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South African Renewable Energy Investment Barriers: An Investor Perspective

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Abstract

This paper investigates the factors limiting financial investments in renewable energy. A qualitative research study was conducted on South African based financial investors in renewable energy technologies with the intention of identifying investment barriers. The methodology employed involved a literature review. In addition, a questionnaire was designed and interviews were conducted to ascertain the prevalence of such investment barriers in a South African context. The results obtained were analysed using both qualitative and quantitative methods. These analyses revealed that the barriers that were identified namely political, economic, social and technological are valid for South Africa. In addition, several other barriers were identified that are specific to South Africa, such as education, poverty, technological readiness and access to the electricity grid. On the basis of the findings some recommendations are made which include building closer relationships between government and the private sector, as well as ensuring that government maintains an active role in promoting the renewable energy industry.

Keywords

Renewable energy, financial investments, investment barriers, South Africa

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other university. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Dhirendra Kumar Ghoorah

10 November 2010

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1. Introduction

1.1. Research title

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1.2. Research problem definition

In the past, renewable energy has often been considered as an alternative energy source, although it has never enjoyed as much interest as it is enjoying currently (Sorensen, 1991). This may be due to the perception that global economic development is being held to ransom by the suppliers of fossil fuels (Roeder, 2005; Chow, Kopp & Portney, 2003). Renewable energy has been recognised globally as being of crucial importance owing to its sustainable advantage over conventional energy sources. In this context, the term “renewable” indicates that this type of energy renews itself and, as such, is an infinite resource that can never be depleted. This is what makes renewable energy sources sustainable. It has been suggested by Johansson, McCormick, Neij and Turkenberg (2004) that, since natural energy occurs freely, it will be able to sustain all of humanity’s current and future energy needs. However, in 2004, only 14% of primary energy and 20% of the world’s electricity were produced from renewable energy sources. This presents attractive business opportunities in this area (Johansson *et al*., 2004).

Historically, prices of renewable energy sources have been persistently higher than conventional fossil-based sources, such as oil and coal (Ogihara, Gueye, King & Mori 2007). Figure 1-1 gives the current relative energy production costs derived from the respective renewable energy technologies. It should be noted that renewable energy costs are still high. Accordingly, Chow *et al*. (2003, p. 1531) argue that fossil fuel will remain cheaper than renewable energy prices for the next two to five decades. This has been attributed to several factors; however, the main reason remains the high cost of production of renewable energy (Pegels, 2010). One potential solution for reducing the cost of energy production from renewable sources is by facilitating technologies that achieve economies of scale. Like any new technology, substantial investment will be needed initially to develop renewable resources to reach the scale necessary (Owen, 2006). According to the free market

principle of supply and demand, an increase in demand will drive prices upward which will be followed by an increase in supply (Parking, 2008). In this instance, an increase in the demand for renewable energy will increase energy prices until the energy supply meets the demand. At that point energy prices should fall to the original equilibrium. Consequently, an increase in supply means an increase in energy generation, which is where renewable energy fits in.

Furthermore, as a result of global environmental concerns, conventional generation methods are being questioned from a sustainability point of view (Gracceva, 2002, p. 25), which makes renewable energy very attractive. It is expected that the demand for renewable energy will increase and attract substantial investment in related technologies. Yet, global investment in renewable energy remains low compared to carbon-based energy (PEW, 2009; Masini & Menichetti, 2010). The same trend can be seen in emerging economies such as South Africa (PEW, 2009).

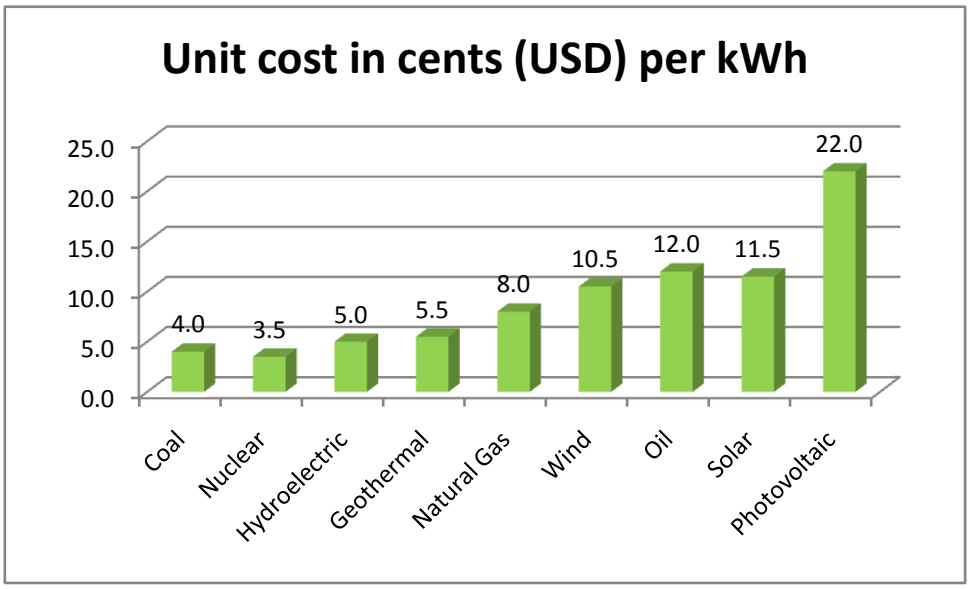

Figure 1-1: Unit costs per energy source

Source: Renewables 2010 global status report; PESWiki

It can be argued that renewable energy has non-financial advantages, such as mitigating air pollution thereby slowing global warming. It should therefore be attracting substantially more funds than it does currently. Clearly, the level of funding is a major factor which could substantially expand the renewable energy industry.

1.3. Research motivation

Egenhofer and Georgiev (2009) argue that the recent Copenhagen summit, where world leaders met to discuss ways to mitigate climate change, was a relative success as only some last minute commitments were achieved as per its mandate (Egenhofer & Georgiev, 2009; Wilson, 2010). However, some doubts exist as to whether that mandate was ever achieved (Müller, 2010; Avdeeva, 2009). One of the most important outcomes of the summit was the undertaking to contain global warming to below two degrees centigrade. Emerging countries, such as the "BASIC" members, consisting of Brazil, South Africa, India and China, were the real surprise of the summit (Müller, 2010), in terms of the voluntary undertakings they made. Table 1-1 lists these voluntary commitments. It should be noted that these targets are quite ambitious and, in order to achieve them and still sustain targeted economic growth, these emerging economies will have to find alternative energy sources (Visagie & Prasad, 2006).

Table 1-1: Summary of voluntary emission reduction pledges

Country	Emission cuts (%)	Year	Condition
Brazil	36–39	2020	From the BAU level
South Africa	42	2025	From the BAU level and support
India	25–25	2020	Based on 2005 level
China	40–45	2020	Based on 2005 level

Source: Egenhofer & Georgiev, 2009

Sustainability and energy are both important aspects of economic growth (Chow *et al.,* 2003). Historically, the world owes its level of economic achievement to fossil fuel. According to Eric McLamb (2008), the latter is said to have fuelled the Industrial Revolution: at this time, the abundance of this resource provided the world with cheap energy which fuelled development at a staggering pace when compared to the centuries that preceded the Industrial Revolution. The world at that time failed to recognise the ultimate price of the so-called cheap energy sources (Sorensen, 1991). Today it is becoming increasingly evident that energy is a precious resource that can no longer be taken for granted. As fossil fuel reserves become depleted, the price of energy is becoming more volatile (Costantinia, Graccevaa, Markandya & Vicini, 2007) and sustainable economic development may therefore be jeopardised.

In addition to this volatility, the environmental impact of fossil fuel-based energy has been so severe that the energy industry has been forced to investigate alternatives (Costantinia *et al.*, 2007).

Renewable energy is an alternative energy source to fossil fuels. It has numerous benefits such as low or zero emissions and the fact that it is renewable and, hence, the source is theoretically infinite (Brower, 1990; Smith, 2006; Mason, 2008). However, Abbasi and Abbassi (2000) argue that certain types of renewable energy can also be detrimental to the environment, including hydro and wind. Such technologies interfere with the natural ecosystem: for example, hydro projects interrupt free-flowing water systems and wind turbines interfere with free-flowing air systems. Nevertheless, Abbasi and Abbassi (2000) also acknowledge that renewable energy is still the best globally sustainable option. With all its positive attributes, the renewable energy industry is expected to be buoyant and is further expected to contribute substantially towards bridging the increasing gap between demand and supply (International Energy Administration, 2009). Therefore, investment in renewable energy based technologies is thought to be essential in further promoting such technologies as the preferred choice over the currently cheaper substitute fossil fuel based energy (Fisher, Egenhoferm & Alessi, 2007). Consequently, it can be argued that investment in renewable fuel technology needs to be more than or equal to that in current mainstream energy technologies such as oil and coal.

According to a report released in June 2009 by the United Nations (UN) News Centre, a total of US $250 billion has been spent globally on new power generating capacity developments by the United Nations Environmental Programme (UNEP). The Global Trends in Sustainable Energy Investment 2009 reports that only 40% of this was allocated for renewable energy developments.

In another report released by the PEW group (G-20 Clean Energy Factbook, 2009), it was announced that China has overtaken the United States in investment in clean energy for the first time. In 2009, investment by the United States amounted to US $18.6 billion, whereas China invested US $34.6 billion. Figure 1-2 lists some of the investments made by the BASIC countries. It is clear from these figures that even

though South Africa is considered part of the fast-emerging economy countries, it is lagging far behind its peers. In 2007, the South African monopoly utility provider, Eskom, allocated a total of ZAR R6.5 billion for its nuclear power generation projects, however, the same government-owned entity allocated a mere ZAR R4.5 million for renewable energy projects during the same period (Gosling, 2007). This clearly demonstrates that there is no sense of urgency from developing countries to migrate from conventional technology to a more sustainable model such as renewable energy. If South Africa wants to compete globally, it needs to ensure that its economic growth can be sustained by promoting further investment in cleaner energy alternatives such as renewable energy technologies.

A review of global and local investment trends makes it clear that South Africa has not invested enough in renewable energy. Accordingly, research dealing with barriers to renewable energy investment has been limited. Most of the available literature suggests that there are external factors that prevent the adoption of renewable energy. According to the available literature, very limited research has been done to examine the actual South African renewable investment decision from the investor's perspective.

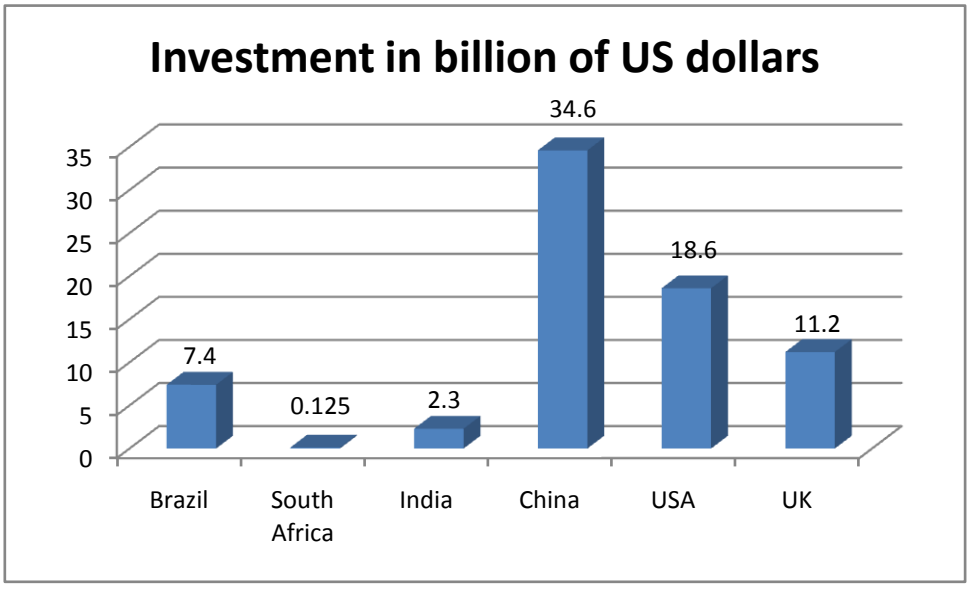

Figure 1-2: Global investment in clean energy

Source: G-20 Clean Energy Factbook, 2009

1.4. Research aim and purpose

The aim of this research is to explore the factors that limit financial investment in renewable energy technologies in South Africa. Such investment is necessary in order to make renewable energy prices attractive compared to conventional energy prices. In order to understand why investment in renewable energy has been limited, it is important to understand the factors that investors consider when making a renewable energy investment decision. This study will therefore explore the nature of investment in renewable energy technologies from an investor's perspective.

Once the investment aspect has been explored, it will be easier to implement or create an environment that attracts increased investment in renewable energy. The outcomes and results of this study will allow the investment community to understand the importance of renewable energy resources in the value chain, as well as the importance of promoting renewable energy projects more aggressively. Renewable energy project shareholders will also be able to tailor their respective projects in order to secure adequate funding by making their projects more attractive for investment. For example, this can be achieved by easing some of the barriers identified in this research. With the appropriate structures in place, such as lower cost of capital, project owners may even be able to sell the output at a reduced price making renewable energy prices more affordable than their current level. An extension to reducing the price of renewable energy is the promotion of its adoption rate. Once the adoption rate has been increased, it will assist the South African government in achieving its reduction in emissions target of 42% by the year 2025, as agreed at the 2009 Copenhagen summit (Houster, 2010; Wilson, 2010).

1.5. Research project scope

There are various studies dealing with barriers to renewable energy. These include the "Diffusion of renewable energy technologies: barriers and stakeholder perspectives" by Reddy and Painuly (2003) and "Renewable energy: externality costs as market barriers" by Owen (2006). Both of these studies mention investment as one of the major stumbling blocks in promoting renewable energy. Investment in renewable energy can take several forms, ranging from small-scale to large-scale investment. This study does not deal with the scale of investment but rather with the

factors that a potential investor considers when making an investment decision. This study will consider the renewable energy investors who are the major role players in financing energy projects. It will include any organisation which allocates funds for renewable energy projects. These also include organisations whose main value proposition is not electricity generation.

The study will consist of the examination of various literature sources that provide insight into those factors that investors consider when making an investment decision in terms of energy projects. The focus will be primarily on renewable energy projects. Once identified, interviews will be conducted to evaluate if those factors are currently valid in South Africa. The interviews will also reveal aspects that may be unique to the South African context and could emerge as special factors which are also considerations for other emerging countries such as Brazil, India and China.

1.6. Delineation and limitations of the study

There are several reasons why renewable energy prices are higher than conventional energy. These include the fact that renewable energy technology has not yet attained economies of scale and the lack of policy enforcement among others (Jacobsson & Johnsonan, 1998, p. 628). With adequate investment into these types of technology, the cost of renewable energy can be reduced in order to compete with current fossil fuel based energy. Therefore, this study will focus only on investment into renewable energy technologies and will investigate the factors considered by investors in the financial investment community. Since the financial institutions form the majority of investors currently interested in renewable energy, it makes them a logical choice for this study. Owing to time and cost constraints, it was not possible to interview all financial institutions even though the number of investment institutions was quite limited. In addition, it was not possible to extend this study to cover all the constraints preventing renewable energy prices from being reduced.

The Copenhagen accord report grouped South Africa as part of the BASIC countries (Houster, 2010). These are emerging economies where future economic growth is believed to be the highest. Since South Africa has been classified as one of the promising economies by the global community, it is expected to be highly competitive. This also means that it will be competing within that community in the

first instance. It is therefore important to focus on South Africa as this focus will provide further insight into how investment in renewable energy can be enhanced to at least the level of India, which is currently US $2.3 billion (G-20 Clean Energy Factbook, 2009). Although it would have been interesting to compare the findings of this study with the rest of the BASIC countries, this falls outside its scope. Such a comparison would be useful as each country could use it as a point of reference to improve their investment profiles. This is an opportunity for future research.

1.7. Definitions of terms

- **Renewable energy resources:** These are energy resources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include biomass, hydro, geothermal, solar, wind, ocean thermal, wave action and tidal action (EIA, 2009).

- **Renewable energy:** This is energy that is derived from natural sources such as sunlight, wind, water, geothermal and biomass. The term “renewable” indicates that the source naturally replenishes itself (EIA, 2009).

- **Emerging market country:** This is a society transitioning from a dictatorship to a free market-oriented economy, with increasing economic freedom, gradual integration within the global marketplace, an expanding middle class, improving standards of living and social stability and tolerance, as well as an increase in cooperation with multilateral institutions (Kvint, 2008).

- **Investor:** Neither a speculator (who takes on high risks for high rewards) nor a gambler (who takes on the risk of total loss for out-of-proportion rewards), but one whose primary objectives are the preservation of the original investment (the principal), a steady income, and capital appreciation (Business Dictionary, Investor).

- **Investment:** Money committed for future income (Business Dictionary, Investment).

1.8. Summary

Given the global environmental challenges, renewable energy technologies provide a very attractive and sustainable solution. It is expected that investment in such technologies should be substantially more than the current level. This research will therefore investigate the factors limiting financial investment in renewable energy technologies in South Africa. It will focus on the major factors that investors consider when making an investment decision in terms of renewable energy projects.

1.9. Report layout

This report consists of the following chapters:

- **Chapter 1 – Introduction:** This section of the report introduces the research topic and defines the main focus of the research. A short motivation is provided to explain what prompted this study and this is followed by the aim and purpose of the research. The scope is then defined followed by a short summary and the layout of this report.

- **Chapter 2 – Literature review:** This section of the report includes a comprehensive review of the relevant literature that was considered during the investigation and the appropriate theory base relating to the research problem defined in chapter 1. The focus is on the factors that investors consider when deciding to invest in renewable energy projects.

- **Chapter 3 – Research questions:** This chapter poses some relevant questions which will assist and guide the research as well as helping to define the research methodology to be applied.

- **Chapter 4 – Research methodology**: This chapter is based on the inputs made to this research in chapters 1 to 3. In this chapter, the way in which the actual research was done is explained in detail. The chapter begins with a short introduction followed by a description of the research design. This design describes and discusses the overall approach taken in answering the research questions stated in chapter 3. This is followed by a methodology section in which the actual design process is explained as well as the

research instrument used. The population and sample size are defined, as well as the data that were collected. The following section then defines how the data collected were analysed. As with any methodology some limitations were experienced and these are presented in this part of the report. Furthermore, some ethical considerations are listed and a conclusion is given.

- **Chapter 5 – Results:** In this chapter the results of the surveys are presented based on the research questions posed and the interview responses.

- **Chapter 6 – Discussions of results:** The results from the preceding section are discussed in relation to the material presented in chapters 1 to 3.

- **Chapter 7 – Conclusion:** To conclude this research, chapter 7 provides a review of the research and the main findings and indicates how these findings relate to academics and practitioners in the field. It also provides some recommendations for further research.

2. Literature Review

This chapter will provide the theoretical background of the research. It will present work done by other academics and will provide a platform as a basis for this research. It will commence with a discussion of the literature on energy, fossil fuel, nuclear fuel and renewable energy in general. This will be followed by other pertinent aspects related to this research, namely, the importance of renewable energy, the need for energy in economic development, the link between fossil fuel and global warming, challenges in renewable energy technologies, investment in renewable energy and the investment community. In conclusion, the research problem will be stated.

2.1. Energy

Energy is defined as the ability to do work (Briethaupt, 1990). It is a construct that indicates the amount of work that can be done with a specific amount of energy. Work in this context can be understood when an object moves as a result of a force is applied to it. The force is said to be doing work and the force is derived from energy (Ramsden, 1990). It can also be stored in various forms; accordingly, there are three known types of energy source on earth, namely, fossil fuel, nuclear fuel and renewable energy (Bushnell, 2010). These will be discussed in the following sections.

2.2. Fossil fuel

Fossil fuel is a carbon-based energy resource, the sources of which include coal, oil, wood and gas. It is argued that since these resources are so abundant that more than 45% of the world's electricity is derived from coal (Demirbas, 2007). It is also estimated that there is only enough coal to last for the next 215 years, while in 1998 oil, reserves comprised only about 39 times the world's consumption and gas 69 times the world's consumption (Demirbas, 2007). Energy derived from these types of resource is mostly obtained through combustion. Owing to the chemical reaction that results, fossil fuel technology has significant negative effects on the environment, such as air, water and noise pollution (Lui, Cheng, Li & Huang, 2007).

2.3. Nuclear fuel

This energy resource uses radioactive materials, which emit vast amounts of heat. This heat is then trapped in order to heat up another medium such as water to generate steam. In this case the steam then turns a turbine which generates electricity. In 1968, Wolhstetter (1968) found that nuclear energy presented substantial challenges which made it unattractive; these challenges include health hazards, its potential use as a weapon of mass destruction, a negative environmental impact, unsafe disposal mechanisms, as well as the fact that it is capital intensive, needs highly complex technology to operate and is also finite. Later, in 2007, Lowe confirmed that the same challenges still exist in using this type of technology (Lowe, 2007). This therefore suggests that the technology has not improved sufficiently in order to address the associated disadvantages.

2.4. Renewable energy

The leading world information repository on renewable energy, the Energy Information Administration (EIA), defines renewable energy as energy that can be harnessed from an infinite number of naturally occurring energy sources but is, however, restricted in the amount of energy available per unit of time. The five major sources of renewable energy are solar, hydro, wind, geothermal and biomass (International Energy Outlook, 2009).

2.4.1. Solar energy

Solar energy is transmitted from the sun to earth in terms of light and radiation, and photovoltaic technology is used to convert sunlight into electrical energy by means of conventional solar panels. Radiation can also be harnessed by trapping heat in another medium, such as water, in order to store it. This then is generally used as solar water heating technology. In 2006, Balat (2006) confirmed that solar energy supplied only 10% of the world's power yet remains a major source of future alternative energy. In a report written by the JRC European Commission in 2008, it was shown that Africa, including South Africa, has one of the most abundant solar resources (Moner, 2008). The South African Department of Minerals and Energy, in conjunction with its financing partner, the CEF group, is actively looking at

harnessing this resource. According to a report released in January 2008, the state wanted to roll out one million solar water heating units in South Africa by 2011 (Renewable energy's place in the sun, 2008).

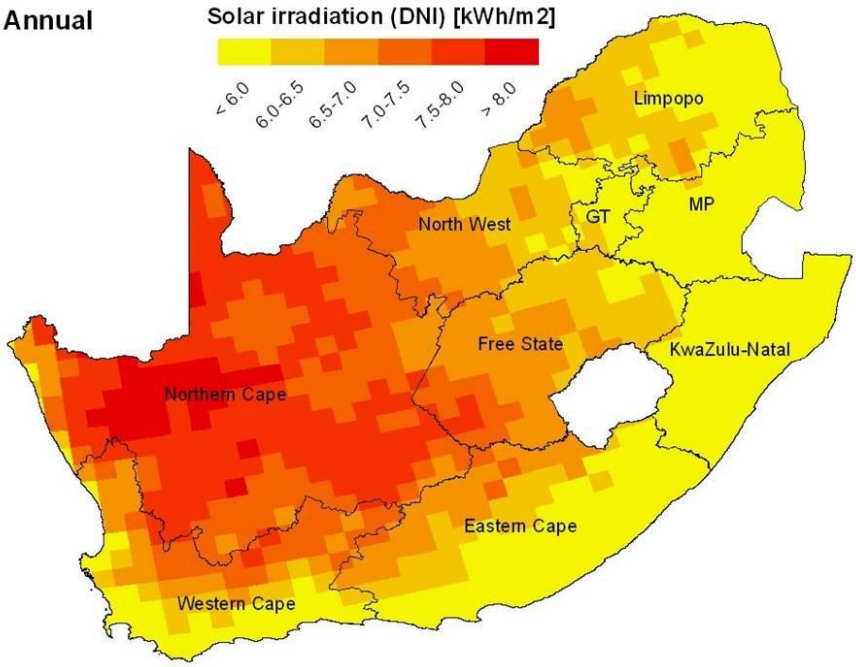

Figure 2-1: South Africa – solar map

Source: South African Renewable Energy Resource Database – Annual Solar Radiation – CSIR, ESKOM, DME, 1999

2.4.2. Hydroelectric energy

Hydroelectric energy is harnessed by using water moving at high speeds to rotate a turbine which, in turn, converts the kinetic energy into electrical energy. Hydroelectric technology is suitable for dams and recent trends in such technology include underwater turbines which are activated by the water current flowing through them. It is argued that with the scarcity of locations for hydroelectric plants, this resource is becoming very expensive and scarce (Lyra, Castro & Ferreira, 1996). However, Deudney (1981) argues that if all the hydro energy of the world could be harnessed, it would be able to sustain the world's energy demand (Deudney, 1981).

