liabilities	42.48%	11%	8%	3.36%
Finance lease liabilities	4.49%	10%	7%	0.32%
Bank overdraft	38.81%	10%	7%	2.86%
Total WACC	**100**			**8.68%**

The weighted average cost of capital of the vegetable farm was 8.68%. This percentage was then used to determine the discounted cash flow.

4.4.2 Net present value (NPV)

To determine if a capital project is a good investment, the NPV at the end of a discounted cash flow can be viewed as an indicator. The cost of the installation of a solar power system was estimated at R1,122,984 (Annexure B). This amount resulted in a cash inflow due to costs saved from not making use of Eskom electricity: R218,632 in year one; R230,067 in year two; R264,577 in year three; R304,263 in year four; R349,903 in year five; R369,567 in year six; R390,337 in year seven; R412,274 in year eight; R435,444 in year nine; and R459,915 in year ten. The farm's cost of capital, as determined by the WACC calculation in Table 4-7, was 8.68%.

The cash inflows in terms of costs saved due to not making use of Eskom electricity, will only be realised in future. In order to determine their present value, these cash inflows had to be discounted back. In Table 4-8, the present value factors for the ten-year Eskom electricity savings were determined by making use of a discount rate of 8.68%.

Table 4-8: NPV calculation for the vegetable farm

	Cash flow	PV factor	Present value
		8.68%	
Cost (Year 0)	R (1,122,984)	1	R (1,122,984)
Year 1	R 218,632	0.92	R 201,161
Year 2	R 230,067	0.85	R 194,767
Year 3	R 264,577	0.78	R 206,083
Year 4	R 304,263	0.72	R 218,058
Year 5	R 349,903	0.66	R 230,728
Year 6	R 369,567	0.61	R 224,221
Year 7	R 390,337	0.56	R 217,898
Year 8	R 412,274	0.51	R 211,753
Year 9	R 435,444	0.47	R 205,781
Year 10	R 459,915	0.43	R 199,978
	Net Present Value		**R 987,443**

*Amount for installation of a solar power system (quotation can be viewed in Annexure B)

**Amount for the savings in Eskom electricity costs, as explained in Table 4.4 and thereafter.

According to the discounted cash flow, the NPV at the end of the ten years would be R987,443. This means that the NPV will be positive after a period of ten years. According to the NPV rule, if the present value of a project's future cash flow exceeds the cost of the project, then the business should accept the project. The IRR for this project was 23.21%, and implied that the WACC could have increased from 8.68% to 23.21% before the project would not have been viable anymore. The discounted payback period would be 4.3 years. The project had, therefore, the ability to pay itself back within 4.3 years. The project to install a solar power system on the vegetable farm was, therefore, definitely viewed as a good investment.

By determining that the project to install a solar power system on the vegetable farm was indeed a good investment, the first part of the research question was answered, namely to determine whether alternative energy can be purchased for the vegetable farm. The second part of the research question − how the alternative energy project will be financed – is discussed in the next section.

4.5 Financing decision

The capital investment decision showed that installing a solar power system on the farm was a good investment. The next step and also the fourth secondary objective was the financing decision: how to fund the purchase of solar power. Money could have been raised from external funders (borrowing funds), or internal funds could have been used (money already in the possession of the business).

To determine the best financing route, the following calculations were used:

1. To determine if money could have been raised from external funds, the *debt to equity* ratio and the *times interest earned* were calculated.
2. To determine if internal funds could have been used to fund the capital acquisition, the *current ratio* was done.

The figures used in these calculations were obtained from the financial statements, as supplied by the vegetable farm (part of the case study). The financial statements of the vegetable farm are, however, confidential and protected (see the consent form in Annexure C).

4.5.1 Debt to equity

Debt to equity ratio indicates the extent that debt is covered by shareholder funds (Correia *et al.*, 2015). With this ratio, the proportion of the company's assets that are financed through debt can be determined. This ratio can give an indication of a company's ability to repay its obligations. A high debt/equity ratio generally means that a company has been aggressive in financing its growth with debt.

Table 4-9: Debt to equity calculations

	2017	2016	2015
Debt to equity:	Total debt / Total equity	Total debt / Total equity	Total debt / Total equity
	(Other financial liabilities + finance lease liabilities + bank overdraft) / (Share capital + reserves + retained income)		
=	(26,692,112 + 2,818,969 + 24,387,981) / (100 + 8,301,505 + 634,414)	(10,000,000 + 5,102,735 + 25,043.173) / (100 + 8,875,302 + 7,132,304)	(0 + 8,227,049 + 33,922.782) / (100 + 0 + 2,652,250)
=	53,899,062 / 8,936,019	40,145,908 / 16,007,706	42,149,831 / 2,652,350
=	6.03	2.51	15.89
=	603%	251%	1589%

When the results of the debt to equity ratio in Table 4-9 were scrutinised, the ratio varied considerably over the past three years. In 2017, the debt equity ratio was very high (603%). This ration climbed from 251% in 2016. It was, therefore, clear that this farm was financing the company through debt.

4.5.2 Times interest earned

A times interest earned ratio measures the extent to which earnings can decline without causing financial losses, and can indicate the inability of a company to meet the interest cost (Correia *et al*., 2015). This ratio measures, therefore, a company's ability to continue to service its debt. A lower times interest earned ratio means fewer earnings are available to meet interest payments.

Table 4-10: Times interest earned calculations

	2017	2016	2015
Times interest earned:	EBIT / interest	EBIT / Interest	EBIT / interest
	(Profit (loss) before taxation + finance costs) / Finance costs		
=	(-7,753,450 + 6,701,344) / 6,701,344	(4,480,054 + 5,221,689) / 5,221,689	(-4,936,121 + 4,053,652) / 882,469
=	(1,052,106) / 6,701,344	9,701,743 / 5,221,689	(882,469) / 4,053,652
=	-0.16	1.86	-0.22

The results of the times interest earned ratio in Table 4-10 are very low (and even negative). If this ratio is negative, it is an indication that there are no earnings available to meet interest payments.

The results of these two calculations (debt to equity ratio and times interest earned) were taken into consideration and it was, therefore, clear that the vegetable farm must rather not acquire additional debt.

4.5.3 Current ratio

The next step was to investigate the liquidity of the farm to determine if there was cash available to purchase the solar power system without raising money from external funds. This was done by calculating the current ratio.

Theoretically, the acceptable ratio for the current ratio must be 2:1. According to Correia *et al.* (2015), this ratio indicates the extent to which the claims of short-term creditors are covered by assets that can be translated into cash in the short term. If this ratio is not in the region of 2:1, it indicates that a company is not in a good position to utilise available cash for other liabilities that are not currently accounted for.

Table 4-11: Current ratio calculations

	2017	2016	2015
Current ratio:	Current assets / Current liabilities	Current assets / Current liabilities	Current assets / Current liabilities
=	Inventories + trade and other receivables + prepayments + cash and cash equivalents) / (Trade and other payables + other financial liabilities + finance lease liabilities + current tax payable + bank overdraft)		
=	(14,324,521 + 2,804,482 + 1,182,297 + 616,197) / (8,548,196 + 0 + 1,346,910 + 0 +24,387,981)	(14,171,565 + 2,666,940 + 580,000 + (1,931)) / (5,622,942 + 2,000,000 + 2,282,028 + 2,220,969 + 25,043,173)	(14,787,000 + 1,270,540 + 984,168 + 71,417) / (4,386,513 + 0 + 2,653,443 + 1,993,088 + 33,922,782)
=	18,927,497 / 34,283,087	17,416,574 / 34,948,143	17,113,125 / 42,955,826
=	0.55:1	0.50:1	0.40:1

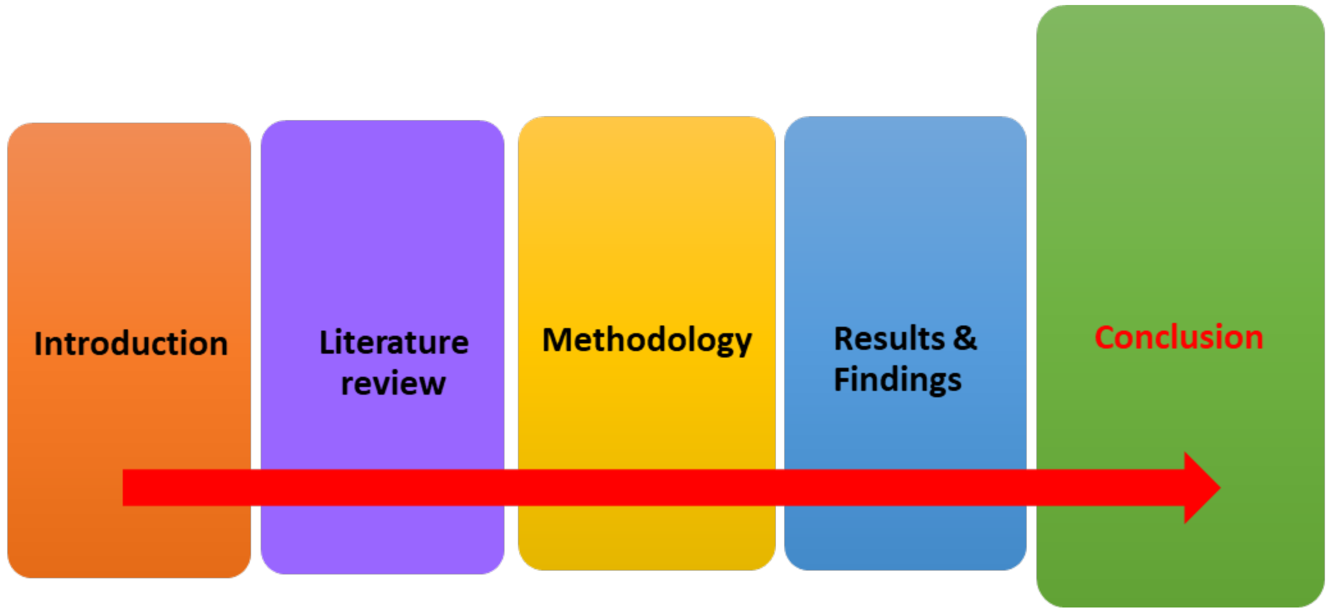
In this instance, the results of this ratio as indicated in Table 4-11 were 0.55:1 (2017) and 0.5:1 (2016), respectively. Although this ratio has improved over the past two years, this farm was not in a healthy liquidity position and by purchasing the solar power system outright would probably have led to cash flow problems in the near future.

4.6 Summary and solution to the problem of the vegetable farm (Company X)

The focus of this chapter was to reach the third, fourth and fifth secondary objective. To be able to reach these objectives, the viability of alternative energy resources for the farm was discussed − can alternative energy be purchased and how will it be financed. Capital investment decision-making techniques were used and it was determined that to implement a solar energy system on the farm, can indeed be viewed as a good capital investment due to the fact that the result of the NPV calculation was positive.

The finance decision was also investigated and it was concluded that due to the current financial position of the farm – the percentage of debt to equity was very high and the interest earned ratio was negative - no additional debt was advisable. The liquidity of the farm was then investigated. The current ratio indicated that the farm would have trouble servicing its current short-term debt and, therefore, to buy a solar power system in such a financial position was deemed an unhealthy business position.

In the final chapter, the conclusion is discussed and the sixth secondary objective was reached − to design the final decision tree to be used as an aid when businesses experience similar challenges.



CHAPTER 5 CONCLUSION

5.1 Introduction

The main purpose of this study was to investigate alternative energy options available for implementation on the farm (Company X) – if alternative energy was viable and how such an investment should be financed.

The main purpose was formulated in the following research question:

Can alternative energy be purchased for the vegetable farm and how will it be financed?

To answer the research question, most of the secondary objectives of this study were achieved in the previous chapters.

In Chapter 2 (literature review), attention was given to the first secondary objective. All of the different alternative energy resources were investigated, namely nuclear power, fossil fuels, solar power, wind power, hydropower, biomass and geothermal energy. The investment and financing decisions were also discussed in this chapter. Along with the insights of other scholars, the definition and calculations of both the investment and finance decision were reviewed.

In Chapter 3 (methodology), the second secondary objective was discussed. In this chapter, the honeycomb of methodology was explained and it was determined that the research philosophy for this study was epistemology and interpretivism. An inductive research approach was followed due to the fact that the investigation was done from the particular (the vegetable farm) to the general (various other farms). This study can be viewed as a qualitative study, because a case study was included, which involved a document analysis of the financial statements and electricity bills, while a semi-structured interview was conducted as the data collection method. Explanation building was used as the data analysis technique. A decision tree was designed to assist with the two decisions regarding implementation of alternative energy on the farm (Company X).

In Chapter 4 (results and findings), the third, fourth, and fifth secondary objective were deliberated. In this chapter, the implementation of all possible renewable energy resources on the farm was discussed. It was concluded that solar power was the best choice for Company X, due to the sunny climate and the amount of kWh required on the farm. The investment and financing decisions were also made based on quotations for the installation of a solar power system, and the financial statements of the vegetable farm. The investment decision and the discounted cash flow indicated that the solar power system was a good investment for the farm to make. The finance decision was made, in accordance with the current debt equity ratio. Unfortunately, Company X had too much debt in relation to the profit generated and additional debt would not have been a good idea. This decision was confirmed by the times interest earned calculation that showed that there was no profit available to service additional interest. Lastly, a current ratio calculation was done in terms of the liquidity of Company X. The ratio for the payback of creditors in relation to current assets was not in a healthy position and there was not really any cash available to implement a solar power system on the farm.

5.2 Credibility and trustworthiness

This enquiry was conducted in a manner to ensure that the subject had been accurately identified and defined. This study can be deemed trustworthy due to the fact that the results are:

1. Transferable – the results can be transferred from this specific situation or case to another.
2. Dependable – the research process was rational and well documented.
3. Conformable – evidence was provided in Chapter 4 to corroborate the findings.