Hydroelectric technology can also be activated by tides and in this context are referred to as a tidal fence. However, hydroelectric energy installations are known for their impact on the ecosystem. Owing to the fact that they prevent the free flow of

water, the bio-diversity of the aquatic ecosystem is disturbed (Santos, Rocha, Rocha & Wisniewski, 2009). One of the major requirements of such a project is an environmental impact study. Since this type of project impacts on human settlements, it is becoming very important to engage public participation in these types of environmental impact studies and projects (Chevez & Bernal, 2008).

2.4.3. Wind energy

Wind energy is the most commonly known renewable energy source. In generating electricity, the wind activates a propeller and turns a turbine. The amount of electricity produced by a single windmill is relatively small, however, therefore it is common practice to install a large number of them at the same location, which is known as a windmill farm. Hammons (2004) argues that much of the world's wind power resources remain untapped. He further states, however, that with the accelerating pace of technological improvements these resources will become

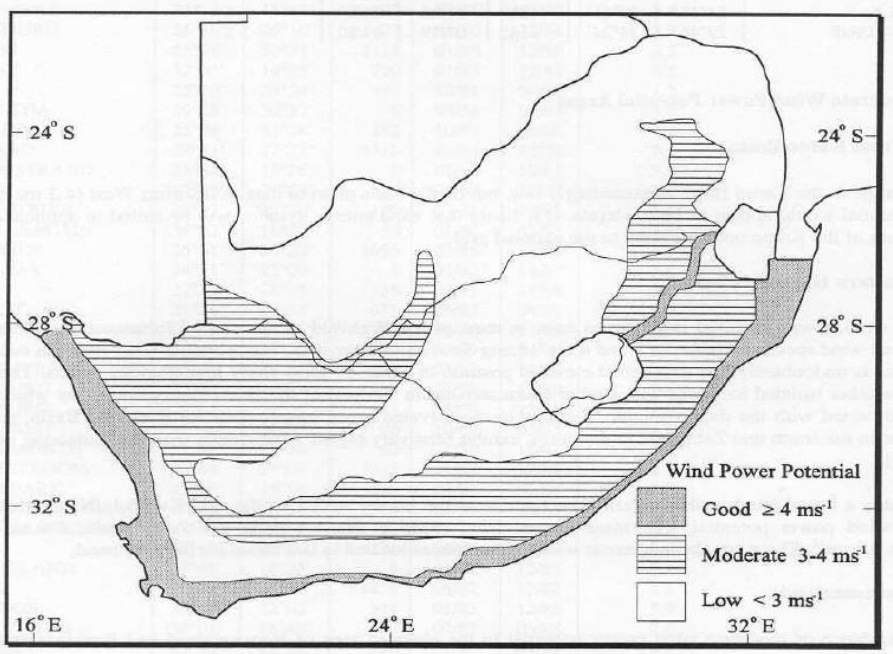

Figure 2-2: South African wind map

Source: South African Renewable Energy Resource Database – Wind Maps

accessible. According to studies conducted by ESKOM, 74% of total renewable energy can be generated by wind in South Africa (Otto, 2008). Figure 2-2 shows the wind map of South Africa that forms the basis of this estimate.

2.4.4. Geothermal energy

A recently identified source that has shown great potential is geothermal energy. The earth's core is extremely hot and can be used for heating purposes or to generate electricity by converting heat energy into electrical energy. Costa Rica is a prime example of a country that has leveraged this geological advantage, as described by Hodgson (2009).

According to a publication released by the Primary Industries and Resources of South Australia (PIRSA), the Electricity Supply Association of Australia stated that if their tests are successful, 6.8% of the country's electricity could come from a geothermal source by the year 2030 (PIRSA, 2010). It also confirms that it is in line with their commitment to reduce their emissions by 70% by the year 2030. Dancey and Mazza (2001) argue that 39 countries could get all their power requirements purely from geothermal energy including Kenya, Costa Rica, Bolivia, Guatemala, Honduras, Iceland, Fiji, Indonesia, Philippines, Ethopia, Uganda and Tanzania (Dauncey & Mazza, 2001). Together they account for almost 17% of the world's population. Dauncey (2009) further recommends that investment into geothermal is also highly recommended for future energy sources (Dauncey, 2009). However, this is still a very new field with limited projects in South Africa.

2.4.5. Biomass energy

The last type of renewable energy is the most widely adopted technology known as biomass. Biomass comprises organic material made up of plants and animals that stores energy from the sun. This energy can be converted into useful energy by either combustion or converting it to other forms or fuel such as methane (Benning & Pichersky, 2008). Balat and Ayar (2005) estimate that 14% of the world's primary energy consumption is provided by biomass. This includes developing countries for which 35% of their primary energy consumption is biomass. Balat and Ayar (2005) further argue that, by the year 2050, developing countries will house about 90% of the world's population, making biomass one of the most important sources of sustainable renewable energy.

2.5. Importance of renewable energy

Energy is one of the most important requirements for economic growth (Toman & Jemelkova, 2003). According to a report issued by the Energy Outlook in 2009 (Appendix 1), the world consumed about 472 quadrillion British thermal units (Btu) in 2006 and is expected to consume 552 quadrillion Btu by 2015 and 678 quadrillion Btu by 2030. This report confirms that the majority of this increase will originate from the non-Organisation for Economic Cooperation and Development (non-OECD) countries. It would seem that, based on consumption patterns, demand for energy will increase significantly. Therefore, emphasis should be placed on energy generation capacity.

In 2006, the United States Energy Information Administration estimated the total capacity of installed electrical power to be 4.1 million megawatts globally (see Appendix 2) (US Energy Information Administration Independent Statistics and Analysis). This figure was estimated to reach more than 5.8 million megawatts globally after 2008. According to the International Energy Administration 2009 report , it is projected that the world net electricity production will increase by 2.4% on average from 2006 to 2030 (Appendix 1) (International Energy Administration, 2009). Total growth in global demand of 2.9% per year for electricity has outpaced total growth of supply of 1.9% per year since 1990. Projections made by the World Energy Outlook (2008) suggest that there is a very strong probability that this trend will continue if not accelerate. Global energy demand will increase by 1.6% per annum till the year 2030 (World Energy Outlook, 2008). According to the World Energy Outlook (2009) report, the financial crisis has managed to reduce energy demand significantly since 1981 World Energy Outlook (2009). The same report also confirms that investment in energy has also been reduced. This unforeseen event has also reduced previously predicted level of emissions. However the report still confirms an average growth recovery of demand of 1.5% per year till 2030. Therefore, based on the installed capacity, the demand will not be met. This reinforces the need for a sustainable alternative resource to meet the projected energy demand and which should be able to facilitate sustainable development.

Robert and Weightman (1994) correlate sustainable development directly with renewable resources. In 1999, this was confirmed by Dincer (1999), who states that for any society to maintain sustainable development, renewable energy is a precondition. This is as a result of several factors, namely the unlimited resource, the limited environmental impact compared to fossil-fuel based technology such as pollution and global warming, and finally energy price stability (Dincer, 1999).

With stable energy prices, economic development will be less prone to supply shocks. Dresselhaus and Thomas (2001) acknowledge that fossil fuel supplies the majority of the world energy consumed. They argue that despite its long-term consequences there are still enough fossil fuel reserves left to last a few more generations (Dresselhaus & Thomas, 2001); however, they recommend that scientists and policy makers use the remaining time to consider alternative environmentally acceptable sources and better technologies (Dresselhaus & Thomas, 2001). In support of Dresselhaus and Thomas's (2001) argument, Nakicenovic, Grübler and McDonald (1998) confirm that fossil fuel will remain an important source of energy for the future. However, Demirbas (2006) argues that the share of renewable energy's contribution to the global demand and supply will increase significantly. Therefore it is evident that while energy derived from fossil fuel would still be available; there is consensus that renewable energy is the most sustainable option for the future.

Based on the available energy supply options and the growing environmental concerns, it is therefore clear that, in order to ensure sustainable economic growth, cleaner sustainable sources of energy, that is, renewable energy, will be required (Luce, 2009).

2.6. Economic development and energy

Toman and Jemelkova (2003) found that energy was one of the fundamental components for economic development; therefore the cost of economic development could be linked to the cost of energy (Toman & Jemelkova, 2003). It follows then that when the opportunity cost of less efficient energy is higher than more efficient energy sources relative to the payoff, then the use of less efficient energy will increase (Binswanger, 2001).

2.7. Fossil fuel and global warming

Global warming has been the major focus of many scientists during the last decade and will remain the focal point for some time, as it will fundamentally change human behaviour (Miller & Spoolman, 2009; Mastrandrea & Schneider, 2005). As part of the natural ecology, humans have established themselves as the dominant species but are still dependant on their environment for survival (Vitousek, Mooney, Lubchenco & Melillo, 1997). As the dominant species, humans have the power to influence their environment and there are fierce ongoing debates as to why the earth's global temperature is rising so quickly compared to the past century (Tsui, Fryar, Hodgkiss, Hyde K. D., Poonyth & Taylor, 1998; Sterman & Sweeney, 2002).

Evidence shown in figure 2-3 confirms that the temperature of the earth and the ocean is rising rapidly. Consequently, scientists have attributed this phenomenon to greenhouse gasses (GHG) (Cox, Betts, Jones, Spall & Totterdell, 2000). Other researchers believe that it is due to non carbon gases (Hansen, Sato, Ruedy, Lacis & Oinas, 2000). While the debate goes on, gas emissions remain the common factor. Houghton (2005) describes the global warming process as follows; as the sun shines on the planet, its energy enters our atmosphere, clouds reflect some of the energy back into space, but the remaining energy heats the ground and the oceans. Subsequently, the energy absorbed by the ground and oceans escapes into space through radiation and convection in the absence of the sun. Since the earth's atmosphere is made up of a mixture of gases, it acts as a conductor of heat and depending on the mixture of the gases the air can either release or trap more heat in the atmosphere. When there is an increase in the level of GHG more heat is trapped rather than being allowed to escape (Houghton, 2005).

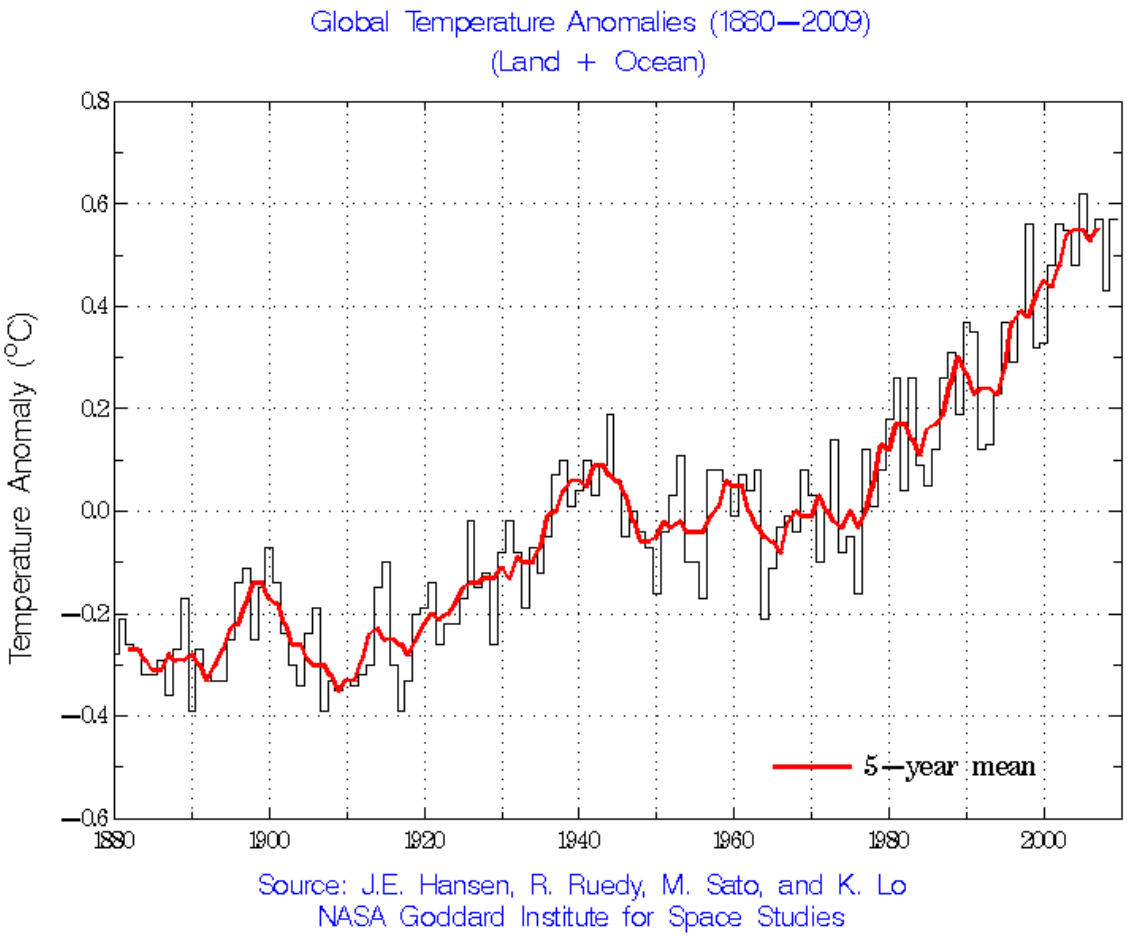

Figure 2-3: Global Temperature Anomalies

Source: Global Temperature Anomalies, 2010

GHG are made up of several components and one of their major constituents is carbon dioxide. Therefore, by measuring the level of carbon dioxide in the atmosphere, it is possible to correlate the rise in air temperature with the amount of the latter and it is thus important to control and mitigate the level of carbon dioxide emitted in the atmosphere. Measurements taken over time have shown that carbon emissions have been increasing very quickly since the Industrial Revolution, with the major source of emission being the combustion of fossil fuel. Figure 2-4 shows the amount of carbon emissions since 1750. The major source of emission is fossil combustion (Climate Change - Greenhouse Gas Emissions, 2010).

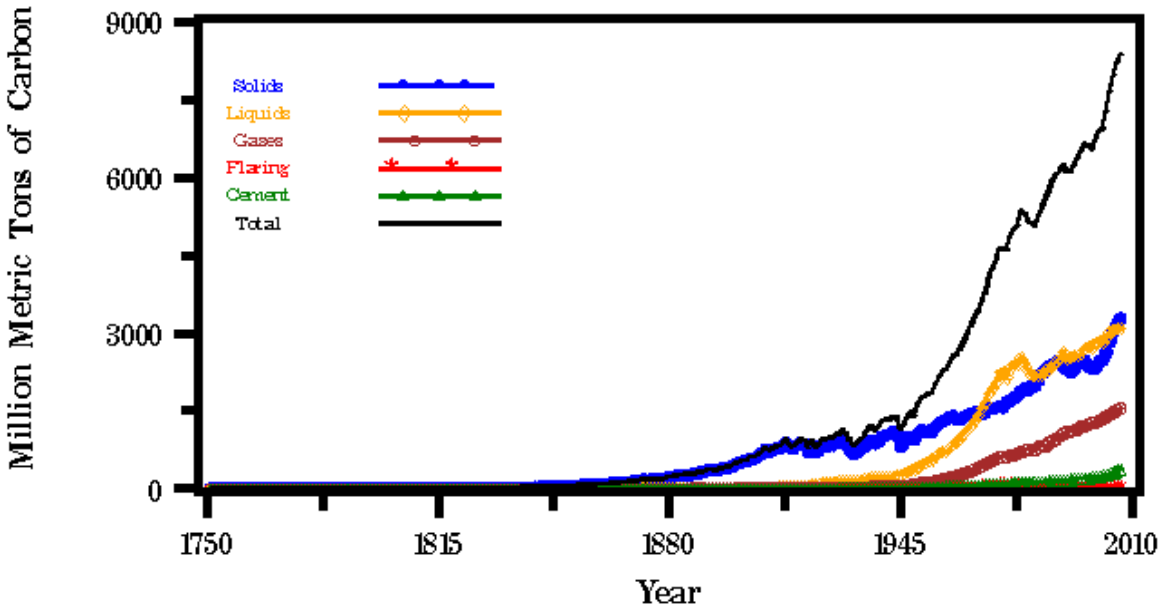

Figure 2-4: Carbon emission estimates

Source: Carbon Emission Estimates, 2010

2.8. Challenges in renewable technologies

Painuly (2001) argues that there are three main barriers hindering the rapid expansion of the renewable energy industry and these can be classified as economic, technological and market based. He maintains that there is a lack of investment by financial institutions to support renewable energy technologies and goes on to say that some of these technologies are economically unviable and therefore uncompetitive. However, since most of the technologies are relatively new they attract more risks which make them uncompetitive. With market-based barriers, the market for renewable energy products is severely compromised as they are relatively more expensive and not readily available. Martinot and Macdoom (2000) also highlight several generic barriers to renewable energy, which can be categorised as political, economic, socio-cultural and technological. The study will be limited to these four main aspects due to time constraints.

2.8.1. Political factors

Since energy is a key driver of economic development, the state prefers to control this resource. Accordingly, control is carried out by means of national policies formulated by the state and put in place in the form of legislation and regulations. Krapels (1993) argues that the energy industry is one of the bases of any stable economy of any stable economy. Therefore this industry will be subjected to heavy political interventions in aid of control. Kefferpütz (2009) who studied the recent Russian and European gas crisis describes how the Russian state took control of the gas supply through various mechanisms (Kefferpütz, 2009). She argues that, due to proven state inefficiencies, gas supplies to Europe could have suffered. Consequently, control of the gas supply gave Russia an advantage when dealing with its neighbouring countries and customers such as the Ukraine and others in Europe. This illustrates how political interventions can affect an industry.

Robert and Weightman (1994) mention a lack of government support as one of the main barriers to the wider acceptance of renewable energy, which confirms Martinot and Macdoom's (2000) views. These authors argue that besides all of the other barriers that are hindering the wider acceptance of renewable energy, politics around the generation of renewable energy should also be considered. Weidenbaum (1983) found that the American public energy policy was inconsistent. Some policies were supportive while others were punitive. Controls took the form of tax policies which promoted energy conservation and production while regulations promoted energy consumption and not enough production. In his argument, Weidenbaum recommends that the state implement a more effective policy where tax policies could provide tax breaks and reduce obstacles for certain types of energy project that the state is trying to promote (Jacobsson & Lauber, 2006).

Shoock (2007) confirms the use of legislation to stimulate both the demand and the supply side of the economy with regards to promoting cleaner and alternative energy sources. He goes on to state that despite all the noble intentions to promote cleaner energy, the US government is still funding conventional fossil-based technologies which have a lower cost base than any alternative energy source.

In 2007, Duffield (2007) studied the US political developments that, among others, led to interest in biofuel as an alternative to petroleum. He found that, owing to a combination of rapid increases in crude oil and the strong influence of the state, the biofuel industry was growing fast – a result of state intervention in terms of which the Energy Policy Act implemented in 2005, which required a total of 7.5 billion gallons of renewable energy by 2012. In support of this initiative, the Department of Energy allocated US $726 million for renewable energy projects over the following two years (Manuel, 2007).

Mandle (2008) argues that politics, through state interventions, can substantially influence the ability to mitigate climate change resulting from conventional fossil fuel technologies. He suggests that, in order to be successful in reducing environmental damage, governments need to have unconditional commitment and make serious investments in alternative technologies. Mandle (2008) cites the case of the US as an example of where the government has not exerted as much influence in favour of alternative sources of energy as they have on fossil fuel.

In 2009, at the Copenhagen climate conference, the South African president, Jacob Zuma, made some bold commitments (Doniger, 2009). He announced that South Africa would reduce its carbon emissions by 42% by 2025 (Müller, 2010). This announcement made South Africa stand out in the eyes of the environmental group Greenpeace. With this announcement President Jacob Zuma impressed most of the participants but the question is: “Is this what South Africa needs?” As a developing economy, can South Africa afford to grow and compete at the same rate as China while reducing its carbon footprint (Houser, 2010)?

Verbruggen, Fischedick, Moomaw, Weir, Nadaı, Nilsson, Nyboer and Sathaye (2009) argue that, generally, governments do not have policies in place to support or promote renewable energy technologies as these technologies are relatively new. Verbruggen *et al.* (2009) continue by saying that owing to the lack of support and alignment policies, renewable energy technologies cannot be developed further. Brigisson and Petersen (2006) confirm that, as a consequence of the lack of enforcement, it is left to the customer to decide, with the preferred solution always being the cheapest option, currently the conventional fossil fuel technologies. Zach

(2008) supports the proposition that unless the current trend is influenced by institutional policies such as emission taxes, subsidies and incentive schemes, renewable energy technologies will not be considered as a viable option.

From a legal perspective, with no appropriate enforceable policies in place, renewable energy technologies will not enjoy appropriate levels of funding or subsidies (Bode & Michaelowa, 2003). It can therefore be concluded that the implementation and enforcement of government policies will influence the level of financial assistance given to renewable energy technologies (Menanteau, Finon & Lamy, 2003). If such policies and subsidies are introduced, renewable energy technologies will become more economically competitive relative to conventional fossil fuel technologies (Lewisa & Wiser, 2007).

2.8.2. Economic factors

One of the major factors making renewable energy technology currently very attractive is the high energy price for conventional fossil fuel (Smith, 2007). As the price of conventional energy increases, the interest and willingness to invest in alternative sources increases accordingly; conversely, as the price of conventional energy decreases, the interest and willingness to invest in alternative sources decreases accordingly. Owing to this relative volatility, Martinot and Macdoom (2000) consider the difficulties inherent in a future fuel-price risk assessment to be a major barrier to investment in renewable energy projects.

It is important to point out that energy prices in South Africa are relatively cheap when compared to its international peers (IEA, 2010; Williams, 2007). It can be argued that developing economies like South Africa need cheaper energy prices to compete globally (Doppegieter, Du Toit & Liebenberg, 1999). Therefore, renewable energy technologies are expected to be less attractive locally when compared to conventional fossil fuel based energy (Kerr, 2010). According to statistics published by the IEA (2007) it is clear that South African energy resources are biased towards the conventional sources as shown in figure 2-5 (IEA, 2007). In addition, the market conditions are as such that the market for renewable energy locally is limited, as the

majority of the population is barely able to afford the basic necessities, including the cheaper energy sources such as paraffin, gas and coal (Cohen, 2008; IEA, 2010).