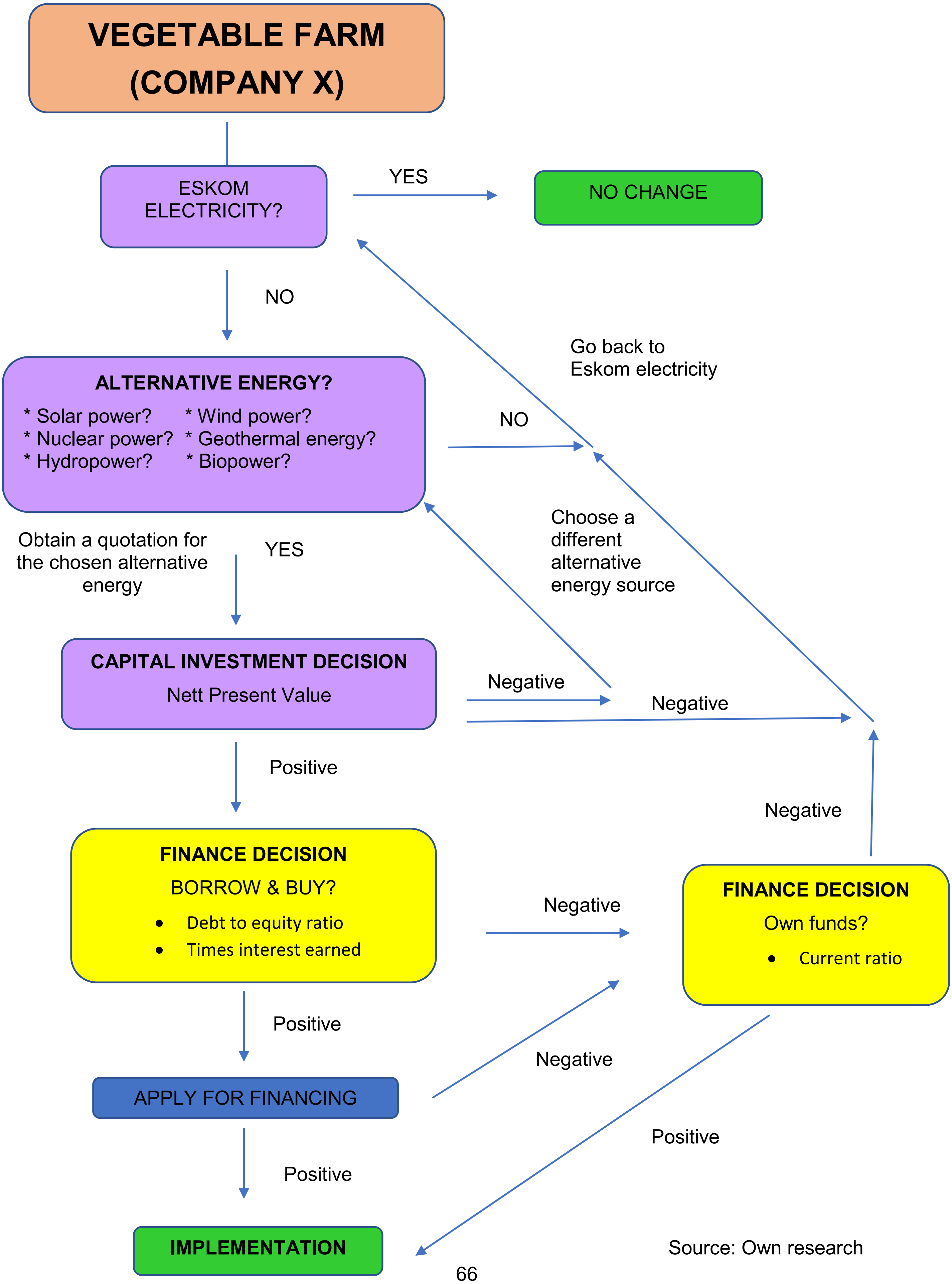
The trustworthiness of this study was also enhanced by the fact that various data collection techniques were used, notes of the research decisions were kept, and the involvement with the participant was kept to a minimum.

5.3 The decision tree

In the previous chapters, most of the secondary objectives were achieved and, therefore, the primary objective was resolved as well. The literature review − investigating the methodology and executing the calculations – was part of the designing of a decision tree as a helpful tool when capital investment and financing decisions were made with regard to the possible implementation of an alternative energy resource on the vegetable farm (Company X).

To achieve the six and final secondary objective, the decision tree is illustrated in Figure 5.1.

Figure 5.1: Capital investment and finance decision tree



Source: Own research

When the owner of a farm is investigating the possible implementation of alternative energy, the decision tree can be used by making use of the following steps:

- Is the farm making use of Eskom electricity, and want to change to an off-grid option?
  - If the answer is negative, no change will take and the status quo (Eskom electricity) will be kept.
  - If the answer is positive, alternative energy options must be investigated to find a viable option to implement on the farm with regard to the kWh requirements and the climate on the farm.
- Is there an alternative energy option suitable for implementation on the farm?
  - If the answer is negative, the farm will still make use of Eskom electricity.
  - If the answer is positive, a quotation must be requested for the chosen alternative energy resource after which a capital investment decision will have to be made with the aid of a discounted cash flow and a NPV calculation.
- What is the outcome of the capital investment decision?
  - If the outcome is negative, it will mean that the use of alternative energy is not a good investment for the farm. The owner of the farm will either consider a different alternative energy option or keep making use of Eskom electricity.
  - If the answer is positive, it will mean that the alternative energy implementation is a good investment for the farm. The owner must then make a finance decision − borrow funds to finance the investment or use the owner's own funds. To determine this, the financial statements of the farm must be investigated, and a debt to equity ratio together with a time interest earned calculation must be done.
- What is the outcome of the finance decision?
  - If the outcome is negative, it will mean that the farm is not a good candidate to borrow funds to implement alternative energy and the owner must then consider making use of his/her own funds. A liquidity test will then be done by making use of the current ratio to determine whether there is enough cash available to implement alternative energy.
  - If the outcome is positive, it means that the owner can apply for finance.
- What is the outcome of the finance decision (own funds)?
  - If the outcome is negative, the owner will revert back to Eskom electricity.
  - If the outcome is positive, the owner will start with the implementation process of alternative energy.
- What is the outcome of the financing application?
  - If the outcome is negative, the owner will then make a finance decision (own funds).
  - If the outcome is positive, the owner will start the implementation process of alternative energy.

5.4 Limitations of the study

The effect of the implementation of alternative energy on the environment is not yet known, due to the fact that the use of alternative energy is still a relatively new field. However, the amount of available fossil fuels are being depleted from the earth and that is why a decision regarding alternative energy could be considered. In this study, only renewable resources were considered.

With this study only one interview was done with the owner of the vegetable farm. The results of this study can be enhanced with additional interview.

Due to the fact that with this study a new theory was not built, this study was not conducted in the context of a specific theory.

When the investment and financing decision must be made, various management accounting methods can be used. Only the NPV, IRR and discounted payback period calculations were used during the investment decision, while the debt to equity ratio, the times interest earned, and the current ratio were used for the financing decision.

5.5 Value of the study

Currently, uncertainty abounds in South Africa concerning the availability of electricity. How will Eskom manage the increase in demand for electricity? How will continual price increases in the coming years affect the profitability of businesses? What will happen in the future when fossil fuels are no longer available to create electricity?

This study provides assistance to farmers when they investigate alternative energy resources, as opposed to Eskom electricity. The decision tree provides steps that can be followed when an alternative energy option is considered.

5.6 Areas for future research

The following areas were identified for future research:

- The case study and calculations can be extended to other businesses and farming activities.
- Future studies can be done in the context of a specific theory, for example
    - Business process engineering
    - Theory of competitive advantage
- The results of this study can be enhanced by doing additional interviews with a farmer who already installed alternative energy on their farm, as well as with an expert in the field of alternative energy who can provide additional information in regards to the advantages and disadvantages of the specific alternative energy sources. These interviews can be transcribed and analysed with specialized software to enhance the study further.

- The capital and finance investment decisions can also be made by performing an accounting rate of return; return on assets (ROA); and earnings before interest depreciation and amortisation (EBITDA).
- A hybrid solar system can be investigated where a farm does not move off the grid, but makes use of shared electricity between the grid and solar power.

5.7 Final conclusion

This chapter focused on each of the specific objectives set out in Chapter 1 by analysing available literature through the case study results. The primary and the first four secondary objectives were achieved in Chapters 2, 3 and 4. The fifth secondary objective and the overall goal of this study were achieved in Chapter 5 with the final capital investment and finance decision tree available for when alternative energy resources on farms are considered.

The research question for this study was whether alternative energy can be purchased for the vegetable farm (Company X) and how will it be financed? By following every step, as set out in the decision tree, this question was answered.

This chapter concluded by stating the limitations experienced within the study, the expected value of the research and areas for future research.

BIBLIOGRAPHY

Alfreds, D. 2018. Are solar panels worth it? Fin24, 8 Apr. 2018. https://www.fin24.com/Money /are-solar-panels-worth-it-20180406 Date of access: 17 May 2018.

Alberts, V. 2005. Solar energy. *Discourse*, 33(1):17-20.

Anon. 2014a. 5 Clever ways agriculture can use solar power. http://www.soventix.co.za/news /5-clever-ways-agriculture-can-use-solar-power/ Date of access: 27 May 2018.

Anon. 2014b. How farmers save money through solar energy. http://www.soventix.co.za/news /farmers-save-money-solar-energy/ Date of access: 27 May 2018.

Anon. 2018. Solar Energy. http://www.altenergy.org/renewables/solar.html Date of access: 27 May 2018.

Azadeh, A., Babazadeh, R., Asadzadeh, S.M. 2013. Optimum estimation and forecasting of renewable energy consumption by artificial neutral networks. *Renewable and sustainable energy reviews*, 27(2013):605-612.

Baker, L. 2015. The evolving role of finance in South Africa's renewable energy sector. *Geoforum*, 64(2015):146-156.

Bhutta, F.M. 2018. Role of renewable energy in sustainable agriculture and food security. https://www.agritechtomorrow.com/article/2018/01/role-of-renewable-energy-in-sustainable-agriculture-and-food-security/10441 Date of access: 27 May 2018.

Bistline, J.E., Comello, S.D. & Sahoo, A. 2018. Managerial flexibility in levelized cost measures: a framework for incorporating uncertainty in energy investment decisions. *Energy*, 151:211-225.

Bless, C., Higson-Smith, C. & Kagee, A. 2008. Fundamentals of social research methods an African perspective. 4th ed. Cape Town: Juta & Company Ltd.

BPP Learning Media. 2015. CIMA Study Text. 2nd ed. London: BPP Learning Media Ltd.

Bragg, S. 2018. Capital investment decisions. https://www.accountingtools.com/articles/ capital-investment-decisions.html Date of access: 27 May 2018.

Brutschin, E. & Fleig, A. 2016. Innovation in the energy sector – the role of fossil fuels and developing economies. *Energy policy*, 97(2016):27-38.

Chaturvedi, V., Clarke, L., Edmonds, J., Calvin, K. & Kyle, P. 2014. Capital investment requirements for greenhouse gas emissions mitigation in power generation on near term to century time scales and global to regional spatial scales. *Energy economics*, 46(2014):267-278.

Chel, K. 2011. Renewable energy for sustainable agriculture. *Agronomy for Sustainable Development*, 31(1): 91-118.

Chen, C., Huang, T. & Lin, C. 2013. Financing Decision and Productivity Growth for the Venture Capital Industry in Taiwan. *Review of Pacific Basin Financial Markets and Policies*, Vol 16(2): 1350014-1 – 1350014-19.

Cheung, G., Davies, P.J. & Trück, S. 2016. Financing alternative energy projects: an examination of challenges and opportunities for local government. *Energy policy*, 97(2016):354-364.

Christersson, M., Vimpari, J. & Junnila, S. 2015. Assessment of financial potential of real estate energy efficiency investments – A discounted cash flow approach. *Sustainable Cities and Society*, 18: 66-73.

Cilliers, A. 2017. Cost of nuclear vs other energy sources. Fin24, 21 Sept. 2017. http://m.fin24.com/fin24/Opinion/anthonie-cilliers-cost-of-nuclear-vs-other-energy-sources-20170921 Date of access: 5 Oct. 2017.

Constant, J. 2018. Renewable energy for businesses. https://www.businessjuice.co.uk/energy-guides/renewable-energy/ Date of access: 10 Feb. 2018.

Coleman, L., Maheswaran, K. & Pinder, S. 2010. Narratives in managers' corporate finance decisions. *Accounting and Finance*, 50: 605-633.

Correia, C. & Cramer, P. 2008. An analysis of cost of capital, capital structure and capital budgeting practices: a survey of South African listed companies. *Meditari accountancy research*, 16(2):31-52.

Correia, C., Flynn, D., Uliana, E., Wormald, M. & Dillon, J. 2015. Financial management. 8th ed. Cape Town: Juta & Company Ltd.

Cresswell, J.W. 2014. Research design: qualitative, quantitative, and mixed methods approaches. 4th ed. London: Sage Publications.

Daraei, M., Thorin, E., Avelin, A. & Dotzauer, E. 2017. Evaluation of potential fossil fuel free energy system: scenarios for optimization of a regional integrated system. *Energy procedia*, 42:964-970.

Davison, A. 2018. Wind energy. http://www.altenergy.org/renewables/wind/ Date of access: 27 May 2018.

De Vos, D. 2016. Analysis: the future of Eskom and South Africa's coal sector will be nothing like its past. Daily Maverick, 4 Jul. 2016. https://www.dailymaverick.co.za/ article/2016-07-04-analysis-the-future-of-eskom-and-south-africas-coal-sector-will-be-nothing-like-its-past Date of access: 20 Jan. 2018.

Du Plessis, A. 2013. A Framework for the measurement and reporting of environmental costs at a platinum mine. Potchefstroom: NWU. (Mini-dissertation – M Com).