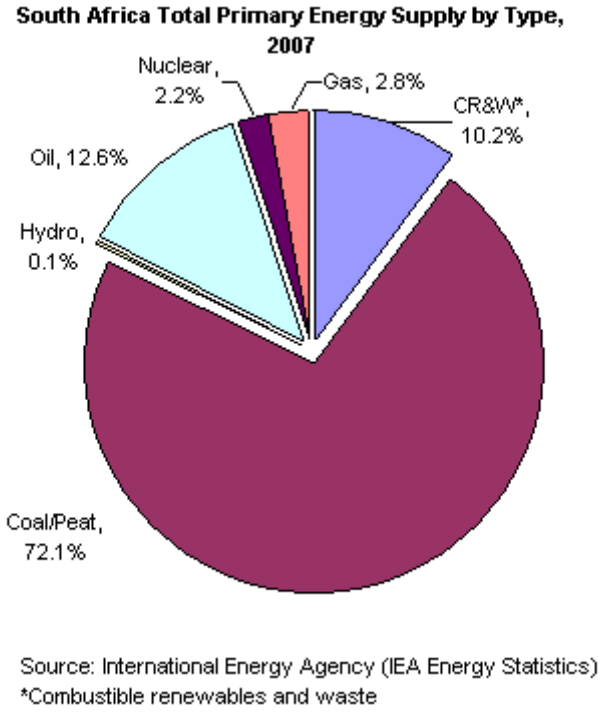

Figure 2-5: South Africa Total Primary Energy Supply by Type Estimates

Source: International Energy Agency, 2007

Bull (2001) confirms that renewable energy technologies are generally more expensive and will remain more expensive compared to fossil fuel until some of the external costs such as their environmental impact is internalised or factored into the input cost. Smith (2007) also argues that renewable energy is generally more expensive than conventional fossil fuel technology, which is confirmed by Lui *et al.* (2007), Lowe (2007) and Bushnell (2010). Therefore, the conclusion is that renewable energy remains more expensive than conventional fossil fuel based energy. In this respect, Martinot and Macdoom (2000) attribute the higher price to the cost of production. This simply means that the associated cost of producing energy from renewable energy sources is substantially higher than from conventional fossil fuel sources such as crude oil and coal. Consequently, the selling price of such energy will be higher than fossil-based energy.

Renewable energy production projects are long term and capital intensive. The amount of capital that a typical renewable energy project attracts is usually dependent on its internal rate of return, payback period and several other variables (Switala, 2003). This is similar for any type of energy project. Since renewable energy projects generally have a lower rate of return and longer payback period than fossil fuel based projects they tend to attract much less capital. This phenomenon has also been highlighted by Schilling and Esmundo (2009).

Mathews, Kidney, Mallon and Hughes (2010) argue that renewable energy projects can be made more economically viable by reducing their cost base. This can be done by applying the right long-term funding model. Thus, with a lower cost of debt, renewable energy projects would be able to lower their selling price. Mathews *et al.* (2010) argue further that, so far, only public funding has been considered for renewable energy projects and without the private finance sector's involvement renewable energy will remain expensive. Renewable energy projects in developing economies are currently funded through carbon trading schemes. These schemes originate from developed economies. As the latter pollute they contribute to the scheme which then makes funds available for renewable energy projects in developing economies (Tyler, Du Toit & Dunn, 2009). However, with the ongoing initiatives to reduce carbon emissions in the developed countries, the level of funding available will be reduced accordingly. Private funding will be able to complement public funding initiatives with an aggregated climate bond scenario. This concept entails a number of smaller bonds being included in a derivative where they would enjoy the economies of scale funding rates over a longer period due to their inherent lengthy project life cycle costs.

In support of Shoock (2007), both Kline (2010) and Tavallali (2010) argue that in addition to better funding models, tax-based incentives could also provide funding assistance to renewable energy projects. Some of the developed economies, such as the US, have tax-based incentives in terms of which renewable energy projects receive tax credits for either investment or production. Such credits can also be redeemed in cash from the Treasury. Another indirect tax-based incentive is the accelerated depreciation method which provides projects with further tax benefits.

Kline (2010) confirms Mathews *et al*.'s (2010) recommendation to involve private investors. As an illustration of the concept, the US Department of Energy promoted the applicants under the Financial Institution Partnership Program to work closely with private sector lenders instead of directly with the Department.

In his article, Owen (2006) demonstrates that if the cost of the environmental damage caused by conventional technology were to be included in the price of power consumed, then the price of power generated by renewable energy technology would be competing on the same level as conventional technologies. Owen (2006) suggests that one of the ways to reduce the cost of production is by achieving economies of scale. However, this can only be done by means of the widespread adoption of technology that translates into increased social acceptance.

2.8.3. Social factors

Wustenhagen, Wolsink and Burer (2006) identify three dimensions of social acceptance, namely socio-political, community and market acceptance. They argue that both policies and technologies need to be adopted by society at large in order for an initiative to be successful. This is followed by community acceptance of decisions and renewable energy projects by local stakeholders, residents and local authorities. Despite community acceptance being an obvious decision, Wolsink (2007) and Bell, Gray and Haggett (2005) found that there is a difference between general acceptance and resistance to specific projects. This is known as the "not in my backyard" syndrome.

Simon and Wustenhagen (2006) found that acceptance increases when stakeholders are directly involved with a specific type of renewable energy project such as wind farms. According to Rogers's (1995) publication, market acceptance depends on the communication process between the potential adopting party and its environment, as this process facilitates the adoption of innovative technologies. His work was later backed up by that of Reddy and Painuly (2003) who applied the theory to a case in the state of Maharashtra in India. The results confirmed that by engaging and communicating with the relevant stakeholder, adoption of the technology can be achieved with reasonable success. This result was achieved

irrespective of the level of competence of the receiver or the complexity of the technology being introduced.

According to the Director of the Energy Research Centre, Professor Kevin Bennett from the University of Cape Town, South Africa is in a very different situation to other developing countries as the majority of its inhabitants cannot even afford basic cheap energy (Bennett, 2008). As a result, the social system is biased towards cheap and dirty sources of power (Lloyd, Cowan & Mohlakoana, 2004). In order to increase the adoption rate of renewable energy sources, the country needs to first uplift its communities to the point where they can afford the basics in order then to switch to renewable energy sources (Bennett, 2008; Visagie & Prasad, 2006).

2.8.4. Technology

Technology is a medium for change which can drastically alter the energy industry. Fossil fuel technologies have long been considered to be mature but they still attract substantial research and development funds to increase efficiencies, with the exception of a few countries such as Sweden, Spain, Switzerland and the United Kingdom (Schilling & Esmundo, 2009).

Manne and Richels (2004) confirm that innovation can reduce renewable energy production costs. This will in turn allow alternatives to compete with the cheap energy being used extensively today. In their work, Helm and Schöttner (2008) confirm that technological innovation can increase the competitiveness of renewable energy technology. Furthermore, technological innovation characterised by the steep learning curves which are essential for learning and steeper learning curves yield quicker return on investment. Therefore, in order to make renewable energy more competitive, technological innovations are necessary (Russell, 1999).

Painuly (2001) highlights several other technological barriers such as a lack of standards, codes and certification, technical skills, lack of infrastructure such as the ability to link up to the grid and a weak technological culture. Most importantly, lack of funding to sustain technological innovation is regarded as a limiting factor for cheaper renewable technology.

Painuly (2001) further argues that the adequacy of potential is a prerequisite for selecting appropriate renewable energy technologies. In South Africa, some renewable energy technologies have to be imported as they cannot be made cheaper locally, for example solar panels, wind turbine blades and Concentrated Solar Power (CSP) equipment among others (Bennett, 2008). The nature and maturity of renewable energy technology also influences any investment decision. Accordingly, a mature and established technology like solar Photovoltaic (PV) energy will attract more funding than any other type of renewable energy technology (Jacobsson & Bergek, 2004).

2.9. Investment in renewable energy

Any financial investment made is generally subject to various considerations by investors. Since all investors are not alike, different types of investor consider different aspects during their investment decisions (Fahlenbrach, 2009; Guild & Bachher, 1996). Owing to the fact that renewable energy projects are not as common as conventional energy projects, investors in these technologies are also not as common. Since these types of project are generally attributed to the benefit of the environment, the nature of the investors is different from the usual investor profiles. Therefore, investor profiles are important during investment decisions (Masini & Menichetti, 2010). In common with any other projects, investors always consider factors that may affect their investments before investing their resources (Aguilar & Cai, 2010). In this instance, in order to identify factors that may influence their investments in renewable energy projects, a review of the main barriers will highlight these. These barriers include the four mentioned in the previous sections, namely, political, economic, social and technological (Martinot & Macdoom, 2000).

2.9.1. Investor background

It has been argued that an investor's sole aim is to maximise returns (Shefrin, 2005; Tetlock & Mellers, 2002), consequently personal values do not influence investment decisions (Beal, Goyen & Phillips., 2005). It has been shown that investors' decisions can be influenced by a desire for social change or based on personal experiences (Pasewark & Riley, 2009; Beal *et al.*, 2005). Since the demand for renewable energy investment has been generated for the benefit of society and the

environment, it is likely that investors will have strong values which will precipitate investments.

A study done by Macmilan, Siegel and Narasimha (1985) revealed that venture capitalists tend to base their investment decisions mostly on the quality of the entrepreneur before considering other aspects of the project. It follows then that certain investors have some predetermined criteria which also influence their investment decision (Masini & Menichetti, 2010). It is therefore important to understand when the investors' background influences their decision processes.

2.9.2. Political

Tyner (2007) argues that since the US government subsidised ethanol in 1978, the ethanol industry has experienced substantial growth. This subsidy was in line with the government's mandate to support the farming industry, environmental concerns and energy security. Tyner (2007) argues that the success of this industry resulted from the state intervention, enabling the growth of the same. Karagöz (2010) mentions that private investors are particularly sensitive to political risks, which include political stability and the stability of policy implementation; this sensitivity can be extended to the facilitation of infrastructure (Karagöz, 2010). It can therefore be argued that investment decisions can be influenced by political factors.

2.9.3. Economic

It is almost inconceivable to separate investment and the prevailing economic factors (Matouschek & Venables, 2005; Tang, Selvanathan & Selvanathan, 2008). These include macroeconomic factors such as the exchange rate and microeconomic factors such as demand and supply, as well as price volatility and financial factors such as lending rates (Parking, 2008). It is a fact that investments in foreign denominated currency are always subject to foreign exchange fluctuations. Since most of the renewable energy technologies used in South Africa are imported (Bennett, 2008), it follows that any investment into these types of project will be subject to foreign exchange exposure. This exposure increases the risk profile of the investment, because for a higher risk portfolio investors expect a higher return, which can make some renewable energy projects unviable (Shefrin, 2001).

It is argued that volatility is also a deterrent for investment (McDermott & Tavares, 2008). Over the last decade, the world has experienced substantial fluctuations in crude oil prices as shown in figure 2-6. Accordingly, as the price of oil rises, renewable energy investments become very attractive. Similarly, as the price decreases, renewable energy investments become less attractive (Wakeford, 2006). It has been proposed that, through government interventions, price volatility can be mitigated by diversifying the energy portfolio to include renewable energy (Janczura, 2010).

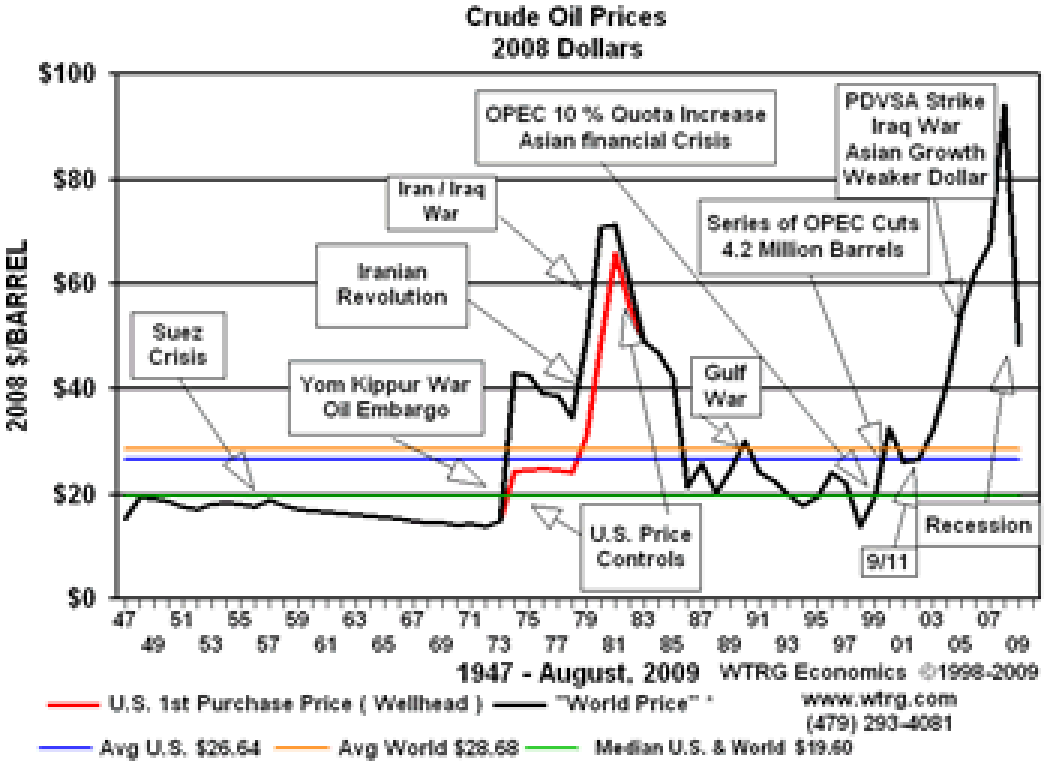

Figure 2-6: Crude oil price trends

Source: History and Analysis, 2009

2.9.4. Technology

Although renewable energy is quite old (EIA, 2010), from an investment perspective, renewable energy technologies are relatively quite new (Sorensen, 1991). While some are more established, like wind and PV solar, others are still in their infancy, such as geothermal and solar CSP (Visagie & Prasad, 2006). It is expected that investors generally consider these different levels of technological development in

their investment decisions. Some organisations may only want to invest in established and proven technology while others may want to only invest in research and development. It also follows that different investors have different mandates, which can be generally identified through their investment policy.

2.9.5. Company structure

Organisations investing in projects generally have investment guidelines which are referred to as investment policy (Investment Policy Definition, 2010). These describe how resources should be allocated on behalf of the organisation. With an understanding of how these policies are implemented, it is possible to assess whether the company is serious in its commitment to objectives. As a new industry, renewable energy has been historically unpopular as an investment candidate (Masini & Menichetti, 2010). While organisations like General Electric have identified the renewable energy industry as a potentially lucrative one, others have not yet decided to embrace the move to a more sustainable energy model. Organisations that have embraced these are being driven from the top to ensure that appropriate resources are being channelled to renewable energy projects. Companies such as General Electric (GE) have launched their Innovation drive such as the Eco-imagination project in response to the call for environmental sustainability (Ecomagination 2009 annual report. 2009). In GE this was started and promoted by Jeffrey Immelt, the Chief Executive Officer (CEO) himself. It follows then that by understanding the internal structure and practices of an organisation, it is possible to understand its commitment to investment in renewable energy technologies.

2.10. Investment community

One of the most important factors that need to be considered for any renewable energy project is commercial viability. This is as important as technical viability which includes capital investment, as renewable energy projects generally require substantial investment (Gatti, Rigamonti, Saita & Senati, 2007). Owing to their lengthy set-up cycle and relatively unproven technology, such projects generally have long payback periods and relatively low margins and hence do not attract aspiring entrepreneurs who seek sustainable higher margins with marginal investments.

As a result, renewable energy projects are usually financed through large financial institutions and government is generally an important shareholder in this type of investment. Government often provides funding for renewable energy projects when the latter are aligned to its mandate. It also provides the policies under which these investments can be made, which also often provide incentives to promote specific types of renewable energy project, usually in the form of tax benefits or subsidies (Lantz & Doris, 2009).

As a result of the long-term benefits attributed to renewable technologies, private investors are also beginning to invest in similar technologies (Biocycle, 2004; 2005; Private investment in green business tops $1.6T since 2007, 2007; Loon, 2010). These investors form part of the venture capitalist network which seeks attractive projects in which to invest its scarce resources. In addition, private organisations such as GE are now also acknowledging the global shift in the energy industry. Consequently, in order to attain sustainable growth and maintain their competitive advantage, profit-based companies are willing to seize the first-mover advantage and acquire the majority of the market share. An example of this trend is the announcement made by GE of a US $453 million investment in its turbine manufacturing division in March 2010 (Masto, 2010). It is expecting that there will be an upcoming surge in demand for energy generation by turbine in the European market.

In 2009, the Global Energy Efficiency & Renewable ESKOM Energy Fund, along with other emerging market institutional investors, committed €51 million for similar types of investment (European funding group invests in renewable energy in Asia, 2009). It is therefore clear that the financial community have a significant influence on the rate at which renewable energy technologies can progress and these can be positively influenced by substantially increasing the amount of investment in them.

In South Africa, Yaw Afrane-Okese from the National Energy Regulator of South Africa (NERSA) states that there is a misalignment in terms of fund allocation for its parastatal ESKOM (Gosling, 2007). In 2007, the energy provider reported a budget worth ZAR 6 billion for nuclear energy development and allocated a mere ZAR 4.5 million for renewable energy development (Gosling, 2007). With government as its

major shareholder, which has been promoting alternative energy, ESKOM was glaringly out of line in its strategic planning. The organisation has, since then, been realigned by embarking on initiatives such as reduced consumption programmes and feed-in tariffs which promote external energy generation that can feed into their grid (Rules on selection criteria for renewable energy projects under the REFIT programme, 2010). The government mandate states that a total of 25% of the energy supplied must come from renewable sources which equates to 10,000 GW hours of electricity by the year 2013 (South Africa Policy and Regulatory Review, 2009).

2.11. Research problem restatement

Renewable energy has been historically expensive and still remains expensive relative to fossil fuel based energy (Ogihara *et al.,* 2007). Limited investment in renewable energy technologies is one of several reasons mentioned for the current status quo regarding renewable energy prices (Owen, 2006). It has been shown that the current level of global investment is substantially inferior to some countries such as China (PEW, 2009). This research therefore aims at investigating the factors limiting financial investment in renewable energy technologies in South Africa from an investor perspective. This will be achieved by studying the investment decision by respective investors for a typical renewable energy project.

As a developing country, South Africa faces several unique challenges, such as a sophisticated financial system at the one end of the scale, and a high Gini coefficient of 53.8 (Human Development Report, 2009), poverty, education and a highly regulated environment with limited resources at the other (Sanders & Chopra, 2006). With these attributes, South Africa provides an excellent profile of an emerging economy, which makes it an ideal choice in which to conduct this research. The study will be confined to South African projects Previous studies have mostly concerned barriers for renewable technologies in a broader sense, dealing with the associated costs and challenges for each type of renewable energy source (Verbruggen *et al.,* 2009; Painuly, 2001). This study will investigate factors that influence investment decisions, including investor background, and political,

economic, social and technological factors, as well as the investment organisation itself.

3. Research Questions

Painuly (2001) provides a framework for analysing potential barriers to the penetration of renewable energy. He also lists several potential barriers as well as some possible solutions to these barriers. Since such barriers determine the market for this type of energy, they are therefore pertinent points that investors will consider in their investment decision. While Painuly (2001) lists a comprehensive list of such barriers, this study will focus on just six major barriers that will significantly influence the investment decision, namely the investor background, political, economic, social, technology and organisational barriers as discussed in the previous chapter.

As such, this research aims to answer the following main questions:

3.1. Research question 1: Investor

- Are renewable energy investment decisions influenced by investors' qualifications and experience?

3.2. Research question 2: Political

- Are renewable energy investment decisions currently influenced by political/legal frameworks in South Africa?
- How do the South African political/legal frameworks influence renewable energy investment decisions?

3.3. Research question 3: Economic

- Are renewable energy investment decisions in South Africa influenced by the prevailing economic factors?
- How do the prevailing South African economic factors influence investment in renewable energy?

3.4. Research question 4: Social

- Are renewable energy investment decisions in South Africa influenced by social factors?
- How do the South African social factors influence investment decisions in renewable energy?

3.5. Research question 5: Technology

- Are renewable energy investment decisions in South Africa influenced by technology factors?
- How do technology factors influence investment decisions in renewable energy?

3.6. Research question 6: Organisation

- Do internal company processes influence renewable energy investment decisions in South Africa?
- How do internal company processes influence renewable energy investment in South Africa?

4. Research Methodology

4.1. Introduction

The aim of this research was to investigate the factors limiting financial investment in renewable energy technologies in South Africa. This chapter describes the research methodology used in detail. It also provides a justification for the design choice and instrument. While there have been many studies dealing with the barriers to renewable energy adoption or penetration globally, limited literature could be found dealing with actual barriers in South Africa. Literature addressing investment in renewable energy in South Africa, with a focus on investment from the investor's perspective, was even scarcer. This may be attributed to the fact that the renewable energy industry in South Africa is a relatively new field. As this is an emerging field of interest, an *exploratory survey-based research design* was considered to be the most appropriate method to use (Zikmund, 2003, p. 54). The research has been designed to collect primary data which will use a combination of both *qualitative and quantitative analysis*. The methodology chosen will reveal the validity of the South African investment barriers that are identified. In addition, it will provide some insights into how these factors affect South African renewable energy investment decisions.

This chapter details the research methodology used for this research. After a short introduction, which contextualises the nature of the research, the following sections are included:

- **Research design** describes and justifies the methodology approach chosen
- **Unit of analysis** defines the phenomenon that the research is investigating
- **Research instrument** describes the instrument used for collecting the data needed for the study
- **Population of relevance** for this research is then discussed
- **Sampling method and size** definition

- **Strengths and weaknesses** of the proposed research methodology
- **Data collection** process followed
- **Data analysis** method used
- **Research limitations**.
- **Ethical considerations** made during the research.
- This chapter ends with a small **conclusions** section

4.2. Research design

This study has been undertaken to identify the factors that investors consider when investing in renewable energy projects. In addition, it is important to understand how these affect investment decisions. In order to achieve its objectives, this research is broken down into three phases: Phase one identifies potential factors which investors consider during their renewable energy investment decision. Since there was limited literature dealing with the factors that South African renewable energy investors consider, an indirect method has been used to identify potential factors. Consequently, an analysis of various global barriers to adoption and penetration of renewable energy provided some insights into which types of factor investors would consider. It is believed that since these barriers influence the size of the renewable energy market, investors should consider them when investing. All of these factors were then grouped into six different categories for data analysis purposes, namely, investor background, political, economic, social and cultural, technology and organisation.

Phase two tests whether these factors are in fact considered by South African renewable energy investors when making investment decisions. This was done by interviewing South African renewable energy financial investors. These interviews also explored the way in which some of these factors influenced investment decisions. The final phase of this research comprised the data analysis.

4.2.1. Survey method

Saunders, Lewis and Thornhill (2003) indicate that structured interviews have several advantages:

- They ensure that the right person is answering the questions.
- They generally have a high response rate.
- They can obtain accurate responses to complicated and open-ended questions.
- All questions asked are answered.

Beatty and Willis (2007) define cognitive interviewing as “the administration of draft survey questions while collecting additional verbal information about the survey responses, which is used to evaluate the quality of the response or to help determine whether the question is generating the information that its author intends”. Based on this definition, the time constraints and the limited sample availability, an adapted cognitive interview technique was chosen. It was adapted in the sense that the structured questionnaire was answered by the respondent during the interview. The interviews were conducted by the researcher in person. In their study, The interview also provided the researcher with the opportunity to explore valuable insights further in order to obtain the required responses. With a generic, distributed, self-administered questionnaire, the qualitative responses can sometimes be incomplete or misunderstood and therefore misinterpreted, which can influence the data analysis and may skew results. Therefore, in order to avoid data bias or error, the adapted cognitive interview technique was the best choice for the purposes of this study.

4.2.2. Questionnaire design

The questionnaires used in this research are included in appendix 3. In order to conduct a data analysis the nature of the data obtained is important. This study investigates the South African factors limiting financial investment in renewable energy technologies from an investor’s perspective. In order to validate the presence

of these factors data consistency is required. Data consistency means that the nature of all data collected needs to be similar: for example, all data should be narrative or quantitative. Data consistency will allow responses to be analysed appropriately. Therefore, a structured questionnaire was required in terms of which the same set of questions would be presented to each sample.

The first step in analysing any data is extracting and compiling the required information. The questionnaire was designed such that the responses were automatically categorised into the six predefined sections, namely Introduction, Political, Economic, Socio-cultural, Technology and General. For example, all the responses pertaining to political aspects were recorded in section 2 of the questionnaire. The same categorisation principle was applied to the remaining sections of the questionnaire. The only overlapping section was the very last question, which was open ended and referred to any section of the document that the respondent chose to discuss.

Questions contained in the questionnaire were mostly closed and required short narrative responses. The first section of the questionnaire investigated any possible relationship between the investor's background and the types of renewable energy. The second section dealt with the political aspect of the research and investigated any political components that could be influencing investment decisions in renewable energy projects. The third section analysed the economic and financial factors that could be influencing the investment decisions, while the fourth investigated the social aspects of the investment decisions. The fifth section looked at technological factors that might be affecting investment decisions and the sixth and last section was designed to gather mainly narrative responses which were analysed with the intention of understanding the internal factors of the organisation that could be influencing investment decisions. The responses given to these questions were designed so as to provide insightful information about what investors consider important structures that need to be in place in order for them to invest further.

The questions in the respective sections required the respondent to select an appropriate response from several alternative statements. If the response was vague or inadequate in terms of richness, then a follow-up question would be asked. This

method ensured that the required narrative response was of sufficient relevance and substance to be used in the analysis. Most of the questions in the questionnaire were structured except for the last question, which was open ended.

The choice of question type, that is, closed or open-ended, was mainly as a result of the time constraints on this research. Each section needed to consist of a balanced number of questions. In addition, each section needed an introduction to explain the context of the questions before participants started to respond. As required, a consent form was included in the front section of the questionnaire.

4.2.3. Research methods

It has been argued that by improving information and perspective, corroboration from data obtained will render less biased information and consequently more accurate conclusions can be drawn (Reams & Twale, 2008). Data corroboration can be achieved by using both qualitative and quantitative methods (Thomas, 2003). Onwuegbuziey and Leech (2005) advocate that polarisation of research method, which means the use of only either qualitative or quantitative research method, is the biggest threat to the advancement of the social sciences. They argue that this practice is counterproductive to the social science and behavioural field. Pragmatic researchers need to appreciate and use both qualitative and quantitative methods in their research (Onwuegbuzie & Leech, 2005). Therefore, this research design includes the use of both *quantitative and qualitative research methods*. Since this research is designed to gather data at a specified point in time it is therefore categorised as a *cross-sectional study*.

4.3. Unit of analysis

The unit of analysis for this research is the financial investment decision made by investors when investing in renewable energy technologies.

4.4. Research instrument

As described previously, this research is an *exploratory survey-based study*. In this regard, the respondents needed to be experienced in the field of renewable energy investment and therefore an *experienced survey method* was used (Zikmund, 2003,

p. 114). Accordingly, a structured interview was chosen using a structured questionnaire.

The structured questionnaire was designed by the researcher to gather the necessary data. For each sample considered, the researcher based the questions on renewable energy technology projects in which funds had been invested. In addition, the research also considered projects where funds had been declined as they would provide insights into factors that were hindering investment. The questionnaire was therefore broken down into six different sections namely: Introduction, Political, Economic, Social & Cultural, Technology and General. The first section gathered data about the respondent and was intended to reveal any investor preference in terms of a particular type of renewable energy, based on their respective qualifications and experience.

Since the questionnaire was unique and untested, it was reviewed by a qualified professional who specialises in questionnaire design. She provided valuable input to the design. It was also reviewed and approved by the supervisor. After approval, the questionnaire was tested on a few volunteer participants and then modified accordingly. Once the questionnaire was ready, contact with the relevant sample was made. Initial contact with potential respondents was made telephonically. A brief of the research was compiled which listed the aims of the research, its desired outcome and the researcher's requirements, the latter comprising an interview with personnel handling a specific portfolio within the company. The desired portfolio for participants was person or persons who are actually involved in the decision-making process and hence have the required knowledge. It also informed the potential candidate of the data gathering process, informed the respondent that an interview would be required and assured them of confidentiality. Once the candidate had been briefed an electronic interview invitation was scheduled.

Interviews were used to gather primary data. The choice was made to conduct a structured interview in order to optimise interview time and to mitigate response bias. As respondents were time constrained, they tended to limit their answers to short cryptic responses. Consequently, using a structured approach, the respondents were given a defined set of responses and could elaborate if they chose or were

requested to do so by the interviewer. This proved to be an effective way of obtaining accurate responses in a relatively short period of time.

The interview was designed to last an hour in order to allow enough time for open-ended questions. In this regard, the interview was chosen so as to ensure that the correct sample provided the data and to facilitate exploring aspects as they emerged. In addition, this method minimised response time, as any other method of interface would have potentially delayed the response or could have contained bias. In order to mitigate response bias, respondents were provided with a brief on the background of the interview only and no questions were forwarded to the respondents prior to the interview, which was conducted personally by the researcher. An audio recording of the interview session was made, whenever permission was granted, and the researcher made use of a hardcopy of the questionnaire on which pertinent points were noted. This kept the engagement honest and maintained the interest of the respondent throughout the interview session.

4.5. Population of relevance

A population of relevance is a segment of a large group within a society sharing some common characteristic (Zikmund, 2003, p. 369; Saunders *et al*., 2003 p. 151). In this study, it is proposed that the population of relevance will be the private and government renewable energy stakeholder community. These will include all entities that are affected or are interested in the South African energy industry including members who are considering or are already investing in the South African renewable energy industry.

4.6. Sampling method and size

A sample is a subset of a population sharing some characteristic (Zikmund, 2003, p. 369). Since this study investigates the investment decision process, it is logical to focus the research on the actual investors in energy projects. Since a renewable energy project generally requires extensive capital investment, it often requires the participation of major financial institutions or similar organisations within the investment community. The sample therefore covered each segment of the

investment community so that it would be representative of the general population of relevance. The selection was a convenience sampling as the number of respondents available was limited. These include financial and other types of institution that currently invest in renewable energy technologies. In the absence of a comprehensive list of all the relevant institutions, one had to be compiled. Such institutions were identified through references from major financial institutions, which were obtained for each of the respondents defined the sample as follows:

Table 4-1: Samples selected

Standard Bank	Innovation fund
Nedbank	CEF Group
Investec	ESKOM
Lereko Investments	SASOL
Rand Merchant Bank	Development Bank of South Africa
French Development Agency	Industrial Development Corporation
Inspired Evolution	SAPPI
Evolution One	EXXARO

4.7. Strengths and weaknesses

The methodology adopted in this research is for an *exploratory survey-based study*. A structured questionnaire was used in an interview to gather primary data and the responses were recorded on the questionnaire. All of the interview sessions were recorded in audio format only except for one, where the respondent did not grant his permission. This method has several advantages, including the fact that the data will be available for review at a later stage for results verification or further analysis. The results therefore will be more accurate. In addition, through the interviews, the relationship between researcher and respondents is personal and in-depth responses can be initiated raising important issues. The primary data therefore become richer in depth and meaningful information and being face to face ensures that the right person is answering the questions which reduces response error or bias. The interview also saves the researcher time in collecting the required information in a shorter time period given the time constraints in this research. Another important aspect of this methodology is the ability to secure a high response rate which forms the basis of result validity.

The above also has some shortcomings, the first one being that renewable energy is made up of different types of technology, namely wind, hydro, solar, biomass and geothermal. This method groups all of them into one category, that is, renewable energy. Owing to time constraints, however, the study could not unpack the different technologies further, and this forms an opportunity for further research.

The other major shortcoming is that the primary research methodology only considered one respondent per organisation. Therefore the views expressed can be viewed as not being representative of the organisation but merely a personal opinion. Again, given the time constraints of this research, this aspect had to be considered. Given the fact that the interviews had to be limited to an hour, the number and nature of the questions asked had to be limited and were mostly closed-ended questions. This also limited the ability of the researcher to explore broader aspects which could have contributed to the richness of the data.

Table 4-2: Summary of strengths and weaknesses

Category	Description	Comments
Strengths	Interviews were recorded in a audio format	Advantages include availability for further analysis, record keeping
	High response rate	Improves validity of results and is more representative of the population
	Results obtained are more accurate	This is due to the right person answering the questions as well as the fact that the answers are more in depth as the session is interactive
	Time saving	In-depth responses were obtained in a shorter time period
Weaknesses	All renewable energy technologies are grouped into one	Need to address each type of renewable energy technology on its own as they may differ
	Only one respondent interviewed per sample	Need more than one respondent per sample to generalise data for the sample
	Interviews limited interface time with sample	More time is needed per interview in order to explore all aspects of the study

4.8. Data collection process

A preamble and background information was sent to the respondent a few days before the actual interview session. This allowed the respondent enough time to

prepare for the interview. However, the interview questions themselves were not sent to the respondent prior to the interview session in order to prevent any response bias. The interviews were conducted by the researcher and captured in an audio format with prior permission from the respondent. A hardcopy of the questionnaire was used to record important response aspects. All audio recordings were critically reviewed to confirm and highlight key insights which the researcher may have overlooked during the interview. They were also integrated with other data recorded (Riley, 1996; Saunders *et al.,* 2003). The recordings could not be transcribed owing to time constraints.

4.9. Data analysis

The primary data obtained from the questionnaire would be a combination of quantitative and qualitative in nature. A frequency analysis method will be used to analyse the former data type while narrative content analysis will be used to analyse the latter. Microsoft Excel and NCSS software packages were used to conduct the frequency analysis. The first step in the narrative content analysis is to group the narrative responses to the same question from each respondent on one page. The responses are then categorised under different headings. After categorisation, similarities, differences and new insights may emerge (Saunders *et al*., 2003) and these will be analysed in relation to the literature review conducted and the pertinent factors limiting investments in renewable energy technologies. These inferences and insights will allow the researcher to assess whether the organisation is experiencing any of the factors highlighted in the literature review. Insights into possible solutions will also be discussed and recorded. The data obtained from the latter discussion will improve the quality of the research results. The major categories that will be analysed are as follows:

- investors' qualifications, experience and type of renewable energy investment
- political influences on decisions
- economic influences on decisions
- social influences on decisions

- level of technology development involved in projects (i.e. proven or not)
- organisation's investment processes

In order to describe the data analysis process, this section of the document has been broken down into each of the six sections dealt with in the questionnaire. The first section of the questionnaire was the introduction. This part of the document investigated whether there was any correlation between the background of the investor and renewable energy investment. The first question (1.1) was a multiple-choice question which will be analysed using a frequency analysis. It will provide insight into what is the most popular background of renewable energy investors. The responses to the subsequent two questions (1.2 and 1.3) will be analysed using content analysis as they will be compared with the rest of the sample to identify any correlation. The first part of the last question (1.4) will be analysed using a frequency analysis to identify which type of renewable energy project is the most preferred option. The second part seeks to understand the reason for the previous choice and will be analysed using content analysis. Relationships between responses to questions 1.4 and 1.1 will also be investigated to identify any relationships between investor background and the type of renewable energy projects preferred.

Table 4-3: Analysis tool for section 1

Question number	Analysis tool
1.1	Frequency analysis
1.2	Content analysis
1.3	Content analysis
1.4	Frequency & content analysis

The second section of the questionnaire investigates political aspects of the decision-making process. A frequency analysis of the responses to the first question (2.1) will indicate whether investment decisions are currently influenced by political frameworks. The response to the second part of the first question (2.1) explains the previous choice. These will be analysed using content analysis to identify similarities among responses. A frequency analysis on the responses to the second (2.2), third (2.3) and fourth question (2.4) will also be conducted. The result will indicate the agreed current role of the state and the desired level of involvement that the state

should have in the renewable energy industry. It will also indicate the adequacy of South African government incentives and regulations for promoting investment in renewable energy. The last question investigates the reasons for the latter opinion. These will be analysed using narrative and content analysis to identify similarities among responses.

Table 4-4: Analysis tool for section 2

Question number	Analysis tool
2.1	Frequency & content analysis
2.2	Frequency analysis
2.3	Frequency analysis
2.4	Frequency analysis
2.5	Narrative & content analysis

The third section of the questionnaire investigates the economic aspects of the decision-making process. Accordingly, a frequency analysis of the responses to the first question (3.1) will indicate whether investment decisions are currently influenced by prevailing economic factors such as macro-economic (exchange rate), micro-economic (demand and supply) and financial (lending instruments) factors. The responses to the second part of the first question explain the previous choice and these will be analysed using content analysis in order to identify similarities among the responses. Responses to the first part of the next question (3.2) will be analysed by means of a frequency analysis, which is intended to reveal whether the selling price of renewable energy is indeed being considered during the investment decision. Responses to the second part of the same question will provide insights into how this affects the investment decision. These will be analysed using content analysis to identify similarities amongst responses. Questions 3.3, 3.4, 3.5, and 3.6 investigate the following respectively: differences between financing a renewable energy project and a conventional energy project; how investors differentiate economically between the two types of energy project; whether investors cater for long-term associated costs to ensure sustainability; and the nature of the economic factors that affect investment in renewable energy projects the most. A frequency analysis of responses to these questions will attempt to indicate the status quo in terms of each issue. Responses to question 3.7 seek to understand the previous

choice and will be analysed using narrative and content analysis to identify similarities amongst responses.

Table 4-5: Analysis tool for section 3

Question number	Analysis tool
3.1	Frequency & content analysis
3.2	Frequency & content analysis
3.3	Frequency analysis
3.4	Frequency analysis
3.5	Frequency analysis
3.6	Frequency analysis
3.7	Narrative & content Analysis

The fourth section of the questionnaire investigates the social aspects of the decision-making process. A frequency analysis of the responses to the first question (4.1) will indicate whether investment decisions are currently influenced by social factors, thus the responses to the second part of the first question explain the previous choice and these will be analysed using content analysis to identify similarities among responses.

The following questions (4.2 and 4.3) deal with communication between investors and stakeholder community, with question 4.4 assessing whether investors consider poverty in South Africa in their decisions. The next question (4.5) assesses how important the needs of the respective social community are to investors during the investment decision; consequently, frequency analysis will be conducted on responses to questions 4.2, 4.3, 4.4 and 4.5. If the investor's response to the question 4.5 indicates that the needs of the community are important, then question 4.6 seeks to understand how these needs are integrated in the investor's investment decisions, thus a narrative and content analysis will be conducted to identify similarities amongst these responses.

The first part of the next question (4.7) compares the level of social acceptance of renewable energy technologies in South Africa with the rest of the world and these responses will be analysed using a frequency analysis. The second part of the same question asks for a justification of the previous choice, which will be analysed by

means of a content analysis in terms of which similarities in responses will be identified.

A narrative and content analysis will then be conducted to identify similarities among responses to the last question (4.8). This is an open-ended question which provides insights from an investor's perspective into what can be done in order to enhance the social acceptance of renewable energy technologies in South Africa.

Table 4-6: Analysis tool for section 4

Question number	Analysis tool
4.1	Frequency & content analysis
4.2	Frequency analysis
4.3	Frequency analysis
4.4	Frequency analysis
4.5	Frequency analysis
4.6	Narrative & content analysis
4.7	Frequency & content analysis
4.8	Narrative & content analysis

The fifth section of the questionnaire investigates the technology aspects of the decision-making process. A frequency analysis of the responses to the first question (5.1) will indicate whether investment decisions are currently influenced by technology factors, with the response to the second part of the first question explaining the previous choice. Responses will be analysed using content analysis to identify similarities among responses. The following question (5.2) investigates the appetite of the organisation for technology development. A frequency analysis will indicate the South African propensity of investment in research and development in the renewable energy technologies. The remaining questions (5.3 and 5.4) will generate narrative responses and therefore a narrative and content analysis will be conducted to identify similarities among responses. The former question (5.3) tries to understand how the investment decision is affected by the level of technology development, while the latter (5.4) compares South African renewable energy technology with the international community in terms of standards, certification, skills and infrastructure.

Table 4-7: Analysis tool for section 5

Question number	Analysis tool
5.1	Frequency & content analysis
5.2	Frequency analysis
5.3	Narrative & content analysis
5.4	Narrative & content analysis

The final section of the questionnaire investigates the organisation's investment processes that may affect investment in renewable energy projects. A frequency analysis will be conducted on the responses to the first four questions (6.1, 6.2, 6.3 and 6.4) to investigate factors such as investment policies, shareholder influence and the distinction between a conventional energy and a renewable energy project. In case the organisation does differentiate between the two, the following question (6.5) explores how they are differentiated, with the narrative response being analysed using both narrative and content analysis. The questionnaire concludes by asking the respondent to choose two of the most important factors that they believe are affecting their investment decisions currently. Responses will be analysed by means of a frequency analysis which will identify which are the most important factors from an investor's perspective. The responses to the last question will generate insightful data which will need to be analysed by means of narrative and content analysis methods. This provides ideas of what can be done to improve the level of investment in renewable energy from an investor's perspective.

Table 4-8: Analysis tool for section 6

Question number	Analysis tool
6.1	Frequency analysis
6.2	Frequency analysis
6.3	Frequency analysis
6.4	Frequency analysis
6.5	Narrative & content Analysis
6.6	Frequency analysis
6.7	Narrative & content Analysis

4.10. Research limitation

At this stage, there are many factors that may inhibit the research. Amongst the most common is non response bias which is normally caused by respondents choosing not to respond to some questions for personal, sensitivity or other reasons. Then there is response bias where the response is influenced by the respondent's perception of what the researcher wants to hear. There could also be extremity bias in terms of which respondents exaggerate issues by responding on the extreme end of the scale to highlight certain issues. In addition, there may be interviewer bias where the interviewer may lead respondents to make responses which they would not normally have given or influence the response obtained.

4.11. Ethical considerations

It is a requirement of the University of Pretoria and the Gordon Institute of Business Science that research goes through an ethical clearance process which vets the questionnaire used. This process ensured the confidentiality and the ethical component of the research. The clearance obtained meant that none of the respondents' names will be revealed and all their responses will be kept confidential, as they were informed from the very first contact. At the beginning of each interview session the respondent was provided with a consent form assuring them of confidentiality. The name and contact details of the researcher were also provided, which can be used as recourse in case they suspect that there has been a breach of confidentiality. They were also informed that they are entitled to a copy of the data gathered.

4.12. Conclusion

The research methodology chosen in this research is an exploratory experience survey-based research making use of interviews. This research seeks to identify the factors limiting financial investment in renewable energy as well as to understand how this affects investments. As such, valuable data will result from this methodology which will provide the basis for the insights required to answer the questions defined in chapter 3.

5. Results

5.1. Introduction

The aim of this research is to investigate the factors limiting investments in renewable energy technologies. This will be approached from an investor's perspective in terms of which research respondents will provide insights into factors currently influencing their investments.

The research method chosen for this study was an experience survey making use of interviews conducted in person by the researcher (Zikmund, 2003, p. 114). The results were recorded in an audio format as well as on the interview questionnaire in writing. The research methodology was intended to collect both qualitative and quantitative data in order to assess and understand the validity of the factors identified and how they influence investment decisions.

This chapter details the results obtained from the research that was undertaken. It is important to highlight here that the material presented and included in this chapter comprises the actual responses made by the respondents. In some cases, the respondents provided arguments and discussions which the researcher has included as part of the qualitative data obtained. The chapter is laid out as follows:

- **Introduction**. Gives a brief summary of the aim of the research, the methodology used, a disclaimer of the content presented and the topics to be covered.
- **Sample description**. This section of the chapter describes the sample surveyed for this research
- **Investor background**. This section of the chapter details the responses obtained to the questions relating to investor background.
- **Political**. This section of the chapter comprises the responses obtained to the questions relating to political aspects.

- **Economic**. This section of the chapter contains the responses obtained to questions relating to economic aspects.
- **Social**. This section of the chapter details the responses obtained for questions relating to socio-cultural aspects.
- **Technology**. This section of the chapter discussed the responses obtained to questions relating to technological aspects.
- **Organisation**. This section of the chapter details the responses obtained to questions relating to the internal structure and processes of their respective organisations.
- **Conclusion**. This chapter ends with a short conclusion which will summarise the chapter.

5.2. Sample description

In line with the research design, as the preferred sample this research chose institutions which finance renewable energy projects. Table 5-1 gives a summary of the sample description. Ten of the 16 companies identified were surveyed, with one respondent from each of the ten companies being interviewed. Owing to time constraints, more respondents from the same organisation could not be interviewed. All of the organisations identified are located in the Gauteng region of South Africa.

The majority of the sample surveyed was male, making up 90% of the population, while female respondents comprised a mere 10%. From a race perspective, 50% of respondents were white, 30% were Indian and 20% were black.

5.3. Investor background

This research was designed to investigate whether the respondents' respective backgrounds in terms of qualifications and experience had any influence on the type of renewable energy in which they would invest. This section will table the results obtained from respondents during the interviews and will consist of data pertaining to

Table 5-1: Demographics of sample surveyed

	Description	Number	Percentage
Sample size	Number of companies	16	100
	Number of respondents interviewed	10	62.5
	Number of respondent per company	1	
Total sample background	Financial	13	87
	Energy	2	13
Surveyed sample background	Financial	8	80
	Energy	2	20
Location of sample	Gauteng	15	100
Gender	Male	9	90
	Female	1	10
Race	White	5	50
	Indian	3	30
	Black	2	20
Respondent's qualification	Financial	7	70
	Technical	4	40

each respondent's qualifications, experience and technology choice. Figure 5-1 shows the makeup of the respondents' respective backgrounds.

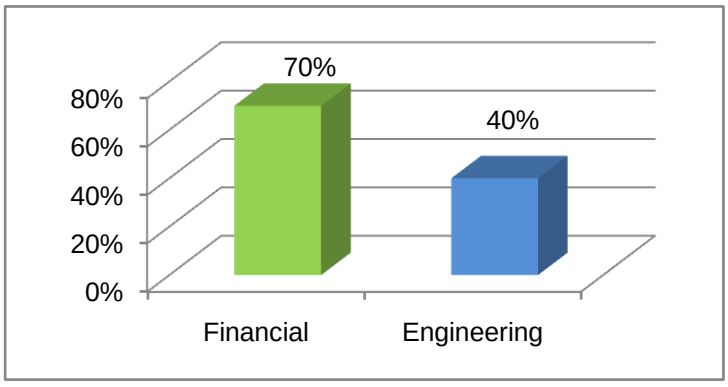

Figure 5-1: Respondent background

The next aspect that this research investigated was the type of technology each respondent would choose to invest in based on their experience and industry knowledge. The results are shown in figure 5-2.

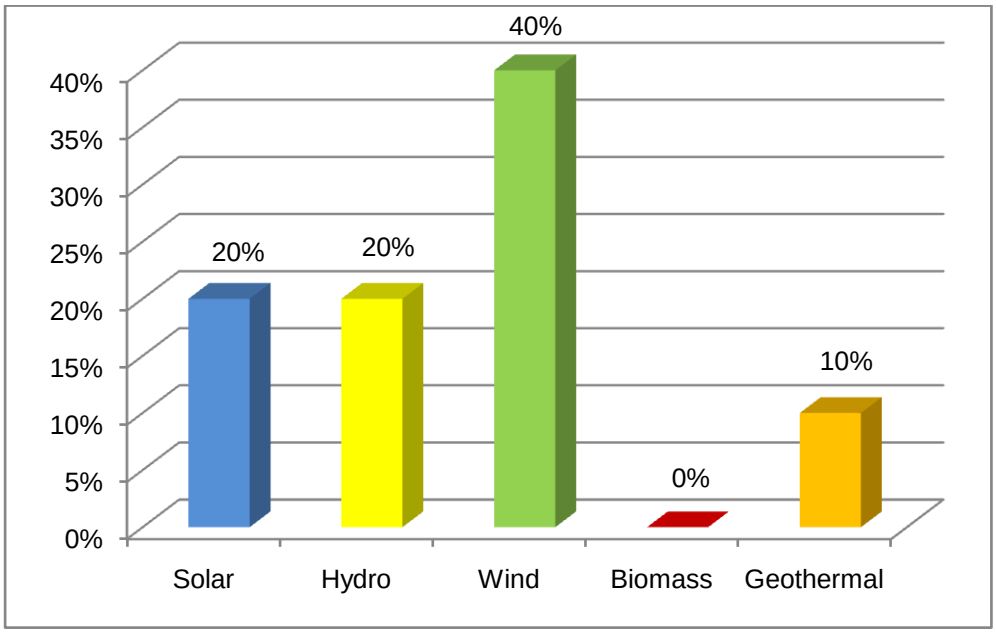

Figure 5-2: Technology preference

In order to further understand whether there were other reasons for their choice, the respondents were asked to give their reasons. Figure 5-3 illustrates the results obtained from all the respondents.