Ellabban, O., Abu-Rub, H. & Blaabjerg, F. 2014. Renewable energy resources: current status, future prospects and their enabling technology. *Elsevier*, 39(2014):748-764.

Eskom. 2018. 2018/19 Tariffs and charges. http://www.eskom.co.za/CustomerCare/TariffsAndCharges/Pages/Tariffs_And_Charges.aspx Date of access: 14 Oct. 2018.

Goodman, T.H., Neamtiu, M., Shroff, N & White, H.D. 2014. Management Forecast Quality and Capital Investment Decisions. *The Accounting review*, 89(1): 331-365.

Google Maps. 2018. https://www.google.co.za/maps/@-27.5511488,26.5896909,278m/data=!3m1!1e3?hl=en&authuser=0 Date of access: 4 Dec. 2018.

Hartley, P.R. 2018. The cost of displacing fossil fuels: some evidence from Texas. *The energy journal*, 39(2):233-258.

Hartman, L. 2015. Top 10 things you didn't know about hydropower. https://energy.gov/articles/top-10-things-you-didnt-know-about-hydropower. Date of access: 10 Feb. 2018.

Hartman, L. 2017. Top 10 things you didn't know about wind power. https://energy.gov/eere/wind/articles/top-10-things-you-didnt-know-about-wind-power. Date of access: 10 Feb. 2018.

Hasan, M., Zhang, M., Wu, W. & Langrish, T.A.G. 2016. Discounted cash flow analysis of greenhouse-type solar kilns. *Renewable Energy* 95(2016): 404-412.

Haw, C. 2013. South Africa's solar resource compared to the rest of the world. https://www.solafuture.co.za/news/south-africas-solar-resource-compared-to-the-rest-of-the-world/ Date of access: 14 Oct. 2018.

Herbert, S., Hashemi, M., Chickering-Sears, C. & Weis, S. 2014. Renewable energy production on farms. https://ag.umass.edu/crops-dairy-livestock-equine/fact-sheets/renewable-energy-production-on-farms Date of access: 27 May 2018.

Hough, J., Thompson, A.A., Strickland, A.J. & Gamble, J.E. 2011. Crafting and Executing Strategy. Berkshire: McGraw-Hill Higher Education.

Huttes, C. 2017. Farming with the power of renewable energy. https://www.agriculture.com/farm -management/farming-with-the-power-of-renewable-energy Date of access: 27 May 2018.

Johansson, R. 2003. Case study methodology. Paper presented at the Methodologies in Housing Research organised by the Royal Institute of Technology in cooperation with the International Association of People-Environment Studies, Stockholm, 22-24 September 2003.

Kaley, M.P. 2016. Nuclear power as an alternative green fuel: why upgrates to commercial nuclear reactors deserve to be eligible for federal loan guarantees, and why the DOE's decision to make them so warrants Chevron deference. *Boston College environmental affairs law review*, 45(1):145-179.

Lam, P.T.I. & Law, A.O.K. 2018. Financing for renewable energy projects: a decision guide by developmental stages with case studies. *Renewable and sustainable energy reviews*, 90:937-944.

Lui, X, Zhang, S & Bar, J. 2017. The nexus of renewable energy-agriculture-environment in BRICS. *Applied Energy*. 204: 489-496.

Lumen Learning. 2017. Defining finance. https://courses.lumenlearning.com/ boundlessfinance /chapter/introducing-finance/ Date of access: 3 Mar. 2018.

Marchioni, A. & Magni, C.A. 2018. Investment decisions and sensitivity analysis: NPV-consistency of rates of return. *European journal of operational research*, 268:361-372.

Maree, K. 2016. First steps in research. 2nd ed. Pretoria: Van Schaik Publishers.

Marques, A.C., Fuinhas, J.A. & Pereira, A. 2018. Have fossil fuels been substituted by renewables? An empirical assessment for 10 European countries. *Energy policy*, 116:257-265.

Mason, P. 2014. Researching tourism, leisure and hospitality for your dissertation. Oxford: Goodfellow Publishers.

Math Worksheets 4 Kids. 2018. How to convert m/sec into km/hr. https://www. mathworksheets 4kids.com/solve/speed/conversion2.php#better Date of access: 12 Dec. 2018.

Mazzucato, M. & Semieniuk, G. 2017. Financial renewable energy: who is financing what and why it matters. Technological forecasting and social change. http://www.sciencedirect.com. nwulib.nwu.ac.za/science/article/pii/S0040162517306820 Date of access: 2 Sept. 2017.

Mendelsohn, M., Kreycoik, C., Bird, L., Schwabe, P. & Cory, K. 2012. The Impact of Financial Structure on the Cost of Solar Energy. National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy12osti/53086.pdf Date of access: 14 May 2017.

Merrit, C. 2018. Capital budgeting decision vs. financing decision. http://smallbusiness.chron.com/capital-budgeting-decision-vs-financing-decision-66730.html Date of access: 3 Mar. 2018.

Miller, A.F. 2018. Hydroelectric energy sources. https://andrewfmiller.weebly.com/hydroelectric-energy-sources.html Date of access: 28 May 2018.

Mouton, J. 2015. How to succeed in you master's & doctoral studies. Pretoria: Van Schaik Publishers.

National Geographic. 2009a. Hydropower. https://www.nationalgeographic.com/environment/global-warming/hydropower/ Date of access: 28 May 2018.

National Geographic. 2009b. Wind power. https://www.nationalgeographic.com/environment/global-warming/wind-power/ Date of access: 28 May 2018.

Ng, T.H. & Tao, J.Y. 2016. Bond financing for renewable energy in Asia. *Energy policy*, 95:509-517.

Nikhila, C. 2018. Capital investment decisions: meaning, significance and techniques. http://www.businessmanagementideas.com/financial-management/capital-investment-decisions-meaning-significance-and-techniques/6920 Date of access: 27 May 2018.

Oludaisi, A., Kayode, A & Ayodeji, O. 2017. Bridging environmental impact of fossil fuels energy: the contributing role of alternative energy. *Journal of engineering studies and research*, 23(2):22-27.

Ohio State University. 2018. Choosing a renewable energy system. https://energizeohio.osu.edu/roadmap/choosing-renewable-energy-system-and-installer Date of access: 10 Feb. 2018.

Painting, A.L. 1985. Corporate finance in the mining industry. Johannesburg: University of the Witwatersrand. (Thesis – MBA).

Paton, C. 2018. The utility has submitted its price application to the National Energy Regulator of SA. https://www.businesslive.co.za/bd/national/2018-10-22-eskom-applies-for-15-tariff-increase/ Date of access: 10 Nov. 2018.

Pierce, E.R. 2013. Solar, Wind, Hydropower: Home Renewable Energy Installations. https://energy.gov/articles/solar-wind-hydropower-home-renewable-energy-installations Date of access: 10 Feb. 2018.

Pierce, E.R. 2016. Top 6 Things you didn't know about solar energy. https://energy.gov/articles /top-6-things-you-didnt-know-about-solar-energy Date of access: 10 Feb 2018.