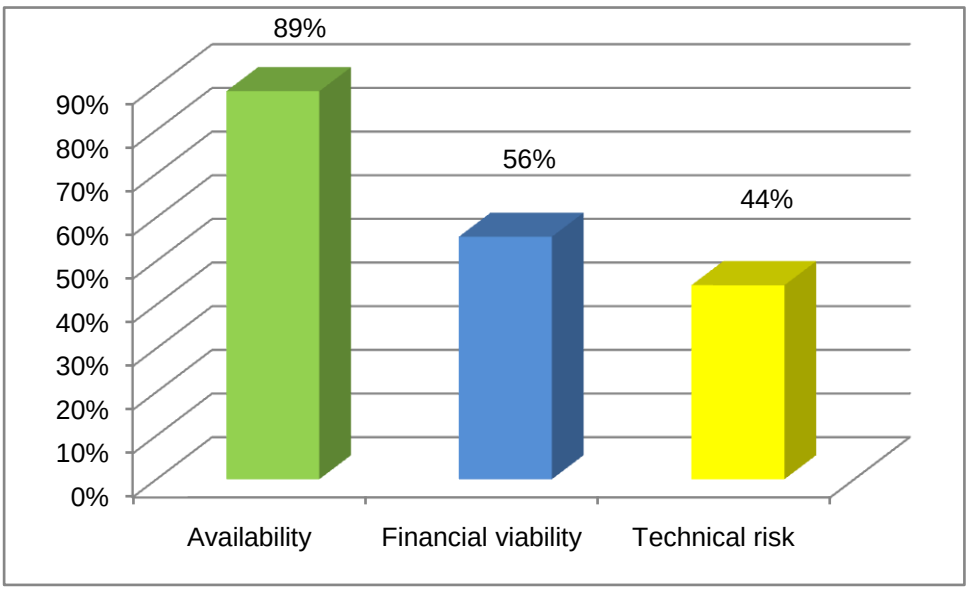

Figure 5-3: Renewable energy selection criteria

This research further wanted to find out what the criteria profile is for the most popular technology choice. This was found to be wind technology, with a frequency

rate of 40%. Figure 5-4 shows the results obtained from respondents who selected wind technology.

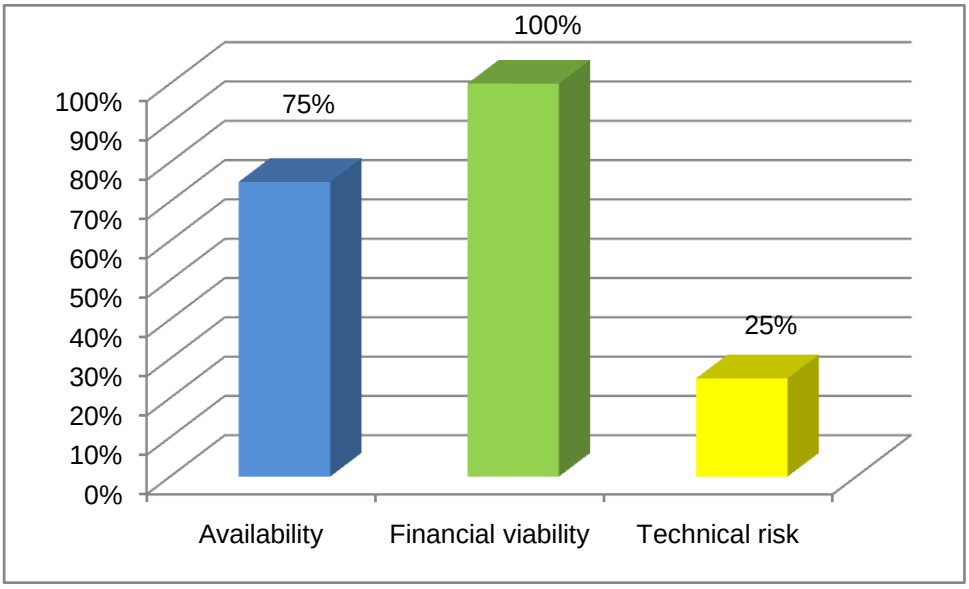

Figure 5-4: Wind selection criteria frequency

Of the 40% that chose wind technology, all of them mentioned financial viability as the reason for choosing wind technology over any other type of technology. The second most popular reason at 75% was the availability of the resource which, according to them, is naturally occurring and can be replenished. It was mentioned that it does not need any type of capital intensive infrastructure to convert this energy when compared to other renewable energy sources such as hydro. At least 25% of the respondents that chose wind technology mentioned technical risk as a reason for their choice. It is believed that wind technology is mature, established and proven. As such, it is has the lowest technical risk among renewable energy technology types.

5.4. Political

5.4.1. Political influence

Under the political aspect of investment decisions, all respondents confirmed that their decisions are currently influenced by political factors. Table 5-2 gives these

Table 5-2: Respondents to political influence

Political influence	Percentage
Yes	100
No	0

results. When respondents were asked to explain their choice a number of factors emerged and these are summarised in figure 5-5.

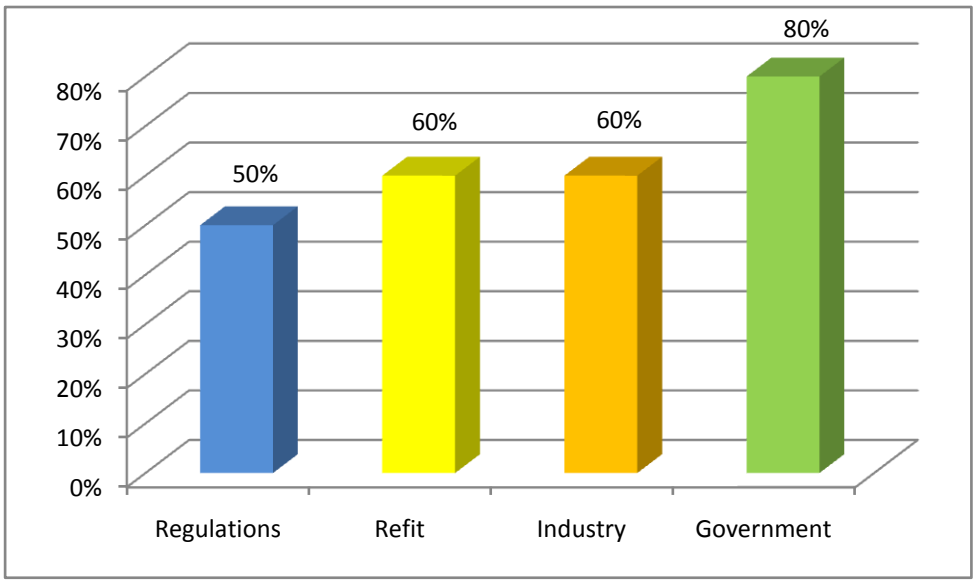

Figure 5-5: Political influence reasons

Four major themes emerged from the respective responses, namely regulations, the Renewable Energy Feed-In Tariff (REFIT), industry and government-related aspects.

In the first category, regulations, the lack of these was cited as one of the major factors currently influencing investment decisions. In addition, some respondents mentioned that the current regulations are not clear enough.

While some respondents felt that the current REFIT tariff system is not clear enough, others felt that the need for it is justified. The latter group also felt it is the only way to induce and promote activity in the renewable energy industry.

Most of the respondents felt that the current energy industry is still biased towards conventional fossil fuel sources of energy such as coal. The national utility, Eskom,

was mentioned on several occasions as having an industry monopoly, which reduces competition and is a barrier to entry owing to the capital intensive requirements of renewable energy technology. This monopolistic market condition was attributed to the government's acceptance.

As shown in the results, most of the respondents mentioned that government needs to provide an enabling environment that is conducive to the promotion of the renewable energy industry. It was mentioned that this could be done through tax benefits that would also increase competition. International agreements, such as the Copenhagen accord, were also mentioned as a factor influencing the role of the state in the energy industry.

5.4.2. Role of the state

Investors believe that government's role is important in promoting renewable energy investment. Figure 5-6 illustrates the difference between what investors feel the current role of the state is compared with what it should be. It can be seen that although 70% of the respondents stated that the current level of state involvement is high, 90% said that the level of involvement needs to be high. This means that 20% of respondents did not believe that the current role of the state is high enough.

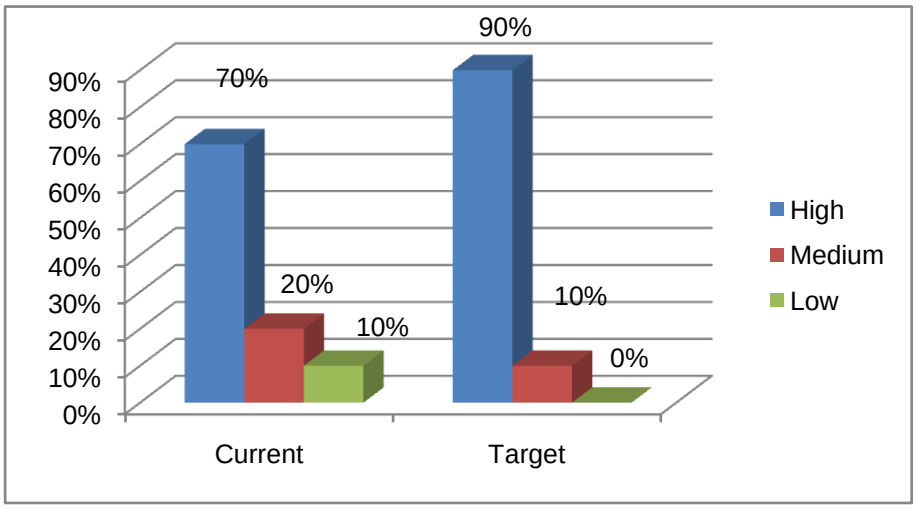

Figure 5-6: Role of the state in the renewable energy industry

5.4.3. Incentives and regulations

Finally, respondents were asked whether the current set of incentives and regulations were sufficient to promote investment into renewable energy technologies. Although one respondent did not answer this question, the remainder of the responses are listed in table 5-3.

Table 5-3: Incentives and regulations

Are incentives and regulations sufficient?	Percentage
Yes	40
No	50

Respondents were then asked to elaborate further on their responses. Figure 5-7 indicates the reasons given. The current framework was mentioned several times by 40% as an example of where incentives were being provided, such as the feed-in tariff system. While some respondents believed that this is sufficient, others believe that they are inadequate and need to be enforced through regulations.

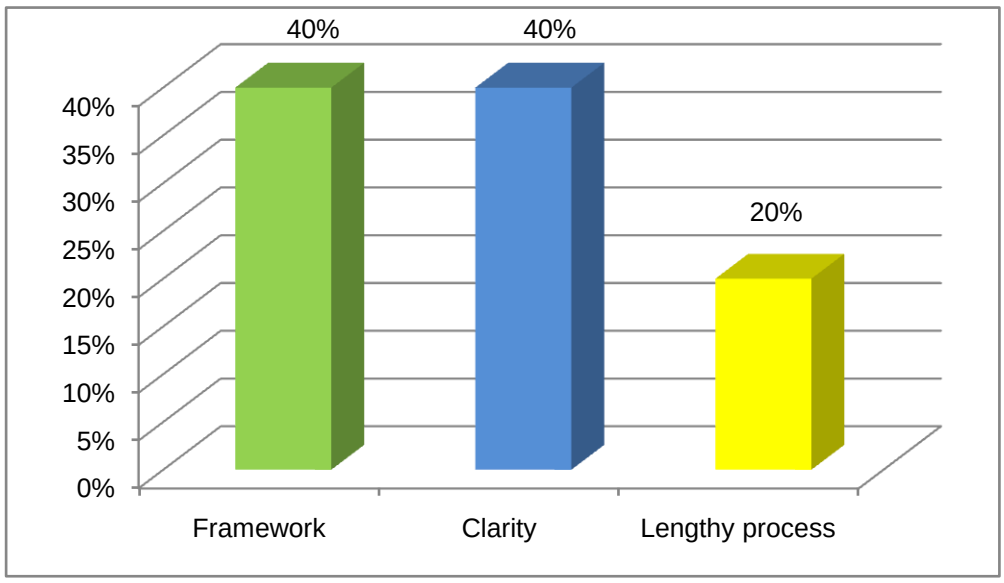

Figure 5-7: Reasons given for current level of incentives and regulations

The second aspect that emerged was the need for clarification of the current incentives and regulations which were mentioned by 40% of the respondents. The REFIT tariff and carbon capture were some examples mentioned.

The third emerging aspect mentioned by 20% of the respondents is the lengthy application and approval processes involved for renewable energy projects and financing thereof. This was mostly prevalent at the government level. They felt that the process involved in the renewable energy industry requires too many procedures which make it lengthy. Red tape was included in the reasons give the longer duration compared to conventional sources.

5.5. Economic

5.5.1. Economic influence

Respondents were asked whether the current prevailing economic factors influence renewable energy investment. The results are listed in table 5-4.

Table 5-4: Influence of economic factors

Do economic factors influence investment decisions?	Percentage
Yes	90
No	10

In order to get a deeper understanding of why respondents responded as they did, they were asked to explain their choice of answer. The explanations received highlight the four major themes, namely financial viability, import-related implications, market issues and industry-related factors. Figure 5-8 illustrates the frequency of responses by theme identified.

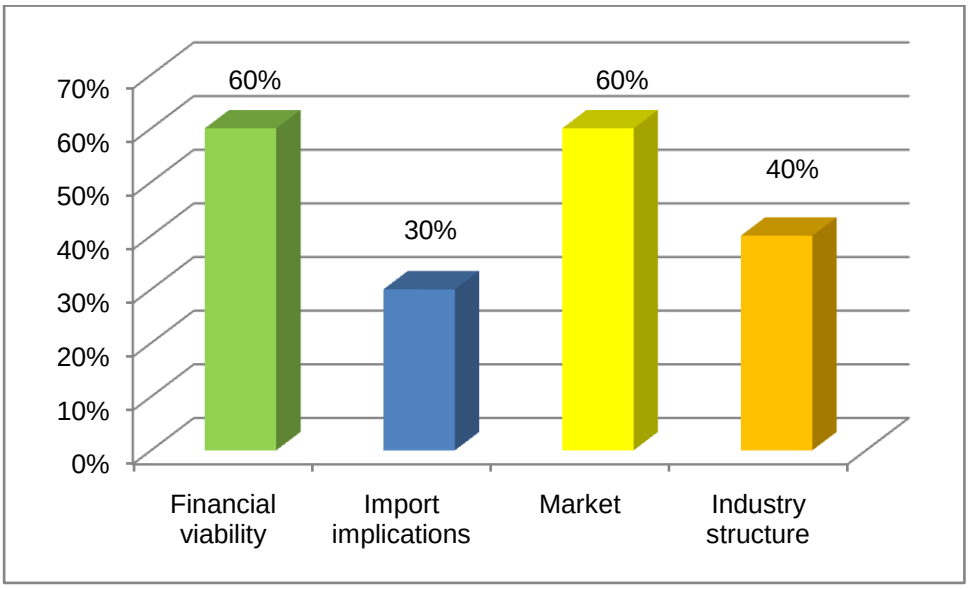

Figure 5-8: Reasons for economic influence

Financial viability

The financial viability of the respective potential projects was mentioned by 60% of respondents. Investors were very concerned about the financial viability of their investments and factors such as high capital costs, the price of products, tax benefits, grants, subsidies and means of raising capital through debt and equity were mentioned as being considered when making investments.

Import implications

The second theme was imported-related issues. According to 30% of respondents, some of the technologies are imported which introduces foreign currency risks into their investments.

Market

Another theme highlighted by 60% of the respondents was market-related factors, which include demand and supply factors. According to the respondents, South Africa's electricity supply cannot meet demand which provides opportunities for new entries into the market. It is, however, believed that these new entries should be in the private sector, as Eskom's generation capacity constraint was mentioned as a major cause of the current lack of energy supply situation. One respondent stated

that while the market for energy has been established, the market for renewable energy does not yet exist in South Africa.

Industry structure

The final theme discussed by 40% of respondents is factors related to industry structure, with government intervention being one of the most important aspects mentioned. Implementation of platforms such as the Independent Power Producers (IPP) agreements and the Integrated Resource Plan (IRP) for electricity policy will facilitate investments, as well as providing transparency and clear guidance for investors. Some of the respondents further stated that the IPPs should be channelled directly to customers instead of Eskom. Grants and subsidies were also seen as part of government's responsibility.

5.5.2. Selling price

Following on from the previous question, investors were asked whether their investment decisions are influenced by the selling price of renewable energy. Table 5-5 shows the responses received.

Table 5-5: Selling price influence

RE selling price & investment	Percentage
Yes	90
No	10

One respondent did not consider the selling price of renewable energy to be important in the investment decision. On the other hand, of the 90% of respondents who answered positively, all mentioned project financial viability as the major reason for their choice.

5.5.3. Renewable versus conventional

Respondents were asked how they rate financial investment in a renewable energy project relative to a conventional energy project in South Africa. Their responses in terms of the three options provided are summarised in figure 5-9.

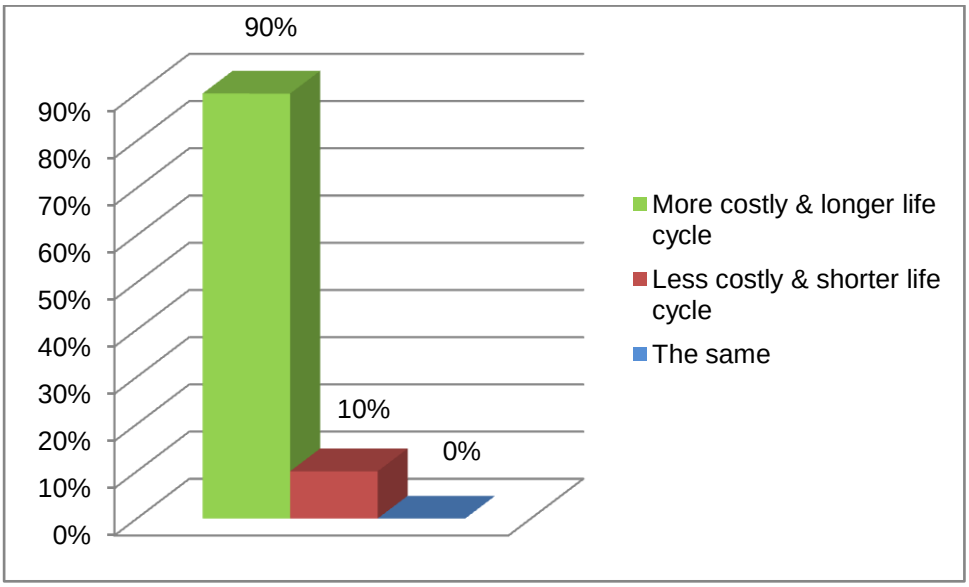

Figure 5-9: Difference in cost and project life cycle

Following on from the previous question, investors were asked how they differentiate between the two types of energy project from an investment perspective. Four options were given to them and their choices are summarised in figure 5-10. Two of the respondents did not answer the question.

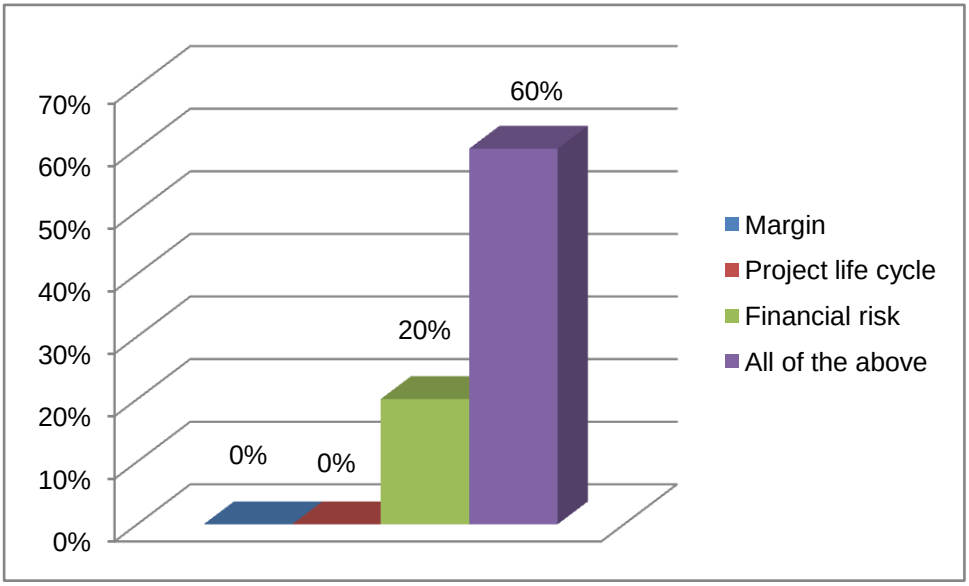

Figure 5-10: Investment differentiating criteria

In view of the lengthy project life cycle of renewable energy projects, investors were asked if they made allowances for the long-term associated costs of ensuring project sustainability. Table 5-6 shows the responses received.

Table 5-6: Long-term associated cost allowance

Allowance made for long term costs	Percentage
Yes	80%
No	20%

Insights provided by some respondents are that some organisations are only mandated to look at innovation while others only invest in commercially proven technologies. It was also stated that while maintenance costs are generally higher than conventional technologies, operational costs on the other hand are generally lower than conventional fossil fuel based technologies. It was also mentioned that specific allowances have to be made in order to ensure sustainability due to the current nature of the energy industry. In view of the monopoly held by the only buyer of electricity, contingencies have to be made in case the sale agreement is not honoured, which has happened in the past. The investor is then forced to write off substantial investments as a direct result of the monopolistic nature of the industry. Since renewable energy investments require substantial funds, the current business context makes investments in the industry neither sustainable nor attractive for investors.

At least one of the respondents made reference to the use of the equator principles (EPFI, 2006) in terms of which all non-financial factors such as environmental and social are considered when making any type of investment.

5.5.4. Most important economic factors

Finally, respondents were asked which of the three economic factor(s) they consider most important when making an investment decision with regards to renewable energy projects. The choices provided were financial, microeconomic and macroeconomic factors as well as all three in combination. The results are shown in figure 5-11.

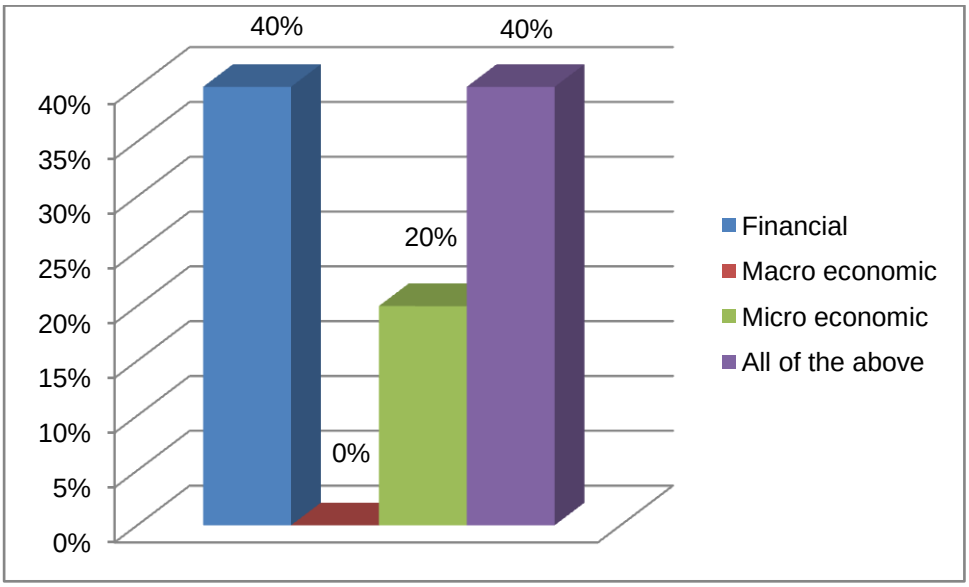

Figure 5-11: Most important economic factor(s)

Respondents were then asked why they chose those factors specifically. The results were assembled and analysed, with three major themes emerging, namely financial viability, shareholder's mandate and import-related issues (see figure 5-12). As in the previous section, 80% of respondents mentioned financial viability as an important factor. One of the respondents stated that while financial viability is important on the one hand, high returns do not promote cost optimisation on the other. According to the same respondent, the current REFIT tariffs are attractive and therefore necessary and timely to include in the IPP agreements with private investors as they will ensure cost containment.

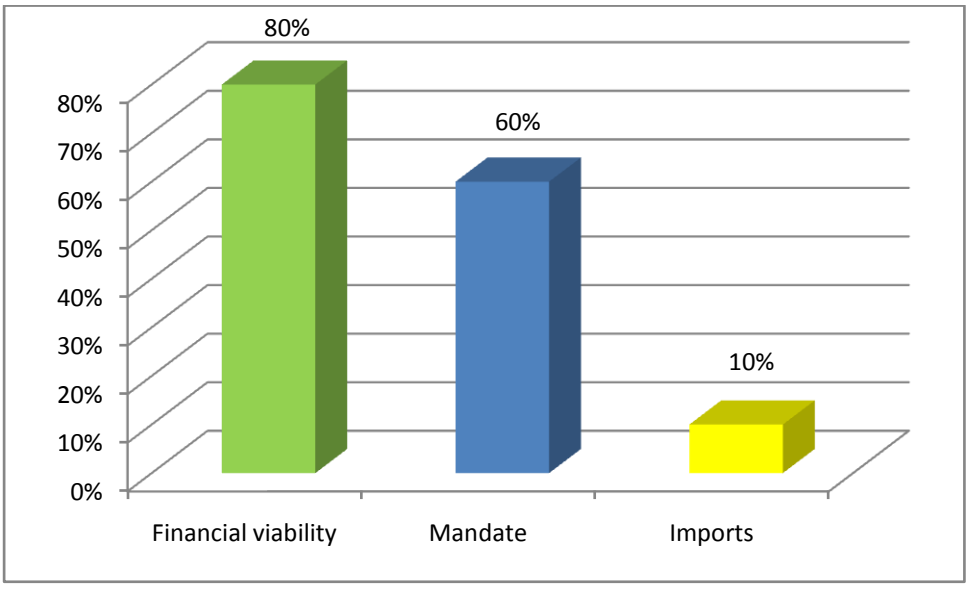

Figure 5-12: Reason for economic factors

Shareholder's mandate was mentioned by 60% of the respondents. Mandates range from maximising returns to promoting social benefits such as job creation. Of course, depending on their respective mandates, different economic factors apply.

Finally, only one respondent mentioned again that some technologies are imported, which has an effect on their decisions, as it exposes investment to currency fluctuations that negatively affect associated risk.

5.6. Social

5.6.1. Social influence

Respondents were asked if they believe that renewable energy investment decisions in South Africa are influenced by social factors. The results are listed in table 5-7.

Table 5-7: Social influence response rate

Social influence	Percentage
Yes	70
No	30

The respondents were then requested to explain their previous choice. These explanations were categorised into environmental, regulatory and infrastructural issues. The response frequency is shown in figure 5-13.

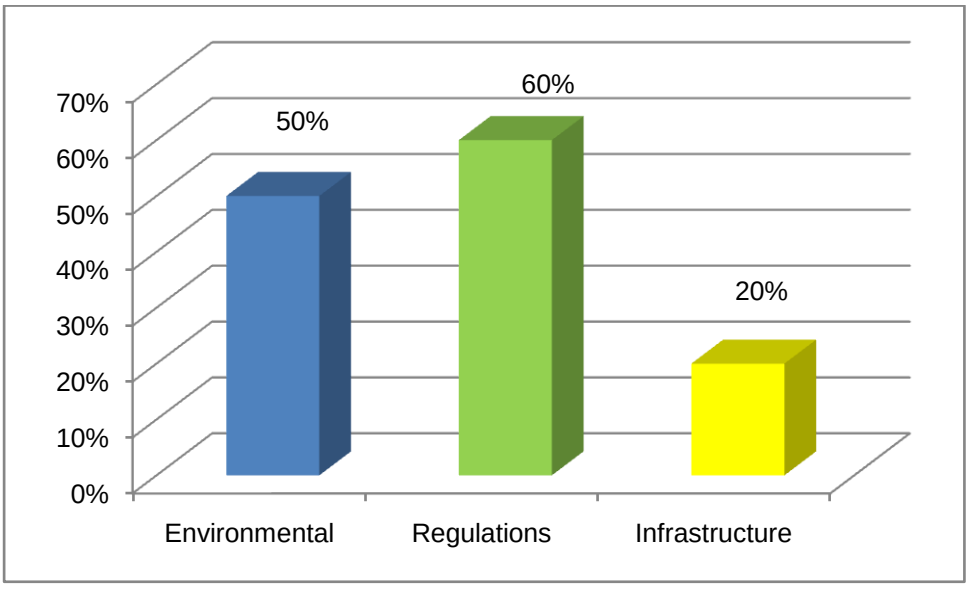

Figure 5-13: Social factor reasons

Investors do consider environmental concerns during their investment decision, which is reflected in 50% of the respondents citing this as important. They would prefer not to invest in projects that are environmentally harmful; however, 60% of respondents mentioned compulsory South African regulations that surround any energy project, that is, the Environmental Impact Analysis (EIA). This is an analysis that has to be carried out in order to prevent environmentally harmful projects from being implemented. The analysis also considers the societal impact of the project and includes a process of public engagement. Finally, 20% of respondents mentioned access to infrastructure, such as land and the energy grid, as one of the factors they would consider.

5.6.2. Community engagement

Respondents were asked to consider a project in terms of which a particular society would be directly affected as a result of its implementation. They were further asked questions about the communication component of the public engagement. One of the questions was the frequency of communication between themselves and the society concerned. Two options were provided in this regard, namely frequently or occasionally. This result is listed in table 5-8.

Table 5-8: Communication frequency

Communication frequency	Percentage
Frequently	30
Occasionally	70

The next stage of the communication process is to assess its nature. Respondents were accordingly asked how they would like to communicate with the society concerned. The choices provided were either personally or through an intermediary and the results is listed in table 5-9. It was also stated that deciding on both the frequency and the nature of the communication is a project specific process.

Table 5-9: Method of communication

Method of communication	Percentage
In person	10
Through an intermediary	90

Staying with the community aspect, respondents were asked if they would like the community to participate in their renewable energy projects. The result is listed in table 5-10.

Table 5-10: Community participation

Community participation	Percentage
Yes	80
No	20

Since poverty is a relevant and present challenge in South Africa, an investor perspective on this aspect would be relevant. Since the majority of South Africans live below the poverty line, respondents were asked if the current level of poverty affects their investment. The result is listed in table 5-11.

Table 5-11: Influence of poverty

Poverty influence	Percentage
Yes	50
No	40

Moving on to the needs of the society concerned, investors were questioned on the importance of societal needs when making an investment. Three options were provided for the respondents and the results are listed in table 5-12

Table 5-12: Needs of society

Needs of society	Percentage
Very important	50
Moderately important	50
Not important	0

The social component in any investment decision can be very delicate. Integrating social factors into an investment decision is therefore quite challenging. Respondents were asked in this regard how would they implement and integrate the information received into their decisions and their responses were categorised into four major themes: project viability, nature of needs, pro rata investment and needs. Figure 5-14 shows the results obtained after the analysis.

The results showed that 50% of respondents consider project viability as most important and which may foreshadow any other aspects. Forty percent of the respondents would consider making a pro rata investment and are prepared to channel some of the investment to address the needs of the society concerned. While 30% of respondents confirmed that they address societal needs outside the project, 20% consider the nature of those needs first. If the need is a once-off cost and is affordable they may consider investing, otherwise they may decide to withdraw.

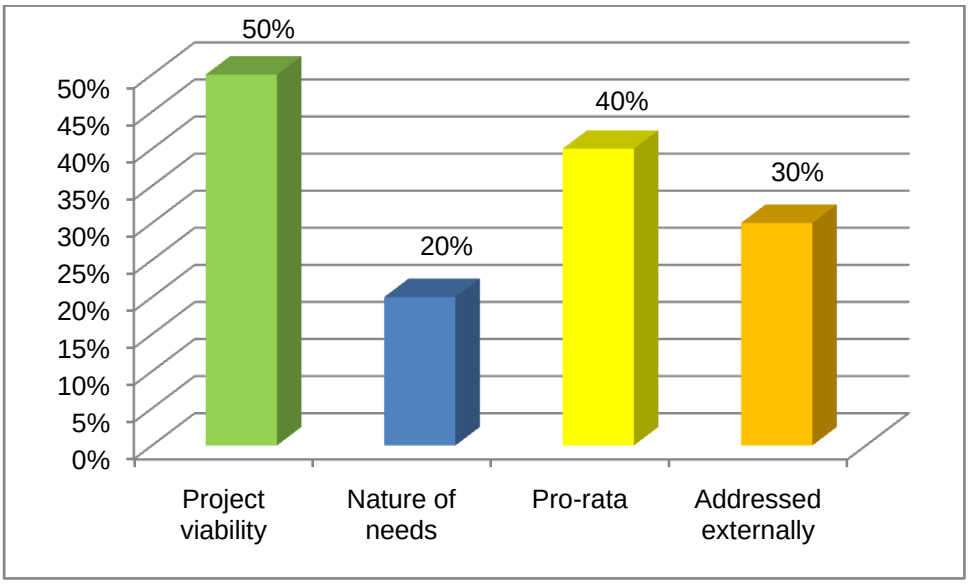

Figure 5-14: Integrating social factors with investment

5.6.3. Social acceptance

Respondents were asked to describe the social acceptance of renewable energy technologies in South Africa compared to the rest of the world. They were provided with three choices namely, more, same and less. Reference was made mostly to countries similar to South Africa such as Brazil, China and India. The results are listed in table 5-13. One respondent did not select an option as it was perceived that South Africa cannot be compared to the rest of the world.

Table 5-13: Social acceptance response

SA versus international	Percentage
More	0%
Same	0%
Less	90%

When respondents were asked for reasons why they made the choice they did, they mentioned several themes including government, market and cost-related factors. These were categorised and figure 5-15 summarises them accordingly.

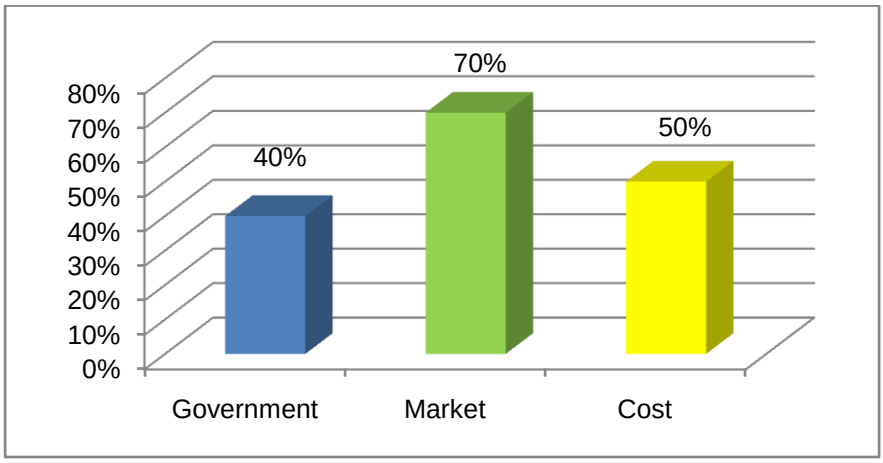

Figure 5-15: International comparison of social acceptance

Government

Issues related to government were mentioned by 40% of respondents as they believe that there is not sufficient drive by government to promote and induce activity in renewable energy technologies. They also believe that government has other more pressing priorities which are preventing them from giving this field the attention it deserves. Other priorities include poverty alleviation, education and healthcare. Typical assistance from the government would be mostly financial in nature.

Market

Market-related issues were mentioned by 70% of respondents, who believed that market-related factors are responsible for the lower social acceptance of renewable energy in South Africa. Market factors include general awareness of renewable energy basics and the alternatives available. Some of the respondents argued that the alternatives available in South Africa are limited which makes renewable energy more expensive and therefore unaffordable. This leads to the next aspect of the developmental state of the nation. Since South Africa is economically far less developed compared with the rest of the BASIC countries, the level of environmental awareness is also lower. Other factors mentioned, which form part of the market factors, is the fact that renewable energy is a relatively new field in South Africa. It is also argued that South Africa has not yet accepted these new technologies and, owing to the lack of education and the skills shortage, the problem is further compounded.

Cost

It was argued that if society is expected to switch to cleaner energy alternatives, there has to be some financial benefit to motivate this choice. This argument was raised by 50% of respondents, who felt that the switching costs are not attractive enough to motivate a shift in behaviour. It was argued that even with the recent South African power crisis, society has now accepted the status quo rather than going for the limited, more expensive choice.

5.6.4. Promoting social acceptance

In closing, respondents were asked what should be done differently to promote the social acceptance of renewable energy technologies in South Africa. Their responses were categorised and a summary is shown in figure 5-16. The three main categories that emerged were awareness, government and financial initiatives.

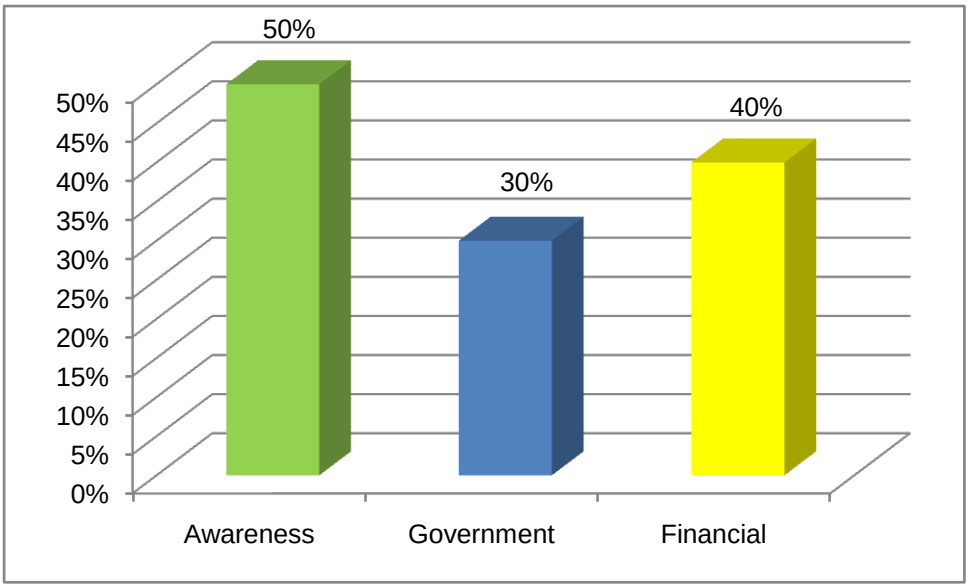

Figure 5-16: Promoting social acceptance of renewable energy

Awareness

The most frequent recommendation was that the public needed to be made aware of renewable energy technologies (50% of respondents). It was suggested that this can be achieved through education at formal institutions or through public awareness

programmes informing the general public about environmental impacts and alternatives currently available.

Government

Government initiatives were mentioned by 30% of respondents. These include setting clear targets and signals while meeting societal and environmental needs. It was felt that the government should meet its commitments and facilitate strategic initiatives that are aligned to its objectives. It was also mentioned that all respective government subsidiaries should be aligned to these objectives.

Financial initiatives

With regards to financial initiatives, 40% of respondents mentioned that energy and electricity prices need to be revised in order to promote renewable energy. It was also mentioned that society needs to understand that electricity prices will have to increase for historical reasons. As a result, the price of renewable energy will become more attractive. In addition, economic benefits need to be demonstrated to show the marginal cost advantage of fossil fuel.

5.7. Technology

5.7.1. Technology influence

All respondents were asked if renewable energy investment decisions in South Africa are influenced by technology factors. The responses are listed in table 5-14.

Table 5-14: Technology influence

Technology influence	Percentage
Yes	90
No	10

Respondents were asked to elaborate on their respective choices and these responses were categorised and three major themes emerged: imported technology, suitability and cost-related factors. The results are shown in figure 5-17.

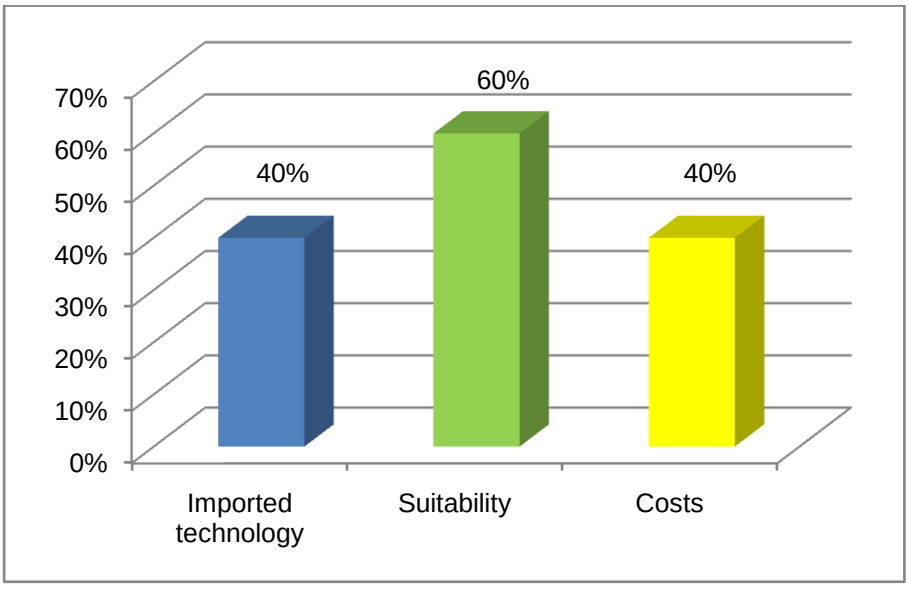

Figure 5-17: Technology influence reasons

Imported technology

Respondents stated that most of the renewable energy technologies are currently imported. This makes these technologies unattractive owing to the limited choice and local availability.

Suitability

Some of the respondents also argued that the current technologies are not suited for South African conditions and need to be adapted to suit or made fit for purpose. They added that some organisations only use established and proven technology which restricts their investment decisions.

Cost

From a cost perspective, respondents believe that while the cost of some renewable energy technologies is decreasing, some remain expensive. In addition, some technologies are not suitable for the South African market such as geothermal. As established previously, the financial viability of the project is the most important consideration for investors. As such, imported technologies attract increased financial risk owing to currency fluctuations.

5.7.2. Financing innovation

Respondents were also asked if they provided funds for technology innovation into renewable energy. The results are listed in table 5-15.

Table 5-15: Technology innovation finance

Technology innovation finance	Percentage
Yes	50
No	50

5.7.3. Developmental stages

This research was designed to investigate the way in which the different technological developmental stages impact on renewable energy investments. These stages begin with basic research and development. At this stage, the ideas are incubated until they are proven or ready to move on to the next stage of field testing. Once proven then they are promoted to commercialisation, where they are mass produced for industrial use. As such, respondents were asked how these various stages affected their investments decisions. The results were categorised according to four themes namely Proven only, Easier, Harder and both R&D and proven. “Proven only” refers to organisations that invest only in proven technology, while “Easier” refers to organisations that readily invest in technologies approaching the commercialisation stage. “Harder” refers to organisations that do not readily invest into technologies approaching the commercialisation stage, while “Both R&D and proven” refers to organisations that invest in all stages of technological development irrespective of their developmental stage. Figure 5-18 shows the result of the categorisation process.

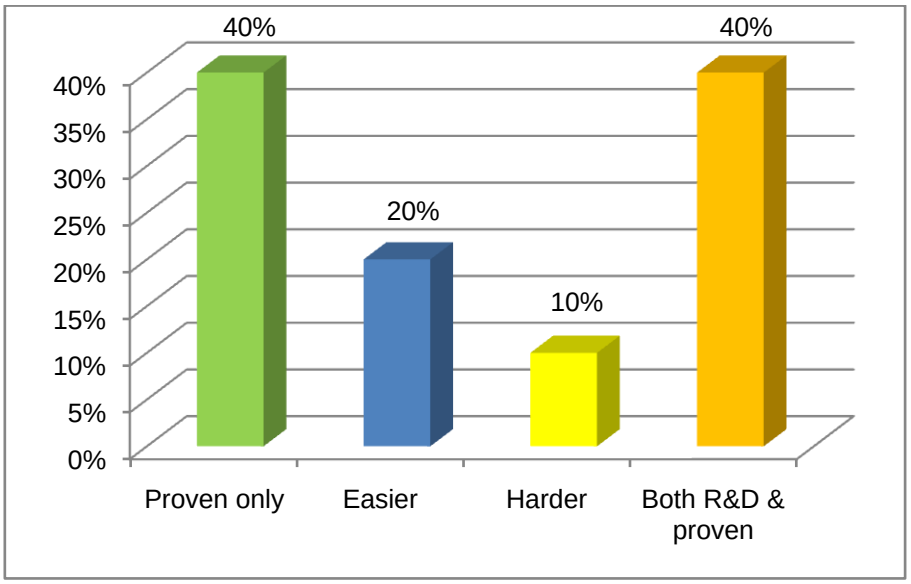

Figure 5-18: Technology investment

5.7.4. South Africa versus international

In order to understand how South African renewable energy technologies compare with the international community, respondents were asked to provide their opinion based on their experience. Four different aspects were considered, namely, standards, certification, skills and infrastructure.

Standards and certification

Lack of standards was mentioned by 90% of the sample, who stated that South Africa does not have any local standards pertaining to renewable energy technologies. Since most technologies are imported, South Africa adopts international standards in this regard. It was also argued that since these international standards are already established, there is no reason for South Africa to develop its own. On the other hand, some respondents believe that South Africa should not adopt international standards but rather adapt them to suit the local context.

Another reason mentioned by the respondents is the fact that renewable energy is a new field in South Africa and consequently no standards yet exist. The same philosophy applies to the certification processes: while compliance with normal

safety certification is compulsory, no specific certification processes exist for renewable energy technologies.

Skills

The results confirm that 50% of respondents believe that South Africa has the internationally comparative skills required to generate and maintain renewable energy technologies locally. However, 40% of respondents believe that South Africa does not have the internationally comparative skills for renewable energy technologies. One of the respondent stated that he was unable to comment.

Table 5-16: International comparative skills

Comparative skills	Percentage
Yes	50
No	40

Infrastructure

The results obtained, shown in table 5-17, indicates that 40% of respondents believe that South Africa has the internationally comparative infrastructure required to support renewable energy technologies. On the other hand, the other 50% did not share this view. One respondent stated that he was unable to comment in this regard.

Table 5-17: International comparative infrastructure

Comparative infrastructure	Percentage
Yes	40
No	50

5.8. Organisation

5.8.1. Organisational influence

Finally, this research wanted to investigate any internal organisational factors which may affect investment decisions. Accordingly, all respondents were asked a series of questions pertaining to the internal processes of their respective organisations. The first question asked if the company had an investment policy, to which 90% of respondents answered positively, with one respondent not commenting. When asked

how often the policy was enforced, respondents were given three choices: always, sometimes and never. The results are listed in table 5-18.

Table 5-18: Policy enforced

Response	Percentage
Always	70
Sometimes	20
Never	0

5.8.2. Shareholder influence

All respondents were asked if their shareholders had any influence on the investment decisions specifically with regard to renewable energy projects. One respondent did not provide a response whereas 50% answered positively and 40% negatively.

5.8.3. Financing differentiation

The next question investigated whether renewable energy projects are currently being recognised as an important investment vehicle in the organisations surveyed. Accordingly, respondents were asked if their organisations differentiated between financing a conventional compared to a renewable energy project. One respondent did not comment, 40% confirmed that they differentiate and 50% of them did not.

Of the 40% that answered positively, all mentioned that financial risk is closely scrutinised and international renewable energy projects are more attractive than those in South Africa. In South Africa, the establishment of the IRP, the REFIT tariffs and the energy white paper are becoming important for differentiating between the two types of project.