Pless, J., Arent, D.J., Logan, J., Cochran, J. & Zinaman, O. 2016. Quantifying the value of investing in distributed natural gas and renewable electricity systems as complements: Applications of discounted cash flow and real options analysis with stochastic inputs. *Energy Policy*, 97(2016): 378-390.

Powell, K.M., Hedengren, J.D. & Edgar, T.F. 2014. Dynamic optimization of a hybrid solar thermal and fossil fuel system. *Solar energy*, 108:210-218.

Puška, A., Beganović, A. & Šadić, S. 2018. Model for investment decision making by applying the multi-criteria analysis method. *Serbian journal of management*, 13(1):7-28.

Range, L.M. 2013. Case study methodologies (Online Edition). Salem Press Encyclopedia of Health.

Rubin, H.J. & Rubin, I.S. 2012. Qualitative interviewing: the art of hearing data. 3rd ed. Los Angeles: Sage Publications.

Salm, S., Hille, S.L. & Wűstenhagen, R. 2016. What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. *Energy Policy*, 97(2016) 310-320.

Schwartz, E.I. 2011. Is renewable energy a "good" investment? https://www.technology review.com/s/422295/is-renewable-energy-a-good-investment/ Date of access: 27 May 2018.

Sibanye Gold Limited. 2017. Sibanye Gold Solar Photovoltaic Project. Part B: Project Information Memorandum. (Unpublished).

Slabbert, A. 2018. Eskom wants another 15% tariff hike for three years. https://www.moneyweb.co.za/news/south-africa/what-eskom-wants-from-you-in-the-next-three-years/ Date of access: 14 Oct. 2018.

Soy, S.K. 1997. The case study as research method. University of Texas, Austin. (Unpublished).

Statistics South Africa. 2018. Table B – CPI headline. http://www.statsa.gov.za/publications/P0141/ CPIHistory.pdf Date of access: 12 Dec. 2018.

Stellenberger, M. 2018. If solar and wind are so cheap, why are they making electricity so expensive? http://www.forbes.com/sites/michaelshellenberger/2018/4/23/if-solar-and-wind-are-so-cheap-why-are-they-making-electricity-more-expensive/#539449a1dc6 Date of access: 25 Apr. 2018.

Sun, J., Ding, L., Guo, J.M. & Yichen, L. 2016. Ownership, Capital structure and financing decision: Evidence from the UK. *The British Accounting Review,* 48: 448-463.

Sykes, K. 2018. Advantages of wind energy in South Africa. https://www.homeinsulations.co.za /renewable/wind-energy-south-africa/ Date of access: 27 May 2018.

Tămășilă, M., Miclea, Ș., Vertolomei, M., Pascu, D. & Albulescu, C.T. 2018. Cash flow and investment decision: an application on the Romanian agriculture sector. *Procedia – social and behavioral science*, 238:704-713.

Tindale, B.E. 1977. An evaluation of financing alternatives for construction equipment. Cape Town: University of Cape Town. (Thesis – MBA).

Tyl, B. & Lizarralde, I. 2017. The citizen funding: an alternative to finance renewable energy projects. *Procedia CIRP*, 64(2017):199-204.

Union of Concerned Scientists. 2008. Renewable energy and agriculture: a natural fit. https://www.ucsusa.org/clean_energy/smart-energy-solutions/increase-renewables/ renewable-energy-and.html#.XDoTyXI7nIV Date of access: 27 May 2018.

Uysal, S., Acar, M., Cavdar, B. & Kiliç, B. 2017. A critical review of energy generation from biomass to limit climate change. *International journal of ecosystems and ecology sciences*. 7(4):899-904.

Van Niekerk, B. 2012. Alternative energy key to competitive advantage. *SABI Magazine*, 4(2): 17.

Van Rooyen, C. 2016. Slim planne met infrastruktuur vir gladde bestuur. *Landbou Weekblad*, 1980:40-41.

Viviani, J., Lai, A. & Louhichi. W. 2018. The impact of asymmetric ambiguity on investment and financing decisions. *Economic Modelling*, 69: 169-180.

Wallington, J. 2016. Energy strategy. Sibanye Gold Limited. https://www.sibanyestillwater.com/ Date of access: 28 Feb. 2017

Walwyn, D.R. & Brent, A.C. 2015. Renewable energy gathers steam in South Africa. *Renewable and sustainable energy reviews*, 41:390-401.

Worldweather Online. 2018. Bothaville monthly climate averages. https://www.worldweatheronline. com/bothaville-weather-averages/free-state/za.aspx Date of access: 13 Oct. 2018.

Weatherbase. 2018. Bothaville, South Africa. http://www.weatherbase.com/weather/weatherall.php3?s=604881&cityname=Bothaville-Orange-Free-State-South-Africa&units=metric Date of access: 13 Oct. 2018.

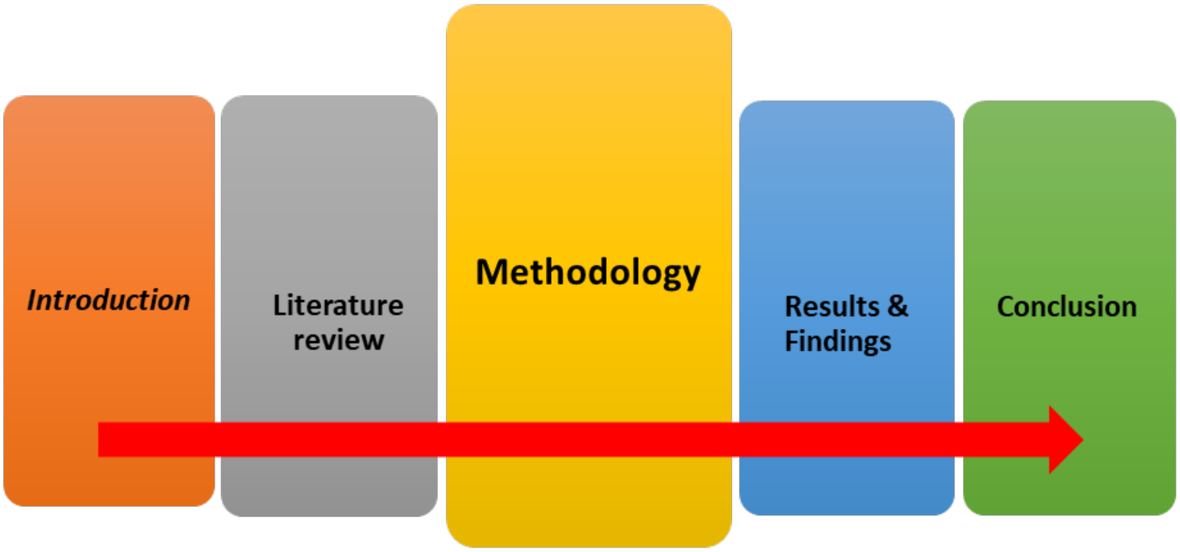
William, J. 2017. Renewable Resources: The Impact of Green Energy on the Economy. Business.com. https://www.business.com/articles/the-impact-of-green-energy-on-the-economy/ Date of access: 14 May 2017.