5.9. Recommendations

To end the interview, respondents were asked an exploratory question: they were asked to choose two of the aspects discussed earlier that they consider to be influencing their investment decisions the most. The choices entailed political, economic, social and cultural and, finally, technology factors. The results of the frequency analysis are shown in figure 5-19. The respondents were then asked what

they would change or add to the current situation in order to further promote renewable energy investments.

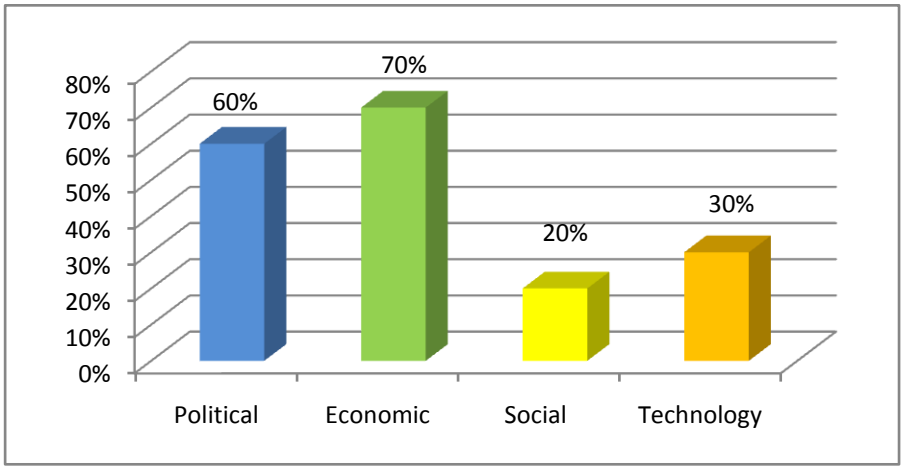

Figure 5-19: Investment factors

5.9.1. Political

From a political perspective, respondents made several recommendations relating mostly to the role of the state. They maintain that stronger leadership is warranted and that government needs to be more persuasive in its approach. Clear goals and objectives need to be set, including government policies such as carbon taxes and environmental policies, which also need to be unambiguous, un-conflicting and clear. The processes involved should be transparent, fast and efficient. In addition, an integrated approach needs to be adopted to achieve these goals. Government needs to lead by example by aligning all its substructures to its chosen mandate.

Another recommendation relates to the nature of competition in the energy industry. It was recommended that government needs to promote a more competitive culture in the energy industry by establishing IPPs and adopting competitive practices. With regard to the government-owned electricity monopoly, it was mentioned that government should allow and enable tradable renewable energy certificates which would allow it to operate more as a business without state interventions.

5.9.2. Economic

As an extension of the previous recommendations, respondents mentioned the need for government to provide more incentives such as grants, subsidies and tax benefits. The implementation of IPPs with private companies would promote competition in the industry. In addition, it was mentioned that government needs to clarify and provide clear guidelines for the REFIT system and the IRP process which will influence future electricity prices.

On the consumption side, it was mentioned that the implementation of the Tradable Renewable Energy Certificate (TREC) mechanism would assist in the adoption process, as it would bridge the existing gap between the producers and end users of green electricity.

On the financing front, respondents mentioned the need for a green bond. This is a pool of money that would be made available for renewable energy projects that will assist in debt finance. In addition, respondents mentioned that the implementation of an equitable REFIT system together with a bankable Power Purchase Agreement (PPA) is of the utmost importance in order to make the renewable energy industry sustainable.

5.9.3. Social

Respondents were unanimous in recommending the promotion of public awareness at all levels, as this would address the benefits of renewable energy as well as the alternatives available currently. This should also include environmental awareness. It was also mentioned that as long as there is widespread poverty, the adoption of renewable energy will not be substantial as priorities will always differ.

5.9.4. Technology

From a technology perspective, respondents made reference to localising the production of renewable energy. According to them, increasing local production capacity of renewable energy would stimulate the local economy which would, in turn, promote awareness and provide adequate consumer choices which would ultimately increase renewable energy adoption. Therefore production incentives

need to be provided to lower production costs. In addition to the latter, it was recommended that access to the electricity grid needs to be extended.

5.10. Conclusion

Base on the results obtained, it can be confirmed that the research design, experience survey and methodology, that is, the personal interviews applied were appropriate. The sample chosen, and the amount and type of data gathered yielded meaningful and insightful data which could be analysed in order to make academically sound and meaningful conclusions. The data addressed most of the renewable energy investment limiting factors that had been highlighted in the literature review. Opportunities for further research can also be derived from the analysis of the data.

6. Discussion of results

6.1. Introduction

This chapter provides a discussion relating to the data gathered and presented in the previous chapter. Since most of the arguments presented in this chapter draw from facts presented in chapter 5, it is logical for the structure of this chapter to follow likewise. Therefore, this chapter will start with a short discussion on the sample used including some observations. Following on from this the observations, insights and inferences pertaining to the dataset will be discussed and an analysis will be made.

Whenever appropriate the observations made would be used to substantiate or support studies done by other researchers and authors mentioned in the literature review chapter 2. The author acknowledges that due to the nature of the findings some material may appear more than once in arguments presented as it demonstrates the frequency and urgency displayed by respondents. The structure of this chapter has been designed to highlight the major findings of this research. As such they are addressed in chronological order with the most important realisation first followed by additional aspects that emerged from the results. This chapter therefore starts with an introduction summarising the structure of the chapter followed by a discussion of the sample and demographics used. The chapter then addresses the main findings on the research starting with the financial viability and follows by highlighting the role of the state, environmental compliance and some barriers. Some recommendations are also made in order to overcome the barriers highlighted followed by a short conclusion.

6.2. Sample and demographics

On account of the nature of this study and the topic chosen, the sample generation was neither trivial nor easy. Contact was made with as many organisations as possible but only ten were willing to participate in the study. With only ten samples, a response rate of 62.5% was achieved. Therefore, it can be argued that the data gathered from these ten respondents will be representative of the population defined. This underlines the fact that the renewable energy investment community is very small. For a country planning to grow at a rapid pace economically, while at the

same time facing an energy shortage and having the intention to substantially reduce carbon emissions by 42% by the year 2025, this would appear at best foolhardy and at worst alarming.

From the sample it can be seen that there are only two organisations in South Africa that are involved in energy production. This clearly signals a monopolistic situation which is not conducive to competition. In addition, it should be noted that the entire sample is located in one region of the country, that is, Gauteng, the province that constitutes South Africa's economic hub.

The sample revealed some interesting facts, the most obvious being that 90% of the sample comprised males. This seems to indicate that the renewable energy industry is dominated by males. From a racial perspective, there would appear to be a fairly well-distributed mix with a slight majority of whites. It can be argued that this indicates that the majority role players in the South African renewable energy industry are white males.

6.3. Discussion of results in order of importance

6.3.1. Financial viability

Most of the investors considered project financial viability as the most important factor. This seems to indicate that investors tend to prefer renewable energy technologies or projects that are generally financially viable. A review of the narrative provided by the respondents reveals the importance of the investors' main concern, that is, the financial viability of their investments. Simply put, they will not invest in any type of technology if it is not financially viable. Financial viability relates to a number of factors such as capital, operational costs, market, selling price and foreign currency risks, as mentioned by the respondents.

Capital and operational costs

One of the reasons why it is so expensive in comparison is the additional risk that such technologies attract. While the initial costs are higher than fossil fuel energy technologies, the operational costs are reported to be lower than the latter. This can be understood in terms of the cost of raw materials. It can be assumed that there is

the cost of raw material in most renewable energy technologies such as solar, wind, geothermal and hydro will be practically nil when compared to the conventional technology which involves burning coal, as the latter is the raw material that has to be purchased. Both cost and availability is a variable in the input cost, which thus supports the argument of lower operational costs. With fossil fuels being depleted at a significant rate, it is only logical that the price of the raw materials will increase even more in the future. In the case of South Africa, when the increasing price of coal is combined with the increasing financial penalties on carbon emissions, the total operating cost of conventional technology will become very expensive. At that point, renewable energy will become a much more financially attractive alternative. Currently, it appears that investors are rightly convinced that renewable energy technologies are not as attractive as conventional energy technologies, as it is still difficult to raise capital, sell the end product and obtain support in financing renewable energy projects.

Market

Theoretically, in any free market, whenever demand exceeds supply, prices increase. This principle is illustrated in figure 6-1. At equilibrium, when demand (d1) meets supply (s1), the price of the product is P1 for quantity Q1. As soon as the demand increases to d2, and the supply remains the same, then the price increases to P2 for quantity Q2 as long as all remains constant.

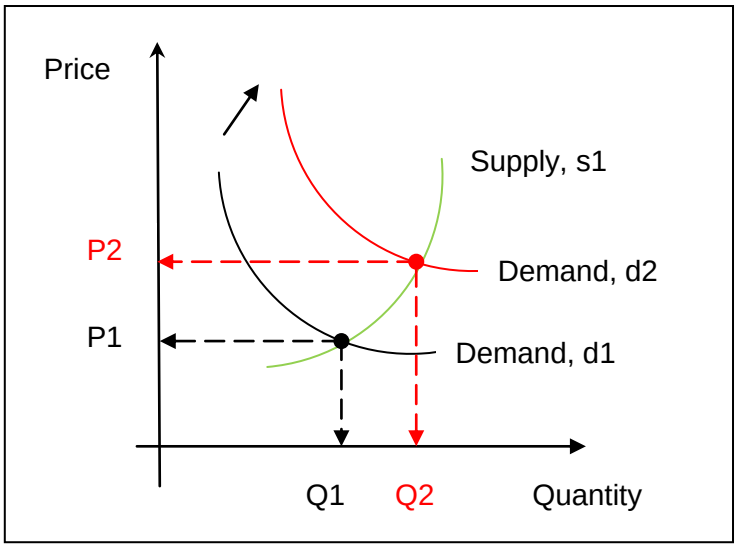

Figure 6-1: Demand and supply

With the recent energy crisis, the situation in figure 6-1 would have been the case. However, owing to the current market conditions, the price of electricity is fixed. As a result, generation capacity is fixed or capped and the demand for electricity is growing. This gap in the energy supply is an excellent opportunity for entry into the energy market and the respondents in this study believe that this space should be filled by the private sector so as to increase competition in the current monopolistic situation. Currently, the only supplier of electricity is Eskom which is government owned.

In addition to the latter, it can also be argued that while there is a demand for energy, there is no evidence to show that there is a demand for renewable energy. Most end users cannot differentiate between electricity and green electricity during consumption; therefore the need or demand for clean energy cannot be directly ascertained. This is where initiatives such as the Tradable Renewable Energy Certificates (TREC) can provide a platform for ensuring that a market for renewable energy is created and maintained.

Selling price

Historically, the price of electricity has been very low in South Africa relative to its international counterparts. The country owes its cheap energy to historical factors which led to the establishment of the national utility, ESKOM. Only recently, however, when demand exceeded the supply, did the government and ESKOM take the decision to increase generation capacity. As a result of this availability of cheap electricity, South African society has seen no reason to adopt alternatives that are more expensive. The narrative result obtained on the social factors investigated supports the above-mentioned argument, which confirms that electricity prices in South Africa have been and are currently very cheap when compared to the international community. Therefore it seems that the selling price of energy does influence consumption patterns.

It is interesting to note that at least one respondent mentioned that the selling price is not an important factor in their investment decision. This was linked to the investor's mandate, as in this case, where the mandate was to promote research and development, which meant that the selling price should not directly influence the

investment decision. It can therefore be concluded that some South African renewable energy investors do participate in efforts to promote research and development, which has the potential to develop new technologies.

Foreign currency risks

Any currency risk generally introduces more variables into investment portfolios, and such risk increases with the amount invested. Renewable energy investors believe that most of the applicable technologies are currently being imported. Therefore, it can be inferred that investors believe that the portfolio risks associated with any renewable energy project are generally higher as they involve foreign currency. Accordingly, higher risks generally require higher returns (Shefrin, 2001). Consequently, it is logical to expect investors to demand higher returns on any renewable energy investment. Currently, however, the cost of producing clean energy is not as competitive as conventional technologies, if at all in some cases; in fact, some renewable energy, technology is far more expensive. Combine this with an economic context such as South Africa, where the price of energy has until recently been the cheapest in the world, and investors will find it difficult to invest in renewable energy projects as they are currently not as attractive as they should be.

6.3.2. Need for clarity

The results obtained are conclusive proof that investors currently consider political factors when making investment decisions. These factors become even more important for renewable energy investments. Based on the responses obtained, it is clear that investors do not believe that the current political climate is conducive to substantial investment in this industry, owing to a lack of clear regulations and government support, and a preference for conventional fossil fuel based energy and the use of political forces to shape the energy industry with its own monopoly. With government giving out mixed signals, it can be understood why investors are confused. On one hand government has committed South Africa to a 42% cut in emissions by the year 2025, while on the other hand it has just approved a multibillion rand project for coal-powered plants.

Responses to the question of whether the current set of regulations and incentives are sufficient were split and therefore inconclusive. However, some themes kept on reappearing, such as the need for clarity on the current set of incentives and regulations. This therefore confirms that the current set of regulations and incentives, such as the REFIT tariff system, are not well understood in the industry. It also appears that investors believe that the renewable energy investment process is lengthy and cumbersome.

The South African government is currently unsure of its course of action, which is demonstrated by the inconsistent policies and initiatives, such as the REFIT system. This document makes references to platforms that have not yet been finalised or endorsed, such as the IPP and the IRP. According to REFIT, the financial capital requirements for joining the grid with any type of renewable energy are substantial, which automatically limits investors in their decisions. Another potential hurdle is the BBBEE requirements. The majority of South African wealth still resides in the white community. It is therefore reasonable to assume that investors will be limited as only those who comply with these requirements will be selected. Unfortunately these investors may not have the substantial capital required to be able to sell to the grid.

6.3.3. Forced compliance

From the results it can be seen that social factors have an influence on investment decisions in South Africa. It is encouraging to learn that most South African organisations are environmentally responsible in that they prefer to steer away from projects which are harmful to the environment. It is important to understand the regulations that apply to this aspect of any investment. The Environmental Impact Assessment (EIA), which is contained in the National Environmental Management Act, is mandated in order to safeguard the environment for the citizens of South Africa from actions that may infringe on the rights of its citizens. As a result, investors are careful to ensure that their potential investment vehicles are EIA compliant. In the case of renewable energy projects, compliance should be a fairly simple matter, however, careful consideration needs to be given to the social aspect of the assessment if projects affect a specific community.

The majority of the respondents mentioned the EIA process in their responses, which demonstrates that compliance with regulations is of paramount importance. It is encouraging to note that most of the respondents believe that communication with and the participation of the society concerned is very important and can play a significant part in the success or failure of their investments.

6.3.4. South African Barriers

The results obtained mention three key challenges that South Africa is facing currently, namely, grid access, poverty, education and technology. These are believed to be hindering the adoption of and investment in renewable energy technologies. As a developing country, it is expected that these barriers will prevail. However, it is perceived that South Africa is in particular has tougher challenges than other developing countries.

6.3.5. Grid access

South Africa is one of the largest countries in the southern hemisphere, covering an area of approximately 1.22 million square kilometres. Figure 6-2 shows the land area

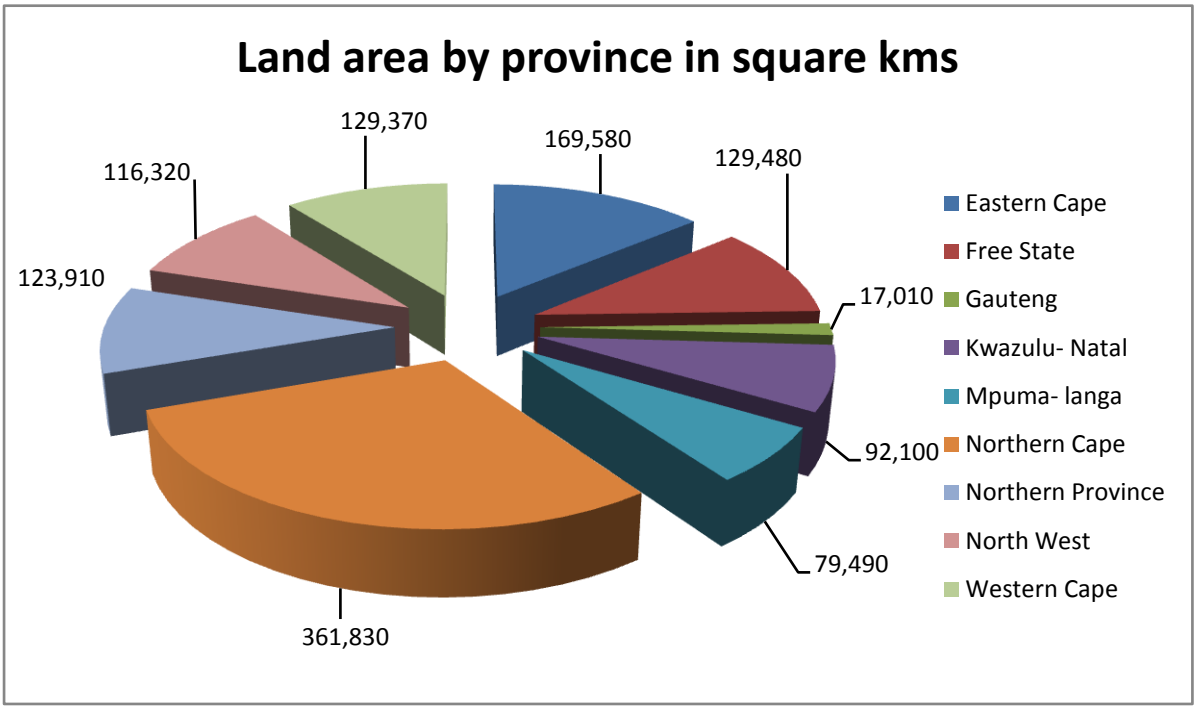

Figure 6-2: The land area of South Africa

Source: South African Statistics 2009, 2009

by region for South Africa. As can be seen, a large grid would be needed to deliver electricity to all these areas.

Although well established, ESKOM's grid still does not cover the entire country; indeed in 1994 it covered only 27,000 km. Subsequently, the government has established a number of initiatives to deliver electricity to at least 71% of the population by 2004. Despite reaching 75% electrification in 2008, only 55% of rural areas are electrified and approximately 12 million people still do not have access to electricity (EIA, 2008). Figure 6-3 shows the area currently covered by ESKOM, from which it can be seen that a large area of the country remains detached from the grid. Therefore, the statement made by respondents that access to the grid is a problem is justified and it can be concluded that access to the grid has an influence on the social component of renewable energy investment.

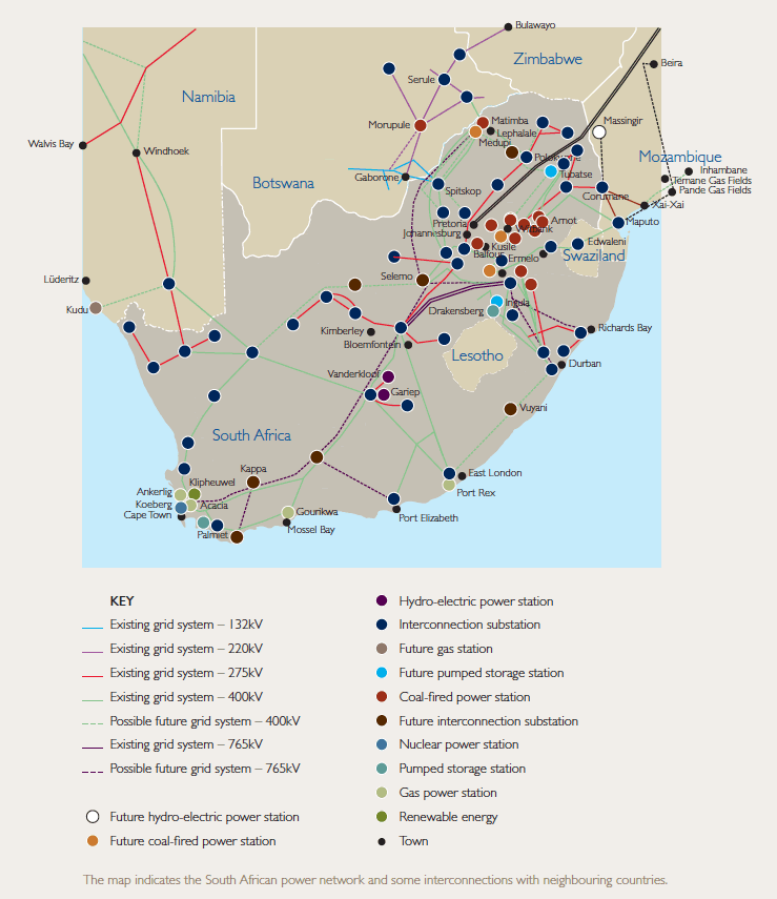

Figure 6-3: Southern Africa grid map

Source: ESKOM Annual Report 2009, 2010

6.3.6. Poverty in South Africa

According to a report released in 2004 by the Human Sciences Research Council, in 2001 57% of South Africans were living below the poverty line. Figure 6-4 shows the poverty levels in South Africa by region.

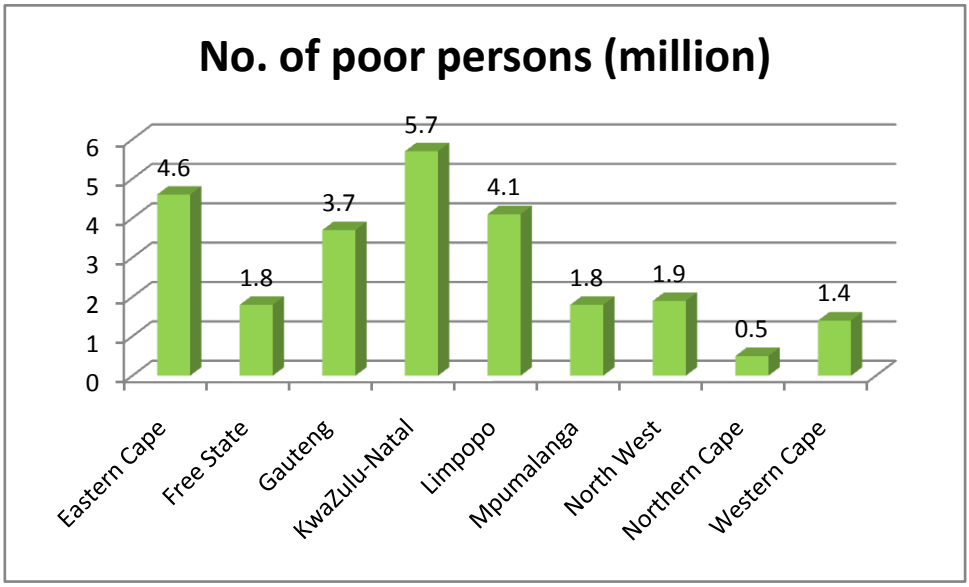

Figure 6-4: Poverty indicators by province

Source: Fact Sheet Poverty in South Africa, 2004

Based on the above, it can be seen that poverty is indeed a challenge for South Africa. With the level of poverty still present, it can be understood why the market for renewable energy, a more expensive alternative to the cheaper electricity currently enjoyed, is not large. This barrier to renewable energy adoption has been confirmed by the sample surveyed.

6.3.7. Education

According to The Global Competitiveness report 2010– 2011, released by the World Economic Forum, South Africa ranked 129th for primary education and 75th for secondary education out of 139 countries in 2009 (Schwab, 2010). One of the most serious issues facing South Africa is in terms of education. According to the HSRC, 12 million children live in poverty, four million of whom are starving and 40% of whom have growth problems. Cohen (2008) confirms that 6 million children live in households in which no one is employed. Approximately 24% of children are in the

wrong grade for their age and 6% are not in school. Surprisingly, 24% of children live in households without both parents (Cohen, 2008). With these numbers of uneducated citizens it is not surprising investors are nervous about the low social acceptance of a new technology. In order for society to adopt this type of technology, people must be able to comprehend its benefits, which requires educated individuals who understand and comprehend the impending disastrous consequences.