Wilson, J. 2013. Essentials of business research: a guide to doing your research project. 2nd ed. Los Angeles: Sage Publications.

Xiang, C., Liu, J., Yingdong, Y., Shao, W., Mei, C & Xia, L. 2017. Feasibility assessment of renewable energies for cassava irrigation in China. *Energy Procedia* 142 (17-22).

Yin, R.K. 2009. Case study research: design and methods. 4th ed. Los Angeles: Sage Publications.

ANNEXURE A



Semi-structured interview

1. What is your position on the vegetable farm?
2. What is your day to day involvement with the electricity on the farm?
3. Is the vegetable farm dependent on electricity and why?
4. Are you experiencing problems with your electricity?
5. What kind of problems?
6. Do you see this as a permanent or temporary problem?
7. What in your opinion will be a solution to this problem?
8. Have you ever considered (other) alternative energy sources? (Depending on answer in Q7.)
9. Why this specific alternative energy?
10. What makes it more suitable for the vegetable farm than other energy sources?
11. What are the future requirements in regards to electricity for the vegetable farm?

ANNEXURE B

ALL OUT SOLAR
INNOVATIVE ENERGY SOLUTIONS

Quotation

Reference No: AIPV07367

Account Code	ALLOSP001	**Description**	Lorette - Off Grid Application
Organisation	All Out Solar CC	**Delivery Organisation**	
Address	1351 Walter Avenue Pretoria Republic of South Africa 0135	**Delivery Address**	1351 Walter Avenue Pretoria Republic of South Africa 0135
		Created Date	07/01/2019
		Payment Terms	No credit available.

Customer-generated quotations are valid for 30 days from the above date

Qty	Part No	Description	Net	Your Price	p/Wp
Photovoltaic Panels					
190	CS6U-330P-F35	Canadian Solar 330W Poly (U) (72 X 6) 35mm frame	R 2 058,01	R 391 021,90	623.6c
Inverters					
Mounting Kit					
19	DFE101BM	Dektite Aluminium Multicable Solar Flashing (Metal Roof)	R 117,52	R 2 232,88	
76	REN-420081	End Clamp+ 30 - 50mm Silver	R 23,12	R 1 757,12	
342	REN-420082	Middle Clamp+ 31 - 51mm Silver	R 15,12	R 5 171,04	
418	REN-420403	MetaSole+ Sheet Thickness: Only for steel 0.75-1.0 mm	R 70,56	R 29 494,08	
418	REN-420401	Renusol MetaSole Corrugated Roof Adaptor	R 19,78	R 8 268,04	
Cable					
9	MC4-2M-2	MC4 Pre terminated cable 2m (Pack of 2)	R 228,50	R 2 056,50	
48	MC4-CONN-2PACK	MC4 Connector Twin Pack (Kit 1)	R 86,28	R 4 141,44	
9	HLK-CABLE4-1-1000	Helukabel 4mm2 single-core DC cable 1000m - Black	R 10 176,32	R 91 586,88	
Switches					
Meters					
1		Delivery/Transport/Accommodation costs	R 47 296,00	47296.00	
Delivery/Transport/Accommodation costs					
Display					
1	JAN-UMG-104	Janitza Power Analyser UMG 104	R 13 821,48	R 13 821,48	
Labels					
19	BOHAZARD-SET	PV on Roof and Hazard Labels Pack	R 84,66	R 1 608,54	
3	VIC-QUATTRO-48-15000-200-100-100	Victron Quattro 48/15000/200/100/100 12000W Inverter/Charger	R 71 607,21	R 214 821,63	
1		Solar Installation	R 45 000,00	45000.00	
Solar Installation					
19	VIC-SMARTSOL-MPPT-250-60-Tr	SmartSolar MPPT 250/60-Tr (12/24/36/48V-60A)	R 9 642,78	R 183 212,82	
19	DCB-F12A-7I-600V-I63A-I_II-1O	600V Fused Combiner Box 7 Inputs 1 Outputs 63A Isolator Type I_II SPD	R 7 079,32	R 134 507,08	
6	VIC-DIR-USB	VE.Direct to USB Interface	R 437,01	R 2 622,06	
6	VIC-DIR-CABLE-1.8	VE.Direct Cable 1.8m	R 180,64	R 1 083,84	
6	KETO-1-200A	KETO Battery Disconnector with 200A Fuses	R 1 734,17	R 10 405,02	
2	LUG6-8	6mm2 Cable Terminal Lug M8 - Single	R 2,93	R 5,86	
1	VIC-UTP-3.0	RJ45 UTP Cable 3.0 m	R 145,09	R 145,09	
1	VIC-TEMPSENSE-702	BMV702 Temperature Sensor	R 377,20	R 377,20	
6	VIC-CONTROL-GX	Victron Colour Control GX	R 7 932,90	R 47 597,40	
1	VIC-MK3-USB	Interface MK3-USB (VE.Bus to USB)	R 1 055,42	R 1 055,42	
1	VIC-RS485-USB-5.0	RS485 to USB interface cable 5 m	R 574,33	R 574,33	
1	DC-POW-5M	DC Power Cable 5m (1A Slowblow)	R 277,76	R 277,76	
1	VIC-CCGX-WIFI-SIMPLE	Victron CCGX WIFI Module Simple	R 347,28	R 347,28	
6	VIC-ENC-CONTROL-BM	Wall mounted enclosure for Color Control GX and BMV	R 754,42	R 4 526,52	
1	VIC-BMV-702	Victron BMV-702 Precision Battery monitor 9-90VDC	R 2 744,64	R 2 744,64	
Delivery					
1	DELIVERY	Delivery and Packaging To Be Determined	POA	R 0,00	

Total Price	R 1 122 983,86
Total Price per Wp	1791.0c
Discount (10.00%)	R 124 775,99
Net	R 1 122 983,86
VAT (15.00%)	R 168 447,58
Gross Total	R 1 291 431,44

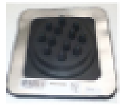
Quotation

Reference No: AIPV07367

CS6U-330P-F35
Canadian Solar 330W Poly (U) (72 X 6) 35mm frame

Rating	330 W
VMPP	37.2 V
Voc	45.6 V
Horizontal	992 mm
Vertical	1960 mm
Type	Polycrystalline
Connection	MC4

DFE101BM
Dektite Aluminium Multicable Solar Flashing (Metal Roof)



REN-420081
End Clamp+ 30 - 50mm Silver

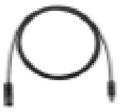
REN-420082
Middle Clamp+ 31 - 51mm Silver

REN-420403
MetaSole+ Sheet Thickness: Only for steel 0.75-1.0 mm

REN-420401
Renusol MetaSole Corrugated Roof Adaptor

MC4-2M-2
MC4 Pre terminated cable 2m (Pack of 2)

Length	2 mm
Area	4 mm2
Cores	1
Connector	MC4
Colour	Black

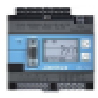


MC4-CONN-2PACK
MC4 Connector Twin Pack (Kit 1)

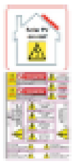
HLK-CABLE4-1-1000
Helukabel 4mm2 single-core DC cable 1000m - Black

Length	1000 mm
Area	4 mm2
Cores	1
Colour	Black

JAN-UMG-104
Janitza Power Analyser UMG 104

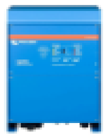


BOHAZARD-SET
PV on Roof and Hazard Labels Pack



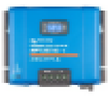
VIC-QUATTRO-48-15000-200-100-100
Victron Quattro 48/15000/200/100/100 12000W Inverter/Charger

Connector	Screw Terminal
Max Battery Current	200 A



VIC-SMARTSOL-MPPT-250-60-Tr
SmartSolar MPPT 250/60-Tr (12/24/36/48V-60A)

Min PP	49 V
Max PP	245 V
Max DC	250 V
Connection	Tr
Connector	Screw Terminal
Max DC	250 V
Max Battery Current	60 A



DCB-F12A-7I-600V-I63A-I_II-1O
600V Fused Combiner Box 7 Inputs 1 Outputs 63A Isolator Type I_II SPD

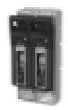
Battery Switch	No
Poles	2
Max Voltage	500 V
Max Cable	35 mm
Rated Current	70 A
Rated Voltage	500 V

VIC-DIR-USB
VE.Direct to USB Interface

VIC-DIR-CABLE-1.8
VE.Direct Cable 1.8m

KETO-1-200A
KETO Battery Disconnector with 200A Fuses

Battery Switch	Yes
Poles	4
Max Voltage	440 V
Max Cable	50 mm
Rated Current	200 A
Rated Voltage	440 V



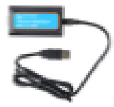
LUG6-8
6mm2 Cable Terminal Lug M8 - Single

VIC-UTP-3.0
RJ45 UTP Cable 3.0 m

VIC-TEMPSENSE-702
BMV702 Temperature Sensor

VIC-CONTROL-GX
Victron Colour Control GX

VIC-MK3-USB
Interface MK3-USB (VE.Bus to USB)

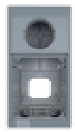


VIC-RS485-USB-5.0
RS485 to USB interface cable 5 m

DC-POW-5M
DC Power Cable 5m (1A Slowblow)

VIC-CCGX-WIFI-SIMPLE
Victron CCGX WiFi Module Simple

VIC-ENC-CONTROL-BM
Wall mounted enclosure for Color Control GX and BMV

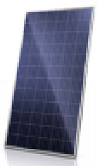


VIC-BMV-702
Victron BMV-702 Precision Battery monitor 9-90VDC

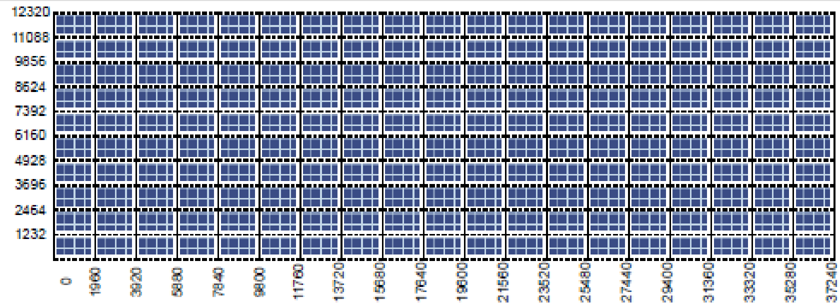
Quotation

Reference No: AIPV07367

Major System Components

Array	Mounting	Storage
		
Canadian Solar 330W Polycrystalline	Renusol on roof (MetaSole)	HOPP-BLOC-48V-105AH
Total:R 391 021,90	Total:R 44 690,28	Total:R 68 056,52

Array Design



System Summary

Physical

Roof	
Orientation	0°
Pitch	35°
Location	
Region	
Array	
Width	37.00 m
Height	12.00 m
Surface Area	458.80 m2
Weight	4330.78 kg
WeightM2	9.44 kg

Panel - Canadian Solar 330W Poly (U) (72 X 6) 35mm frame

Panel Specifications	
Number required	190
Rating	330 Wp
Length	1,960 mm
Width	992 mm
Voc at STC	45.6 V
Vmpp at STC	37.2 V
Impp at STC	8.88 A
Array Specifications	
Array Power	62,700 Wp

Storage - Hoppecke Solar.Bloc 48V - 105Ah Pack (4 x 12V blocs)

System Type	Direct DC Charging
Type of Battery	Lead Acid
Usable Battery Capacity	4176 Wh
Voltage	48 V
Max Charge Rate	835 W
Max Discharge Rate	1044 W

PV Performance Estimation

A. Installation Data - New MCS Calculation

Installed capacity of PV system - kWP (stc)	62.700 KWp
Orientation of the PV system - degrees from South	0°
Inclination of system - degrees from horizontal	35°

B. Calculation

kWh/kWp (KK) from table	1,738 kWh/kWp
Shade factor (SF)	1.00
Estimated annual output (kWp x KK xSF)	109,000 kWh

General Wind Loading Calculation	
Base Wind Speed	28
Air density at height above sea level	1.02
Crz (Drag Coefficent of terrain)	0.84
TopographyCorrectionFactor	1.00
Peak Velocity Pressure:	562 Pa

ANNEXURE C

Consent Form for Participation in a Research Study by North-West University

Title of Study: Developing a capital investment and finance decision tree for alternative energy resources at a vegetable farm.

Description of the research and your participation

You are invited to participate in a research study conducted by Lorette Bester. The purpose of this research is to develop a capital investment and finance decision tree, for future use when faced with the decision in regards to switching over from Eskom Electricity to alternative energy resources. As such, the ideal candidate will be a company that is faced with issues regarding electricity supply.

Your participation will involve the following:

- to provide the farm's financial statements, for us to investigate the capital investment and finance decision.
- To provide current kWh used on the farm, to assist in determining the most effective alternative energy to be used in future.
- conduct a short semi-structured interview regarding the energy circumstances and requirements of the business

Risks and discomforts

There are no known risks associated with this research. With the capital investment and finance decision calculations, only calculation will be shown and thus no direct figures relating to the business. The name of the business will also not be disclosed.

The semi-structured interview will only be used to determine the background of the company and to motivate the decision in regards to which alternative energy resource to implement.

Potential benefits

The objective of this research is to develop a decision tree to assist companies in the future. You will be part of the process of creating this decision tree.

Protection of confidentiality

We will do everything we can to protect your privacy. Your identity will not be revealed in any publication resulting from this study. No figures directly associated with the company will be used, but only results acquired through analyzing the figures.

Voluntary participation

Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

Contact information

If you have any questions or concerns about this study or if any problems arise, please contact Lorette Bester at lorette.bester@ohms.co.za or 084 601 0224.

Consent

I have read this consent form and have been given the opportunity to ask questions. I give my consent to participate in this study.

Participant's signature____________________

Date: 28/05/2018