6.3.8. Technology

According to The Global Competitiveness report 2010-2011 released by the World Economic Forum South Africa ranks 76th for technological readiness out of 139 countries in 2009 (Schwab, 2010). It is clear from the results that renewable energy investment decisions are influenced by technology factors. The major factor highlighted by respondents in this regard is the use of technologies developed and produced outside South Africa. While some may believe that these technologies are unsuitable for the local market, it would be difficult to overlook these technologies entirely, as most of them have already been developed and tested. It would be easier for South Africa to adapt to suit the technology, rather than the other way around.

From a cost perspective, the rise of China as a global manufacturing powerhouse cannot be ignored and it is difficult to ignore the cost savings that would result from buying these technologies abroad. Until South Africa can address its own social and technical barriers, it will be difficult to develop a local manufacturing industry for renewable energy technologies. While it may be possible, the cost premium attached to buying locally would be too high for the current limited market. Local manufacturing is also accompanied by other requirements such as standards, certification, skills and infrastructure requirements.

In order to understand how South African renewable energy technologies compare with the international community, respondents were asked to provide their opinions of this based on their experience. Four different aspects were considered in this regard, namely, certification, skills and infrastructure. The South African Bureau of Standards currently only has a standard for solar water heating systems. According to a press release, the SABS is planning to implement standards for further

infrastructure, such as electric vehicles, smart grids and fuel cells, among others. However, until they are developed and implemented South Africa has very limited renewable energy technology standards. With these limited standards only in place, certification is also very limited, which was confirmed by the results obtained.

Since renewable energy is a relatively new field in South Africa, skills will definitely be a challenge. With the limited human capital that South Africa possesses, it will be difficult to find qualified and experienced skilled labour force to service the industry. Extensive training and experience will be needed to build up the skills base needed to sustain and serve the industry. As the respondents seem split on this issue, further research is needed to determine whether South Africa has the skills required for this new industry.

In terms of infrastructure, South Africa's is one of the most developed on the African continent. This infrastructure, including roads, ports and a well-established railway system, provides South Africa with an unquantifiable advantage. Hence, in terms of renewable energy projects, the only constraint that remains is access to the grid. As established previously, since the grid still does not cover the entire country, grid access remains a challenge. This situation explains the mixed results obtained for this section.

6.3.9. Equator principle

The equator principles are a set of rules which organisations adopt in order to be regarded as a responsible business entity (Equator Principles Financial Institutions, 2006). These categorise the company as being socially and environmentally conscious. Currently, the equator principles are not enforced in South Africa. These principles are voluntary guidelines that organisations adopt in order to be regarded as a responsible entity. In terms of these, companies are categorised as being socially and environmentally conscious. It is consequently encouraging to learn that some South African organisations are willing to adopt this type of guidelines voluntarily; an example which should be followed by many more in order to demonstrate organisations' commitment to being responsible instead of being forced into being responsible.

6.4. Recommendations

6.4.1. Role of the state

It appears that the only means by which all of the above can be addressed is through selective state interventions. Interventions in this sense have to be selective otherwise they will not work. In order to deal with the uncertainty regarding current policies and initiatives, it is important that communication between government and investors is good. Government needs to ensure that it remains accessible for engagement by investors when required.

Since government is the gatekeeper financially, it can provide the incentives required to create activity in the renewable energy field. While some tax incentives are being introduced such as the carbon tax, it is not enough. Substantially more tax benefits and grants are needed to drive the industry to the level it is needed to start contributing to the economy. Platforms such as the Tradable Renewable Energy Certificates (TRECS) are perfect examples of how the government can ensure that society can be made aware of how consumption can be influenced. Currently this tool remains mostly hidden as only a selected few are using it. This has to be integrated into the current regulatory system.

6.4.2. Technology

One way to overcome this hurdle is through local technological innovation. Revolutionary technologies that can be developed locally will attract more attention and benefits than proven foreign technologies. Since they will be unique, they will attract foreign investment. Foreign companies are generally on a permanent look out for revolutionary technologies. This would also assist in developing manufacturing facilities locally which can in turn supply the world. However, in order to achieve revolutionary breakthroughs, substantial investments are needed. From the results obtained, it can be seen that this is not the case currently. While there is some investment in innovation, it is unfortunately not enough and the majority of the current funds are invested in proven technologies which are close to the commercialisation stage.

6.4.3. Financial

This study highlighted the need for a green bond. This can be seen as a global pool of funds from various countries that is specifically allocated to clean energy projects or projects that assist in mitigating climate change (World Bank Green Bond Fact Sheet, 2010). In fact the World Bank has already established a green bond. This was conceived in response to investors' demand for a triple-A rated fixed income product that supports projects that mitigate climate change. As per its definition, the green bond raises funds from fixed income investors. It has issues more than US $1.5 billion for such projects. It also appears that South Africa has already been issued with a green bond to the value of US$ 250 million for projects that are intended to mitigate climate change. Therefore, it is recommended that South African investors are made aware of the international assistance available. In addition, a subsidiary bond can be set up for private investors to access. This bond would provide very competitive tax benefits with a special focus on easy access to competitive funds.

6.5. Conclusion

Based on the arguments presented, it is clear that both South African investors and government have some challenges to overcome. While the state has a pivotal role to fulfil, it has to do so cohesively in conjunction with all stakeholders. This will increase renewable energy investors' confidence which will, in turn, increase investment levels.

7. Conclusion

7.1. Summary and conclusions

This study was undertaken to investigate the factors limiting financial investment into renewable energy technologies from an investor's perspective. As far as could be ascertained, this is the only South African study dealing with renewable energy investments. As such, it will provide a basis for further research into similar fields.

The literature reviewed provided a context for renewable energy investments and the current level of investment made by major economies. The review also revealed that most of the literature available dealt with renewable energy in a global context. It was found that most research has addressed renewable energy issues in the major economies, such as the United States of America, Europe, China and India, and limited literature was found on Africa and South Africa in particular. The majority of the literature that was found mentioned the barriers to renewable energy.

This research aimed at exploring all the factors that may be preventing investors from investing more in renewable energy in South Africa. Accordingly, a list of organisations that invest in renewable energy projects was compiled. Some of the samples defined were recommended by the financial institutions interviewed.. A total sample size of 17 investors was identified in South Africa, comprising both state-owned and private-sector companies.

Consequently, an experience survey was conducted using exploratory interviews. The data were then summarised and both a quantitative and a qualitative analysis were performed. The quantitative analysis consisted of a frequency count while the qualitative analysis comprised a narrative and content analysis. The data were categorised into six aspects, namely Investor background, Political factors, Economic factors, Social factors, Technological factors and Company structure.

The major finding of the research was that majority of the factors investigated were found to influence renewable energy investment decisions. However, it was found that, despite the influence of all the other factors investigated, the financial viability of the potential project is the most important criterion that investors consider when

making investment decisions. Therefore, irrespective of all other criteria, if the potential renewable energy project is not financially viable, investors will not invest. This is true for all the organisations surveyed. The other major finding is that the majority of the organisations aim at optimising return on investment. This is an overriding factor when investors consider their investment decisions.

Overall, it can be concluded that, although this study categorised the data into a number of sections, in reality they are intertwined. For example, it is very difficult to separate the political and the economic issues as they are inevitably linked. When government provides subsidies, grants or tax benefits, it influences the economic aspect of the industry, as it promotes investment by making access to capital easy. Another example is the socioeconomic component. With the pronounced level of poverty and lack of education, it is impossible to isolate economics from socioeconomics, as poor, uneducated people cannot afford even cheap electricity, let alone expensive forms of electricity. With this in mind, the following section contains a summary of the independent conclusions that can be made with regard to each of the factors considered to affect investment in renewable energy.

7.1.1. Investor background

Investors with a financial qualifications and experience tend to consider financial viability as the most important aspect when considering a project irrespective of their preference for the technologies involved. This means that the background of the investor does not mean the investor will have a preference for any particular type of renewable project. It can be inferred that this will hold for any other type of project as the logic will still apply.

7.1.2. Political

It is clear that South African renewable energy investment decisions are affected by political and legal frameworks, as stated by both Martinot and Macdoom (2000) and Painuly (2001). This is in line with the current level of state involvement in the energy industry. Currently, the renewable energy environment is not conducive for optimising investment. The absence of clear objectives, lack of alignment of state substructures and lack of government support are the major reasons given for this

status quo. This is in line with the findings of Robert and Weightman (1994) and Mantle (2008).

7.1.3. Economic

As expected, South African renewable energy investment decisions are influenced by economic factors, as stated by Martinot and Macdoom (2000). These factors mainly consist of demand and supply, foreign exchange and access to capital. Consequently, it would seem that the current South African market for renewable energy has not been established. With the price of electricity being controlled and capped, it is difficult for any investor to influence and manage a return on their investment. Since most of the renewable energy technologies are imported, projects that need capital for these technologies are exposed to foreign currency risks and, consequently, investors expect higher returns. However, renewable energy technologies generally yield lower returns than conventional fossil fuel technologies, as found by Schilling and Esmundo (2009). As stated by Martinot and Macdoom (2000), this is due mainly to the higher capital cost requirements and cheap alternative fossil fuel based energy sources. In addition, raising capital in this economy is another constraint, as the amount of capital needed is substantially higher than conventional energy projects. However, there are currently no incentives for investors to raise capital for this type of project.

7.1.4. Social

The data revealed, and are supported by Martinot and Macdoom (2000), that investment decisions are definitely influenced by social factors. While investors believe that the social component is important, social adoption and compliance is mostly regulatory in nature and is predominantly addressed by the project owners. Although compliance with the EIA is mandatory, investors do not get involved in this process. However, awareness is a major stumbling block for investors. Social unawareness of alternative energy technologies limits renewable energy technology adoption rate which in turn limits the renewable energy market. It was found that according to investors society are not aware of the current environmental issues, need for renewable energy technologies and alternatives available to them which is in line with what Simon and Wustenhagen (2006) found. Other constraints

mentioned include the lack of grid access, poverty and lack of education in South Africa as stated by the Director of Energy Research Centre, Professor Kevin Bennett, from the University of Cape Town.

7.1.5. Technology

The data confirmed, as mentioned by Martinot and Macdoom (2000), that renewable energy investments are influenced by technological factors as. It also revealed that most technologies are imported, as South Africa does not currently produce any itself. As a result, the country adopts most of the international standards and certification. Owing to the fact that the South African renewable energy industry is in its infancy, relevant skills and expertise are scarce, and although its infrastructure is the most advanced on the African continent, it still needs to be improved to enable growth in the renewable energy industry. The above supports Painuly (2001) findings.

7.1.6. Organisation

The data revealed some very consistent results. Almost all investment companies allocate resources strategically in order to optimise their returns. This was proven to be the case in this study where all the organisations surveyed had a mandate to maximise their returns in different ways (Shefrin, 2005; Tetlock & Mellers, 2002).

7.2. Recommendations for further research

South African renewable energy investment decisions are influenced by numerous factors; however, owing to the time constraints this research was scoped into just six categories. Nevertheless, a study of other potential factors could prove to be important in understanding the issues that affect investment decisions in the renewable energy field in more detail.

No similar research was found for any other countries in the African region. Since developing countries are expected to experience higher growth in the future, energy demand is also expected to increase. This research could be repeated on an international level for any other African country. It can also be expanded to the BASIC countries with which South Africa is constantly being compared.

While this study found no compelling evidence to suggest that renewable energy investment decisions are not influenced by investor background, it would be interesting to investigate the nature of the ideal renewable energy investor's profile and requirements.

This study found that investors experience the current policies and regulations surrounding the energy industry as unclear and state a need for their clarification. This same need for clarity applies to various sets of initiatives, such as the REFIT, the IPP and the IRP, that the government has undertaken. A study of thsse documents and initiatives needs to be done in order to identify areas for improvement and to establish whether these initiatives are aligned to the needs of the renewable energy industry.

Investors in the study also mentioned that the capital needed for joining the grid is substantial; hence, access to capital is a challenge. A potential solution for this, a "green bond", has been mentioned. This global green fund should be able to provide better access to capital which could assist investors' worldwide. A study in terms how this bond should be set up and how it will operate would make a very interesting topic.

It was found that investors believe that there is no South African renewable energy market. This is mainly due to several other priorities which the government is facing such as poverty and education. These other priorities will attract a larger segment of the available funds which could have been allocated for renewable energy technologies. Therefore with limited funds available for the government to grow the renewable energy market, the latter will remain insignificant. While the facts seem to support this insight, a study to actually prove it would assist in adding to the main findings of this research. This could be further improved by suggesting initiatives that could promote social awareness of renewable energy.

At the moment, consumers are unable to differentiate between clean energy and fossil fuel based energy. The Tradable Renewable Energy Certificate (TREC) platform has been identified as a potential solution to this. Therefore, a study of how

this could be used to facilitate renewable energy consumption would complement this study. Another potential topic is how the TREC system can be integrated into the existing initiatives to bolster the adoption of renewable energy in South Africa.

This study found that most of the technologies currently used for renewable energy are imported. As a result, very limited manufacturing of such technologies takes place locally. Innovation is one way in which new technologies can be developed and this has been established as an important part of a country's economy. As such, an investigation into the prevalence of innovation in the renewable energy industry is warranted. Another study could comprise an investigation of the propensity of innovation in renewable energy in South African organisations. This would establish whether further investment is needed in renewable energy technologies.

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Appendix 1: World Electrical Installed Capacity

Table 11.17 World Electrical Installed Capacity by Type, 1980, 1990, and 2006 Million Kilowatts

Region and Country	Fossil Fuels			Nuclear Electric Power		Hydroelectric Power [1]			Total [2]			
	1980	1990	2006	1980	1990	2006 P	1980	1990	2006 P	1980	1990	2006 P
North America	481.7	574.9	835.6	57.7	112.2	115	135.7	159.1	181.7	676.6	861.3	1,160.30
Central and South America	36	44.9	81.9	0.4	1.7	3	43	84.1	128.5	81.2	132.8	220.1
Europe [4]	351.2	386.6	457.6	46.5	125.7	135.7	135.3	153.9	164.6	533.8	669.3	810.2
Eurasia [5]	201.9	240.8	237.7	12.5	37.9	38.6	52.3	65	67.9	266.7	343.7	344.5
Middle East	27.6	67.6	135.9	0	0	0	2.6	4.8	8.7	30.1	72.4	144.7
Africa	30.3 [R]	57.3 [R]	86	0	1.8	1.8	13.9	18.8 [R]	22	44.3 [R]	78 [R]	110.3
Asia and Oceania [4]	218.9	365.4	917.4	18.5	43.9	82.6	74.4	109.3	224.7	312.5	520.3 [R]	1,243.90
World	1,347.60 [R]	1,737.50 [R]	2,752.20	135.5	323.1	376.8	457.2	595 [R]	798.2	1,945.40 [R]	2,677.80	4,033.90

[1]Excludes pumped storage, except for the United States.

[2]Wood, waste, geothermal, solar, wind, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies are included in total.

[3]Net summer capability.

[4]Excludes countries that were part of the former U.S.S.R. See "Union of Soviet Socialist Republics (U.S.S.R.)" in Glossary.

[5]Includes only countries that were part of the former U.S.S.R. See "Eurasia" and "Union of Soviet Socialist Republics (U.S.S.R.)" in Glossary.

R=Revised. P=Preliminary. – – = Not applicable. (s)=Less than 0.05 million kilowatts.

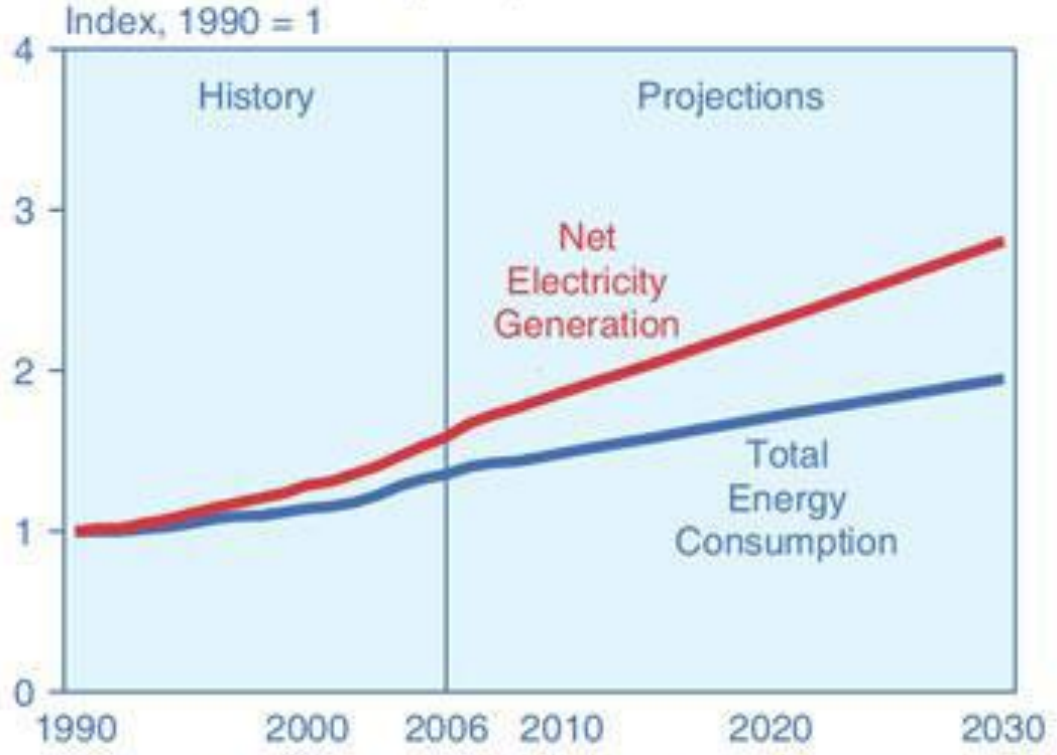
Note: Totals may not equal sum of components due to independent rounding.

Web Page: For related information, see http://www.eia.doe.gov/international.

Source: **United States:** Table 8.11a **All Other Data:** Energy Information Administration, International Energy Database, March 30, 2009.

Appendix 2: Growth in World Electrical Power Generation and Total Energy Consumption

Figure 48. Growth in World Electric Power Generation and Total Energy Consumption, 1990-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

Appendix 3: Questionnaire

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UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

GORDON INSTITUTE
OF BUSINESS SCIENCE

Research Interview

On

South African Renewable Energy Investment Barriers: An investor perspective

Date:

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Consent Form

This research investigates the main reasons why financial investments in renewable energy based technologies have been limited in South Africa. The outcome of such a study will assist stakeholders in evaluating and allocating more funds to such technologies. This interview will take approximately one hour.

Your participation is voluntary and you can withdraw at any time. Of course, all data will be kept confidential. By completing the survey, you indicate that you voluntarily participate in this research. If you have any concerns, please contact me or my supervisor. Our details are provided below.

Researcher name : Dhirendra Kumar Ghoorah

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Questionnaire

1.1 Company

a) 1

b) 2

c) 3

d) 4

e) 5

f) 6

g) 7

h) 8

i) 9

j) 10

1. Introduction

This section will gather some data about you the investor.

1.1 Background

a) Financial

b) Engineering

c) Social Science

d) Other

If other, please state:

1.2 What is your highest qualification?

1.3 What did you major in?

1.4 If all things were equal and you had to choose one project for investment, which type of RE project would you invest in?

a) Solar

b) Hydro

c) Wind

d) Bio Mass

e) Geothermal

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Please explain reason for this choice?

---

2. Political

This section of the questionnaire investigates the political aspect of the decision making process. It considers if there are any influence that state or government related policies have on the investment decision. It will also attempt to understand how they affect the decisions.

2.1 Are renewable energy investment decisions currently influenced by political/legal frameworks in South Africa?

a) Yes

b) No

Please explain reason for this choice?

2.2 Based on your experience, how would you describe the current role of the state in the RE industry?

a) High

b) Medium

c) Low

2.3 Please indicate the importance of the role the state should have with respect to RE investments?

a) High
b) Medium
c) Low

2.4 Do you think the current government incentives & regulations are enough and in favour of promoting investments in RE industry?

a) Yes
b) No

2.5 Why?

---

3. Economic

This section of the questionnaire investigates the economic aspect of the decision making process. It considers if there are any influence that economic factors, such as micro (ie Repo rate, demand & supply, scale), macro (ie exchange rate, GDP growth, FDI) and financial (ie funding instruments), have on the investment decision. It will also attempt to understand how they affect the decisions.

3.1 Are renewable energy investment decisions in South Africa influenced by the prevailing economic factors?

a) Yes

b) No

Please explain reason for this choice?

3.2 Does the selling price of RE influence your RE investment decision?

a) Yes

b) No

How?

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3.3 How do you rate the financial investment involved in a RE project relative to a conventional energy project in SA? Is it

a) More costly & longer life cycle
b) Less costly & shorter life cycle
c) The same

3.4 How do you economically differentiate between RE projects and conventional energy project?

a) Margin
b) Project life cycle
c) Associated financial risk
d) All of the above

3.5 Do you cater for the long term associated cost to ensure sustainability?

a) Yes
b) No

3.6 Which of the following economic factors affect your investment decisions with special focus on RE the most?

a) Financial eg interest rate
b) Macro economic eg Foreign exchange
c) Micro economic eg Market share
d) All of the above

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3.7 Why?

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4. Social

This section of the questionnaire investigates the social aspect of the decision making process. It considers if there are any influence that social factors, such as social acceptance and market acceptance, have on the investment decision. It will also attempt to understand how they affect the decisions.

You have identified or approached to finance a project which is in the vicinity of a community, please answer the following questions in relation to this project.

4.1 Are renewable energy investment decisions in South Africa influenced by social and cultural factors?

a) Yes

b) No

Please explain reason for this choice?

4.2 If yes, how do you communicate with the society concerned?

a) Frequently

b) Occasionally

a) In person

b) Intermediate

4.3 If yes, would you like the community to participate in the RE project?

a) Yes

b) No

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4.4 Do you think that poverty in SA influences the adoption of RE which in turn influences your investment decision?

a) Yes

b) No

4.5 In your opinion, how important is the needs of the particular society when considering an investment in an RE project affecting that particular society?

a) Very important

b) Moderately important

c) Not important

4.6 If your answer to question 4.6 is either a or b then how would you integrate the social component into the RE investment decision?

4.7 How would you describe the social acceptance of RE technologies in SA compared to the rest of the world?

a) More

b) Same

c) Less

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Please explain reason for this choice?

4.8 In your opinion, what should be done differently to promote further social acceptance of RE technologies in SA?

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5. Technology

This section of the questionnaire investigates the technology aspect of the decision making process. It considers if there are any influence that technological factors, such as nature or developmental stage, have on the investment decision. It will also attempt to understand how they affect the decisions.

5.1 Are renewable energy investment decisions in South Africa influenced by technology factors?

a) Yes

b) No

Please explain reason for this choice?

5.2 Do you finance technological innovation in RE?

a) Yes

b) No

5.3 How does the development stage of the technology involved in a RE project influence your investment decision?

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5.4 In your opinion, how does the RE technology in SA compares to international in terms of the following:

a) Standards

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b) Certification

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c) Skills requirements

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d) Infrastructure

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6. General

This section of the questionnaire investigates general issue with regards to the company internally that may affect the decision process.

6.1 Does the company have an investment policy?

a) Yes
b) No

6.2 Is it enforced?

a) Always
b) Sometimes
c) Never

6.3 Does the shareholders have any influence in the RE investment decision making process?

a) Yes
b) No

6.4 Does your organisation differentiate between financing a conventional energy technology versus a RE technology?

a) Yes
b) No

6.5 If yes how?

6.6 Based on your experience and given the challenges that SA is facing currently, select two of the most important aspects discussed above (ie Political, Economic, Social and technological).

6.7 Considering these two aspects chosen above, describe what would you change or add in order to improve the level of investment in RE technologies in South Africa?

Aspect 1:

Aspect 2:
